JOURNAL OF SLEEP AND SLEEP DISORDERS RESEARCH
ISSN 0161-8105

SLEEP

VOLUME 35, 2012 | ABSTRACT SUPPLEMENT

26th Annual Meeting of the Associated Professional Sleep Societies, LLC

Boston, Massachusetts

Scientific Highlights/Abstracts of Original Investigations

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Official publication of the
Associated Professional Sleep Societies, LLC

A joint venture of the
American Academy of Sleep Medicine
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SLEEP (ISSN: Online 1550-9109; Website: www.journalsleep.org) is published on-line monthly plus abstract in May by the Associated Professional Sleep Societies, LLC, a joint venture of the American Academy of Sleep Medicine and the Sleep Research Society located at 2510 North Frontage Road, Darien, IL 60561-1511, phone (630) 737-9700 and fax (630) 737-9790.

ANNUAL SUBSCRIPTION RATES: Subscription rates for Volume 35, 2012: Individual Online (US and International): $225.00; Institutional Online (US and International): $425.00. Mid-year subscriptions are not available. Subscriptions begin with the January issue of the current year. Renewals should be secured as early in the year as possible to avoid uninterrupted service. Questions about subscriptions (including payments, billing procedures, or policy matters) should be directed to the APSS office at (630) 737-9700.

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EDITORIAL

This abstract supplement unites *SLEEP* and the science of the SLEEP 2012, the 26th Annual Meeting of the Associated Professional Sleep Societies, LLC (APSS), and provides a glimpse into the new ideas and latest research taking place in the field of sleep.

All abstracts presented at SLEEP 2012 held June 9-13, 2012, in Boston, Massachusetts are included in this special issue. This year, a record number – 1,333 – abstracts will be presented at the meeting. 196 will be presented in an oral presentation format, and the remainder will be presented in a poster format. In addition, individuals in training programs will be presenting posters of case reports, which are contained in the supplement, and abstracts, which, although not included in this supplement, will be an exciting portion of the meeting.

The abstracts are divided between basic and clinical sleep science and then assigned to one of 27 subcategories. Each abstract has a unique four-digit number to facilitate identification and location both within this issue and at SLEEP 2012. The four-digit number in the abstract supplement matches the four-digit code published in the SLEEP 2012 final program.

The SLEEP meeting fosters an environment in which members and attendees obtain education on the latest basic science, clinical science and technologies, which will further promote the continued growth of the field through the dissemination of new knowledge. We look forward to sharing in the success of this pivotal event.

David F. Dinges, PhD
Editor-in-Chief

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0001

A NOVEL SELECTIVE MELATONIN MT_2 RECEPTOR LIGAND FOR THE TREATMENT OF INSOMNIA

Comai S[1], Ochoa-Sanchez R[1], Dominguez-Lopez S[1], Spadoni G[2], Rivara S[3], Bedini A[2], Fraschini F[4], Mor M[3], Tarzia G[2], Gobbi G[1]
[1]Psychiatry, McGill University, Montreal, QC, Canada, [2]Institute of Medicinal Chemistry, University of Urbino "Carlo Bo", Urbino, Italy, [3]Pharmaceutical Department, University of Parma, Parma, Italy, [4]Pharmacology, Chemiotherapy and Medical Toxicology, University of Milan, Milano, Italy

Introduction: The neurohormone melatonin, synthesized by the pineal gland during the dark period of the light/dark cycle, acts mostly through two G protein-coupled receptors called MT_1 and MT_2. Melatonin is receiving considerable attention for its involvement in sleep promotion and regulation, but its effectiveness is still debated. Here, we investigated if a selective activation of MT_2 receptor by the MT_2 partial agonist UCM765 can produce an effect on sleep, in particular NREM sleep.
Methods: EEG and EMG sleep-wake patterns were registered across the 24-h light-dark cycle in rats treated with vehicle, 20, 40, or 60 mg/kg (s.c., every 4-hr) of UCM765.
Results: The latency to the first long (>2 min) episode as well as the total amount of NREM sleep were significantly affected by the dose of UCM765: 40 and 60 mg/kg respectively decreased the latency by 59% and 49% ($p<0.05$) and increased the total amount during the inactive/light phase only by 48% ($p<0.01$) and 33% ($p<0.05$). On the contrary, at the same doses, UCM765 decreased the total time of wakefulness during the inactive/light phase only by 37% ($p<0.001$) and 26% ($p<0.005$). No significant effects of UCM765 were reported on number of episodes of NREM sleep and wakefulness as well as on REM sleep parameters. Noteworthy, UCM765 (40 mg/kg, s.c.) increased the number of spindles/min during the inactive/light phase only ($p<0.001$). Analyzing the power spectra of NREM and REM sleep, UCM765 produced an increase of delta power of NREM sleep during both the light and the dark phases, with no effects on REM sleep.
Conclusion: The novel MT_2 selective partial agonist UCM765 induces and promotes NREM sleep without altering REM sleep. These findings demonstrate that MT_2 receptor might represent a novel target for the treatment of sleep-related disorders.
Support (If Any): CIHR, CFI, FRSQ, MDEIE, MSBiV.

0002

SLEEP SLOW WAVE ACTIVITY REGULATES CEREBRAL GLYCOLYTIC METABOLISM

Wisor J[1], Moore ME[1,3], Schmidt MA[1], Clegern WC[1], Rempe M[2]
[1]Washington State University, Spokane, WA, USA, [2]Mathematics, Whitworth University, Spokane, WA, USA, [3]Physics and Astronomy, Washington State University, Pullman, WA, USA

Introduction: Sleep is characterized by profound shifts in cerebral metabolism. Metabolic intermediates associated with glycolytic processing of glucose, such as lactate, are elevated in the brain during enforced wakefulness relative to sleep. An increase in slow wave activity (SWA), oscillations between relatively depolarized and hyperpolarized states in the cerebral cortex, discriminates non-rapid eye movement sleep (NREMS) from wakefulness. The metabolic consequences of SWA remain uncertain. We sought to determine whether SWA modulates the rate of glycolysis within the cerebral cortex.
Methods: Mice of the B6.Cg-Tg(Thy1-COP4/eYFP)18Gfng/J transgenic line expressing the blue light-sensitive cation channel, Channelrhodopsin-2 were subjected to simultaneous EMG and bilateral EEG recording and optogenetic manipulation of cerebral cortical pyramidal neuronal activity. An enzymatic biosensor was implanted 1 mm into the frontal cerebral cortex to measure cerebral lactate concentration in real-time.
Results: Lactate concentration in the cerebral cortex increased by 30% during 3 hrs of enforced wakefulness relative to baseline. In spontaneous sleep/wake cycles, lactate concentration increased during wakefulness and REMS and declined during NREMS. The rate at which lactate concentration declined during NREMS was directly proportional to the magnitude of EEG activity at frequencies of less than 10 Hz and inversely proportional to the magnitude of EEG activity at frequencies between 10 Hz and 20 Hz. Induction of 1 Hz oscillations, but not 10 Hz oscillations, in the electroencephalogram by optogenetic stimulation of cortical pyramidal cells during wakefulness triggered a decline in lactate concentration.
Conclusion: We conclude that cerebral SWA promotes a decline in the rate of glycolysis in the cerebral cortex. These results demonstrate a cellular energetic function for sleep SWA, which may contribute to its restorative effects on brain function. Intrusion of high frequency activity into the NREMS EEG may, by disrupting the discharge of glycolytic load, contribute to the failure of sleep to be perceived as restorative in insomnia.
Support (If Any): Funded by Department of Defense (Defense Advanced Research Projects Agency, Young Faculty Award, Grant Number N66001-09-1-2117) and NINDS (R15NS070734).

0003

THE ROLE OF CHOLINERGIC BASAL FOREBRAIN NEURONS IN THE BIOCHEMICAL AND ELECTROPHYSIOLOGICAL CHANGES IN THE CORTEX DURING SLEEP DEPRIVATION

Kalinchuk A[1], Kim S[2], McCarley RW[1], Basheer R[1]
[1]Harvard Medical School - VA Boston Healthcare System, Boston, MA, USA, [2]Brown University, Providence, RI, USA

Introduction: Short duration sleep deprivation (SD) (2-3h in rodents) is known to increase the levels of inducible nitric oxide (NO) synthase (iNOS)-mediated NO and adenosine (AD) in the basal forebrain (BF). We showed recently that the prolongation of SD for 5h triggers a similar cascade in the frontal cortex (FC), the area, which receives projections from the BF (Kalinchuk et al., 2011). Lesion of the BF cholinergic cells attenuates both the SD-induced AD increase in the BF and the recovery sleep response (Kalinchuk et al., 2008). However, it is not known whether the cholinergic cells have a role in SD-induced biochemical changes in the cortex. In the present study we lesioned BF cholinergic cells and compared the biochemical changes simultaneously in the FC and BF during SD in the same animals before and after the lesion. We paralleled the changes in biochemical cascade with changes in electrophysiological markers of homeostatic sleep pressure, theta power during SD and delta power during NREM sleep after SD.
Methods: Male rats were implanted with electrodes for EEG/EMG recording and 2 guide cannulae for microdialysis probes targeting BF and FC. Microdialysis samples were collected simultaneously from both areas every 30min during 8hSD. Dialysates were analyzed for AD using high performance liquid chromatography (HPLC) and for NO metabolites nitrate and nitrite (NOx) using Fluorimetric Assay Kit (Cayman). Further, the lesion of cholinergic cells in the BF was performed using the injections of 192-IgG saporin into the BF, and similar experiment was repeated 2 weeks after the injection. Histochemical analysis confirmed the localization of the probes in the BF and FC and the quality of the lesion procedure.
Results: Before saporin injection, SD induced rapid increases in the levels of NOx and AD, which became significant after 1h (NOx) and 2h (AD) of SD in the BF and after 4h (NOx) and 5h (AD) of SD in the FC. EEG recording detected increases in the intensity of theta power during SD and NREM delta power during recovery sleep. After saporin injection, SD-induced changes in NOx and AD were completely blocked both in the BF and the FC. Also, the increases in theta and delta power were significantly attenuated.

Conclusion: We conclude that cholinergic neurons of the BF contribute to the generation of homeostatic sleep pressure during SD, including its biochemical and electrophysiological correlates. The FC changes are likely due to the strongly activating input of the BF to FC.
Support (If Any): VA Merit Award, NIMH Grant MH 39683.

0004

DIFFERENTIAL EFFECTS OF GABA-A MODULATORS AND DUAL OREXIN RECEPTOR ANTAGONISTS ON EEG FREQUENCY DISTRIBUTION IN SLEEP/WAKE STATES IN RATS

Winrow CJ, Fox SV, Garson SL, Savitz A, Hargreaves R, Renger JJ
Neuroscience, Merck & Co., Inc., West Point, PA, USA

Introduction: Orexin 1 (OX1R) and Orexin 2 (OX2R) Receptor signaling pathways have been implicated in regulation of wakefulness. A number of small molecule Dual Orexin Receptor Antagonists (DORAs) are being developed as a novel therapeutics for the treatment of insomnia. The current study compared the quantitative EEG spectral frequencies observed within sleep/wake states for standard of care GABA-A receptor modulators and DORAs.
Methods: Rats were implanted with wireless radio-telemetric monitors to permit continuous recording of electrocorticogram (ECoG/EEG), electromyogram (EMG), and generalized locomotor activity. GABA-A modulators (eszopiclone or zolpidem) or DORAs were evaluated using a vehicle controlled 3-day crossover study design. The EEG, EMG, and activity data were used to assign sleep/wake states by an automated algorithm. Quantitative EEG analysis was performed on the EEG channel for each sleep/wake epoch to produce a spectral profile from 1-100Hz. Compound data were normalized to vehicle to generate a spectral ratio for each sleep/wake state.
Results: Active phase treatment with DORAs decreases active wake, while increasing Slow Wave and REM sleep relative to vehicle. By comparing spectral frequency distribution within sleep/wake states, we observed that GABA-A modulators showed a consistent and dose dependent spectral ratio profile for all sleep/wake states characterized by a pronounced suppression from 1-10Hz, an increase in 20-55Hz, followed by a decrease from 75-100Hz. In marked contrast, DORAs, while inducing comparable decreases in active wake, showed no modulation of the spectral ratio across the entire 1-100Hz frequency range for any sleep/wake state.
Conclusion: These findings suggest that DORAs promote sleep in a manner that differs significantly from current standard of care compounds in preclinical studies, and could provide important implications for treating insomnia.
Support (If Any): This project was supported by Merck & Co., Inc.

0005

SOCIAL ISOLATION INDUCES THE UNFOLDED PROTEIN RESPONSE

Brown M[1], Zimmerman J[1], Chan MT[1], Pack A[1,2], Naidoo N[1,2]
[1]Center for Sleep & Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [2]Division of Sleep Medicine, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Social isolation has a multitude of negative consequences on human health including, but not limited to; the ability to endure a challenge to the immune system, sleep amount and efficiency and general morbidity and mortality. In the fruit fly Drosophila melanogaster, social isolation leads to increased aggression, impaired memory and reduced amounts of daytime sleep. There is a correlation between molecules affected by social isolation and those implicated in sleep in Drosophila. We previously demonstrated that acute sleep loss in both flies and mice induces an adaptive signaling pathway termed the Unfolded Protein Response (UPR). One mechanism that indicates UPR upregulation is elevated levels of the endoplasmic reticular chaperone BiP/GRP78. We have shown that BiP/GRP78 overexpression in Drosophila leads to increased sleep rebound. Increased rebound sleep has also been demonstrated in socially isolated flies. We hypothesize that the reduction in sleep seen in socially isolated animals is a stressor that induces the UPR. Chronic induction of the UPR activates apoptotic pathways, a mechanism that could contribute to the negative health outcomes observed in cases of social isolation.
Methods: We compared total sleep, sleep bout number and average bout duration in group-raised and socially isolated animals. We used 3 strains: Canton-S (iso20), wCS10 and w1118ex and recorded sleep/wake behavior 7 days post-eclosion. Animals were separated into 3 different categories: Grouped Always, Grouped/ Isolated and/or Isolated Always. Protein expression levels for BiP and other UPR markers were quantified for all groups.
Results: We found that flies which were socially isolated expressed significantly greater amounts of BiP ($p<0.01$) and that the effects of isolation on this marker were reversible. We also found that inducing sleep pharmacologically reduced BiP levels.
Conclusion: The increased wakefulness observed in flies kept in isolation leads to the upregulation of the UPR.
Support (If Any): NIH T32 Training Fellowship HL07713.

0006

EFFECT OF SCHISANDRIN ON SLEEP-WAKE ACTIVITY IN DROSOPHILA

Huang L, Yu S, Bian H, Li T
Heilongjiang University of Chinese Medicine, Harbin, China

Introduction: Schisandrin is one of the lignan components of Schisandra Chinensis. Baill, which is clinically prescribed to improve work efficiency and sleep. Over the past decade, many studies have suggested that rest in drosophila is a sleep state. The aim of this study is to explore the effect of Schisandrin on the sleep-wake activity in fruit flies.
Methods: Canton S flies aged 6 days were collected by CO2 anesthesia and located separately in 30 tubes, each with a filter paper. The flies were allowed to recover and adapt for 1 day, and starved for 4 hours. The filter paper was saturated with Schisandrin or placebo. Locomotor activity was continuously recorded in 5 min bins using the Drosophila Activity Monitoring System devices (DAMS) from Trikinetics (Waltham, MA).
Results: Compared to placebo, Schisandrin (2.54 mg/ml) significantly reduced sleep duration in female ($p<0.01$) and male ($p<0.01$) fruit flies, respectively. Schisandrin decreased sleep duration in male flies due to prolonging arousal duration, and the reduction in sleep time in female flies is associated with an increase of awakening times. Moreover, Schisandrin also significantly reduced the time spent sleeping of light deprivation on male flies ($p<0.01$), and had no effect on the females compared to sleep-deprived flies.
Conclusion: Schisandrin significantly reduced sleep duration in female and male fruit flies. The reduction of sleep duration of Schisandrin is characterized by an decreased arousal threshold and increased arousal time.
Support (If Any): Chinese National Natural Science Foundation 30801528.

0007

MICROINJECTION OF ARECAIDINE INTO THE MEDIAL PREOPTIC AREA OF CATS INCREASE REM SLEEP AND HIMBACINE INTO THE PERIBRACHIAL AREA REDUCES IT

Jimenez-Anguiano A[1], Garcia-Cardenas N[2,1], Rojas Zamorano J[3,1], Velázquez-Moctezuma J[4,1]

[1]Biologia de la Reproduccion, Universidad Autonoma Metropolitana, Nezahualcoyotl, Mexico, [2]Biologia de la Reproduccion, Universidad Autonoma Metropolitana Iztapalapa, Mexico, Mexico, [3]Biologia de la Reproduccion, Universidad Autonoma Metropolitana Iztapalapa, Mexico, Mexico, [4]Biologia de la Reproduccion, Universidad Autonoma Metropolitana Iztapalapa, Mexico, Mexico

Introduction: It has been shown that muscarinic-M2 selective agonist administered into the pontine reticular formation modulates REM sleep. However, the cholinergic inputs to this site during the physiological onset of REM sleep are given by the dorsolateral mesopontine tegmentum. On the other hand, basal forebrain also regulates sleep, contains cholinergic neurons and receives inputs from the brainstem. The purpose of the present study was to analyze the possible participation of muscarinic receptor subtype M2 in the peribrachial area (PBL) and in the medial Preoptic Area (mPOA) in the regulation of sleep.
Methods: Five cats (2.5-3.5 kg) were implanted with the standard set of electrodes for sleep recording. In addition, stainless steel guide cannulas were implanted oriented towards the mPOA and in the PBL. After recovery period, the animals were recorded for 8 hours after the following injections into the mPOA: A: 0.2 µl of saline. B: Arecaidine (AREC) (1 µg/0.2 µl) a m2<m4 subtype muscarinic receptor (SMR) agonist. C: Himbacine (HIMB) (1 µM/0.2 µl), a m2<m4 SMR blocker, D: AREC in mPOA plus HIMB into the PBL.
Results: Results showed that AREC into the mPOA increases REM sleep and HIMB decreased it. When AREC was administered into the mPOA in combination with HIMB into the PBL, the increases of REM sleep was abolished.
Conclusion: The present results suggest a cholinergic interaction between the mPOA and PBL on REM sleep regulation.
Support (If Any): This project was supported by CONACyT.

0008

REDUCED HOMOEOSTATIC SLEEP PRESSURE AND ACCOMPANIED CHANGES IN BRAIN ENERGETIC AFTER ORAL CREATINE-SUPPLEMENTATION IN RATS

Dworak M, Kim T, Kalinchuk A, McCarley RW, Basheer R

Psychiatry, VA Boston Healthcare System & Harvard Medical School, West Roxbury, MA, USA

Introduction: Sleep has been hypothesized to restore energy depleted during wakefulness. The guanidine amino acid creatine (Cr) is an essential molecule in cellular energy homeostasis. Oral creatine-monohydrate supplementation (CS) increases total Cr in the mammalian brain and has substantial effects on cognitive performance, neuroprotection and circadian rhythms. Because Cr-induced accelerated restoration of brain energy metabolism might also affect sleep-wake behavior, we examined the effects of 4 weeks of oral CS on sleep-wake behavior and brain energetics in rats.
Methods: Male Sprague-Dawley rats were fed on a standard rodent diet enriched by 2% Cr for 4 weeks. EEG was monitored for 24h and 6h SD and RS. Frontal cortex (FC), basal forebrain (BF), cingulate cortex (CCX) and hippocampus (HIPP) samples were collected before and after 4 weeks of CS. Brain tissue concentrations of phosphocreatine (PCr) and Cr were measure by HPLC/ UV-detection. Microdialysis samples were collected from the BF after 6h SD and RS and analyzed by HPLC.
Results: We found that 4 weeks of oral CS result in a significant decrease in total sleep time and non-rapid eye movement (NREM) sleep (-15.14%; P=0.04) during the light but not during the dark period. Rebound NREM-sleep and NREM delta activity in CS rats were significantly decreased after 6h of sleep deprivation (NREM: -30.09%; P<0.05), while time awake was increased (+41.01%; P<0.05). CS rats showed lower extracellular AD concentrations in the BF after 6h SD (-36.61%; P<0.05).
Conclusion: Together these data suggest that 4 weeks of a high-energy CS diet decrease extracellular AD in the BF with a concomitant decrease in sleep homeostasis in rats.
Support (If Any): This work was supported by a Deutsche Forschungsgemeinschaft Fellowship (DW66/1-2), VA Medical Research Award and MH039683.

0009

THE EFFECT OF MORPHINE ON SLEEP-WAKEFULNESS CYCLE ORGANIZATION IN RATS

Basishvili T, Gogichadze M, Datunashvili M, Emukhvari N, Oniani N, Nemsadze M

T.Oniani Laboratory of Sleep-Wakefulness Cycle Studies, Ilia State University, Tbilisi, Georgia

Introduction: Opiates are the most effective and widely prescribed drugs for pain management. While sleep disturbances are common complaint in patients with pain, numerous animal and clinical studies report that opiates themselves cause sleep disruption. Opioid receptors are widely distributed in sleep-regulating structures. This present study examined the effect of systemic administration of low doses of morphine on the sleep-wakefulness cycle organization in rats.
Methods: Male mongrel rats, weighing 300-330 g at the beginning of the experiments, were surgically implanted with chronic cortical electroencephalogram (EEG) and dorsal neck electromyogram (EMG) electrodes for assessment of sleep-wakefulness states. On the 8th day after surgery, rats were recorded for 24h baseline sleep-wakefulness cycle followed by acute i.p. injection of morphine (2 mg/kg or 3 mg/kg). EEG/ EMG recordings were performed within 24 hours post injection.
Results: Acute administration of morphine resulted in a dose-dependent suppression of deep slow-wave sleep (SWS) during the first 4-h period post injection, compared to baseline (11±7.1% versus 23±6.5%, for the dose 2 mg/kg; 6±2.2% versus 21±1.4%, for the dose 3 mg/kg). Following morphine injection, rats spent more time in wakefulness, compared to baseline condition (77±11.3% versus 49±14.2%; 82±14.9% versus 59%±3.8 for 2mg/kg and 3mg/kg, respectively). In addition, i.p. morphine resulted in a dose dependent increase of both SWS (89.1±33min and 157.3±14.1min, p<0.01 vs. baseline 23.2±5.2min) and paradoxical sleep (181.9±15.3min, p<0.005 and 187.2±17.1min, p<0.001 vs. 28.3±5.6min) onset latencies, compared to control for 2mg/kg ad 3 mg/kg morphine, respectively. Mean duration of deep SWS episodes increased in the second 4h period following 3 mg/kg morphine injection (3.9±0.1 min versus 2.4±0.2 min, p<0.0005).
Conclusion: These findings suggest that morphine-induced suppression of sleep may be mediated by activation of opioid receptors located in sleep-promoting structures.
Support (If Any): Research supported by the Georgian National Science Foundation Grant #STO/6-232.

0010

THE EFFECTS OF SACLOFEN INFUSION IN THE GLOBUS PALLIDUS ON RAT SLEEP BEHAVIOR

Roffler M[1], Kelly J[1], Harless M[2], Patel A[1], Albers J[1], Anch AM[1]

[1]Psychology, Saint Louis University, St. Louis, MO, USA, [2]Chemical Engineering, Northeastern, Boston, MA, USA

Introduction: The present study examined the role of gamma aminobutyric acid (GABA)b receptor subtypes in the basal ganglia (BG) and their effect on sleep architecture. Recent evidence from lesion studies has shown a potential role for the BG in sleep behavior. GABAb receptors are most prevalent in the relay structure of the BG, known as the external globus pallidus (GPe). Previous studies have found evidence

for the GABAb receptors as sleep modulators in other brain areas, such as the thalamus. The primary focus of this study was to determine if GABAb receptors localized in the GPe contribute to sleep mechanisms.
Methods: Four male Sprague-Dawley rats (250-350g) underwent stereotaxic surgery for implantation of a bilateral cannula system targeted at the GPe, as well as epidural electrodes to record muscle and cortical activity. In each subject, a baseline of sleep behavior was recorded, followed by a 24-hour infusion of saline, a washout day, and a 24-hour infusion of the GABAb antagonist saclofen. Records were scored in 22-second epochs as one of four sleep stages: wake, high voltage (HS), low voltage, or paradoxical sleep.
Results: No significant differences in total sleep time were found between conditions, although total sleep time was increased in both infusion conditions as compared to the no infusion condition. Stage shift frequency did not differ significantly between conditions. Power spectral analyses revealed significantly higher ECoG amplitudes in HS during saclofen infusion relative to saline infusion.
Conclusion: GABAb receptors present in the GPe were not implicated in changes in sleep architecture. Other substances like dopamine, adenosine, or GABAa receptors may be responsible in conjunction with GABAb receptors for the changes observed in sleep following lesions to the GPe. However, sleep intensity, denoted by a change in amplitude during HS indicates that GABAb receptors may play a sleep-modulating role in the GPe.

0011

SUPRACHIASMATIC NUCLEUS IS ESSENTIAL FOR SLEEP-IMPROVING EFFECTS OF GLYCINE

Sakai N[1], Deguzman C[1], Bannai M[2], Nishino S[1]
[1]Psychiatry and Behavioral Sciences, Stanford University, Palo Alto, CA, USA, [2]Ajinomoto Co., Inc., Kawasaki, Japan

Introduction: Glycine, an amino acid, has been physiologically and pharmacologically implicated in the sleep regulation. However, the mechanisms underlying sleep-improving effects of glycine are still unknown, but sleep enhancement by glycine are often associated with a decrease in core body temperature (CBT). We previously reported that glycine increases c-Fos positive cells in and around the SCN and that microinjection of glycine into SCN increased cutaneous blood flow associated with a decrease in CBT, possibly through activation of NMDA receptors. In this study, to investigate if the SCN is essential in the mode of action of glycine, sleep-improving effects of glycine was analyzed in normal and SCN-lesioned rats.
Methods: Adult male rats were implanted with EEG and EMG electrodes along with a transmitter to record CBT. After recovery, vehicle or 2 g/kg of glycine were orally administered at ZT2. To determine the effect of glycine on sleep in mild sleep deprivation condition, oral administration was also performed in a new cage environment at ZT2, which induce acute insomnia. An effect of glycine on circadian rhythm was also examined under constant dark conditions. SCN-lesioned rats were also used for glycine administration with cage change at ZT2. Successful lesioning of the SCN was confirmed by the loss of circadian rhythmicity under the constant dark condition. The SCN-lesioned and sham rats were then implanted with electrodes.
Results: Glycine administration had little effect on sleep and temperature at the regular housing condition. However, in a new environment, glycine shortened sleep latency and increased non-REM sleep, especially first 2 hrs. Simultaneously, CBT significantly decreased. No effect of glycine on circadian rhythm was observed. In SCN-lesioned rats, effects on both CBT and sleep were disappeared, while they were spared in sham group.
Conclusion: Our results showed that an intact SCN is required for sleep facilitating effects of glycine in mild sleep deprivation condition at the resting period. Histological analyses of the SCN lesioned rats are in progress.

0012

ABSENCE OF THE HYPOCRETIN PEPTIDE INCREASES BODY WEIGHT AND DECREASES ENERGY EXPENDITURE IN FEMALE BUT NOT MALE MICE

Ramanathan L[1,2], Siegel J[1,2]
[1]Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, Los Angeles, CA, USA, [2]Neurobiology Research, VAGLAHS-Sepulveda, North Hills, CA, USA

Introduction: Several studies have reported that Hcrt knockout (KO) mice have increased body weight, despite decreased food and water intake, compared to wild type (WT) mice. However, conflicting results on gender specific changes have been reported. We carried out a detailed study of Hcrt KO and WT male and female mice, including analyses of body weight, body composition and energy expenditure.
Methods: A total of 4 mice of each genotype and gender were used. The animals were housed under standard light and temperature conditions, and fed normal laboratory diet. The mice were weighed starting at 5 months. At 20 months, NMR analyses and metabolic studies were carried out. Three way ANOVA with repeated measures (for body weight and energy expenditure) and two way ANOVA (for body composition) were used with post hoc Newman Keuls.
Results: A significant interaction between gender and genotype on body weights ($F=46.36$, $p<0.0001$) was observed, with female KO mice showing significantly higher body weights (50-62%, $p<0.05$) than female WT mice starting as early as 10 months and persisting until 24 months, when the mice were sacrificed. Male KO and WT mice did not differ in body weights. A significant difference in body composition between genotypes ($F=12.73$, $p=0.005$) was observed, with both male and female KO mice having higher amounts of fat/body weight (100% and 52% respectively, $p<0.05$) compared to sex matched WT mice. Furthermore, a significant interaction of gender and genotype ($F=13.03$, $p=0.004$) on energy expenditure was observed, with female KO mice exhibiting significantly lower energy expenditure compared to female WT mice, during both the light (36%, $p<0.01$) and dark (35%, $p<0.01$) periods. No significant difference in energy expenditure was observed between male WT and KO mice.
Conclusion: We conclude that lack of the hypocretin peptide increases body weight and decreases energy expenditure. These effects are gender specific.
Support (If Any): Research supported by NS14610, MH64109 and the Medical Research Service of the Department of Veterans Affairs.

0013

EFFECT OF GABOXADOL ON A RAT MODEL OF STRESS-INDUCED INSOMNIA

Cano G[1], Bruinstroop E[2], Saper C[3]
[1]Neuroscience, University of Pittsburgh, Pittsburgh, PA, USA, [2]Endocrinology and Metabolism, Academic Medical Center, University of Amsterdam, Amsterdam, Netherlands, [3]Neurology, Program in Neuroscience, and Division of Sleep Medicine, Harvard Medical School and Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Gaboxadol (Gbx), a selective agonist for extrasynaptic GABA A receptors, was in clinical development for the treatment of insomnia due to its hypnotic effects in humans and animals. Nevertheless, Gbx has not been tested in animal models of insomnia. We analyzed the effects of Gbx on sleep architecture and brain activity in a rat model of stress-induced insomnia.
Methods: Gbx (5 and 10 mg/kg) was injected i.p. in male rats subjected to a psychosocial stressor (exchange to a cage previously occupied by a conspecific male) at their peak of sleep. In untreated rats, this was followed by a period of transient insomnia with characteristics similar to those observed in humans. EEG/EMG activity was recorded constantly. Rats were killed and the brains were processed for immunohistochemical detection of Fos, a marker of neuronal activity.

Results: Gbx (5 mg/kg) reduced sleep latency (36%), increased delta power (30%), decreased fragmentation, increased nREM sleep, and decreased wakefulness to levels similar to control (unstressed) rats, but only partially restored REM sleep. This dose abolished Fos expression in the tuberomammillary nucleus, locus coeruleus, and cerebral cortex, which were highly active in insomniac rats. Fos expression was not inhibited in limbic areas, which may explain why REM sleep was still decreased after Gbx treatment. The patterns of sleep and Fos expression induced by Gbx (10mg/kg) were highly unusual and quite different from those evoked by 5 mg/kg.
Conclusion: Gbx 5 mg/kg ameliorated insomnia in rats by inhibiting the arousal system and cortex and increasing delta power, although REM sleep was not fully recovered. The similarity between these results and those reported in humans strongly suggest that this model is useful to test drugs for insomnia treatment. In addition, the model allows identification of the brain areas affected by the drug and evaluates possible mechanisms of action.
Support (If Any): Merck Grant # 31744.

0014

IN VIVO VISUALIZATION OF CAFFEINE OCCUPYING A_1 ADENOSINE RECEPTORS IN THE HUMAN BRAIN

Elmenhorst D, Meyer PT, Matusch A, Bauer A
Institute for Neurosciences and Medicine - 2 Molecular Neuroimaging, Forschungszentrum Jülich, Juelich, Germany

Introduction: Societal demands and work-related requirements supersede regularly the fundamental biology of sleep and sleepiness. To overcome these constraints, unstandardized attempts of "self-therapy" with psychoactive stimulants like caffeine are widely practiced. Caffeine's stimulating effects are thought to be mediated by antagonizing adenosine receptors. In this study we investigated the in vivo occupancy of A_1 adenosine receptors (A_1AR) by caffeine in the human brain with the highly selective and affine ligand [^{18}F]CPFPX and positron emission tomography (PET).
Methods: 18 subjects (24-68 years) participated in a bolus plus constant infusion PET experiment (140 min duration) after caffeine abstinence. Caffeine was administered intravenously in different concentrations (0.5-4.3 mg/kg body weight) between 90 and 100 min during the steady state phase of ligand binding. Caffeine plasma levels were determined at regular intervals. The applied dose per body weight versus the attained plasma caffeine concentration showed a highly significant, linear relationship. One subject received the vehicle alone. An outcome parameter proportional to the A_1AR density (total distribution volume of [^{18}F]CPFPX) was determined before and after caffeine application. The differences between these two conditions in different brain regions reflected the occupancy levels. These were used to calculate the concentration of caffeine sufficient to inhibit 50% of binding (IC_{50}).
Results: Caffeine displaced between 5 and 44% of [^{18}F]CPFPX binding in a concentration dependent manner whereas no displacement was found after placebo administration. Half-maximal displacement was achieved at a plasma caffeine concentration of 65 µM which corresponds to 460 mg in a 70 kg subject (approximately 4.5 cups of coffee).
Conclusion: Considering the biological half live of caffeine of about 5 hrs. and a repeated intake of caffeinated beverages during a day, it can be extrapolated that caffeine consumers are likely to reach an average occupancy of 50% of cerebral A_1ARs throughout the day.

0015

SLEEP IN A DISH: KEY ELECTROPHYSIOLOGICAL, MOLECULAR, AND METABOLIC SIGNATURES OF SLEEP AND WAKEFULNESS REVEALED IN PRIMARY CORTICAL CULTURES

Hinard V[1], Mikhail C[1], Pradervand S[2], Curie T[1], Houtkooper R[3], Auwerx J[3], Franken P[1], Tafti M[1]
[1]CIG, University of Lausanne, Lausanne, Switzerland, [2]GTF, University of Lausanne, Lausanne, Switzerland, [3]Laboratory for integrative and systems physiology, EPFL, Lausanne, Switzerland

Introduction: Although at the organism level, sleep is defined as a behavioral state, at the level of the cerebral cortex, sleep has a distinct local and use-dependent aspect. Moreover, the conservation of sleep across phylogeny (sleep is found from worms to mammals) strongly suggests that sleep must have some fundamental functions distinct from the complex architecture of the mammalian brain. These observations raise the question whether sleep is a functional property of a complex brain or occurs at the level of neuronal assemblies, or even at the very cellular level.
Methods: Here, we show that dissociated primary cortical cultures share key signatures with their *in vivo* counterparts.
Results: Cortical cultures have the capacity to change between sleep- and wake-like states. They initially exhibit random firing activity that is gradually replaced by a "sleep-like" synchronized burst-pause firing activity as neurons mature and stabilize their connections. When stimulated with excitatory neurotransmitters, transient tonic firing is observed, followed by the reappearance of a "sleep-like" state. Besides electrical similarities, the transcriptional profile of stimulated cortical cultures greatly resembles that of the cortex of sleep deprived animals. We then used our *in vitro* model to map the metabolic pathways activated by the "wake-like" state and found evidence for increased lysolipid release, strongly suggesting that sleep plays a role in neuronal membrane homeostasis.
Conclusion: With our *in vitro* model, the cellular and molecular consequences of sleep loss and the genetic determinants of disturbed sleep can now be investigated in a dish.

0016

RESTLESS FLY (REF, INSOMNIAC (INC)) ENCODES A KEY GENETIC LINK BETWEEN SYNAPTIC AND SLEEP HOMEOSTASIS

Pfeiffenberger C, Allada R
Northwestern University, Evanston, IL, USA

Introduction: Synaptic scaling is thought to be a sleep-dependent homeostatic process that sets sleep levels; however, key genetic evidence and the underlying molecular mechanisms for this model remain unclear.
Methods: We performed a reverse genetics screen in Drosophila using standard genetics techniques. Sleep was monitored with the DAM system from Trikinetics. Sleep deprivation experiments were performed using a mechanical sleep deprivation device that resulted in ≥ 90% sleep deprivation. Dopamine levels were modulated pharmacologically by adding 3-iodo-tyrosine or DOPA to the food, and measured by HPLC. CoIP and western blots were performed using standard techniques. Immunostaining was performed using standard techniques; identical settings were used for image capture to retain quantitative data.
Results: We have identified an insertion in the BTB domain protein CG32810/ref/inc that exhibits one of the strongest sleep phenotypes thus far observed, a ~10h sleep reduction. ref mutants exhibit elevated dopamine levels and pharmacological blockade of dopamine biosynthesis can fully suppress ref short sleep phenotypes. We find that the putative REF-interacting proteins, the E3 ubiquitin ligase Cul3 and a potential CUL3 target and regulator of memory, cheerio (filamin), also regulate sleep, suggesting ref links protein turnover to synaptic plasticity. Although wake typically elevates synaptic proteins, we find that synaptic markers, including the cell adhesion molecule FASCICLIN-II (FASII), are reduced in ref mutants. On the other hand, we find that sleep deprivation increases FASII levels; however, homeostatic regulation of sleep behavior and sleep-dependent regulation of FASII are blocked in ref mutants.
Conclusion: Taken together, ref genetically links synaptic and sleep homeostasis by connecting altered sleep behavior (reduced, poorly consolidated sleep lacking homeostatic regulation) and a molecular phenotype at the synapse (reduced levels of synaptic markers, and an uncoupling of sleep/wake regulation of FASII levels).
Support (If Any): NRSA 1F32NS062556, NIH R01MH092273 and R01NS059042.

0017

OREXIN GENE TRANSFER INTO THE ZONA INCERTA NEURONS BLOCKS CATAPLEXY AND IMPROVES WAKE MAINTENANCE IN NARCOLEPTIC OREXIN-ATAXIN-3 TRANSGENIC MICE

Blanco-Centurion C[1], Liu M[1], Konadhode R[1], Pelluru D[1], van den Pol A[3], Shiromani PJ[2,1]
[1]Psychiatry and Behavioral Sciences, Medical University Of South Carolina, Charleston, SC, USA, [2]Ralph H Johnson VAMC, Charleston, SC, USA, [3]Yale University, New Haven, CT, USA

Introduction: Permanent disruption of the orexin pathway causes narcoleptic symptoms. Cataplexy is an important symptom of narcolepsy. Likewise, narcoleptics suffer from episodes of excessive sleepiness during the active period. Current therapy for narcolepsy relies on lifetime use of strong stimulants and NE reuptake blockers. Gene therapy offers narcoleptics a chance to reduce or stop their dependence on medications. In the present study we introduced the prepro-orexin gene in different surrogate neurons to assess whether narcoleptic symptoms could be controlled.
Methods: Orexin-ataxin-3 mice were surgically implanted with sleep electrodes while rAAV was delivered into the lateral hypothalamus (LH), zona incerta (ZI) or striatum (ST). Three different rAAV vectors were used: 1) rAAV-orexin, 2) rAAV-GFP and 3) rAAV-MCH-orexin where the CMV promoter was replaced by the MCH promoter. Age-matched non injected ataxin-orexin-3 and WT mice were used as controls. Three weeks after surgery a 48h recording of the animal's sleep and behavior were made. Then CSF and brains were removed for analysis of orexin release and number, location and phenotype of transfected neurons and its projections.
Results: Orexin-ataxin-3 mice given the rAAV-orexin into the LH showed numerous orexin positive neurons in midline thalamus, LH, DMH, and TMN. The number of orexin-ir neurons was higher than in WT although orexin CSF level was similar. In these mice cataplexy attacks were blocked (-85% vs. non-injected) Nighttime wake maintenance was also significantly improved (+100% vs. non-injected) but never reached WT levels. Similar findings were observed in mice transfected with orexin into the ZI. These mice had similar number of orexin-ir neurons and CSF level as WT. Transfected neurons in the ZI expressed the GABA transporter while its orexin projections were similar to WT. In contrast, ectopic orexin expression into MCH or striatal neurons neither blocked cataplexy nor increased wake maintenance despite the number of orexin-ir was similar to WT.
Conclusion: Our results suggest that gene therapy could be applied to cure narcoleptic symptoms using putative GABAergic ZI neurons as surrogates.
Support (If Any): VA Medical Research, NIH-HL091363, NIH-MH055772, NIH-NS030140 and J. Christian Gillin Research Grant from the Sleep Research Foundation (CBC).

0018

ACUTE PHARMACOGENETIC ACTIVATION OF THE MEDULLARY PARAFACIAL ZONE INDUCES SLOW-WAVE-SLEEP

Anaclet C, Lu J, Saper C, Fuller PM
Neurology, BIDMC/Harvard Medical School, Boston, MA, USA

Introduction: In a recent study we provided evidence that the medullary parafacial zone (PZ) contains putative slow wave sleep (SWS)-promoting neurons. We specifically found that GABAergic PZ neurons are active during sleep but not during wakefulness and that both cell-body specific lesion in rats and selective, genetic disruption of GABAergic/glycinergic transmission in mice results in large and sustained increases (40-50%) in total wakefulness (Anaclet et al., in submission). In the present study, we sought to 1) establish a causal linkage between specific and acute activation of GABAergic PZ neurons and sleep induction and 2) map the projections of these neurons.
Methods: For our experimental template, we used a cre-driver mouse line that expresses cre-recombinase exclusively in neurons expressing the vesicular GABA transporter (vGAT-ires-cre mouse). In the first experiment, we placed bilateral microinjections of an adeno-associated viral (AAV) vector containing a modified muscarinic G protein-coupled receptor (hM3Dq-AAV10; so-called DREADD), expressed in a cre-dependent manner, into the PZ of vGAT-ires-cre mice and non-cre expressing littermates. In the second experiment, we placed unilateral microinjections of an AAV containing a cre-dependant retrograde tracer (hrGFP-AAV10) into the PZ of vGAT-ires-cre mice.
Results: Ligand injections (CNO, ip; 0.3mg/kg) at the beginning of the normal waking period (ZT12) produced a large increase in SWS in vGAT-ires-cre mice (those with histologically-verified expression of hM3Dq in the PZ) as compared with vehicle injection controls. Importantly, similarly timed and dosed CNO injections into non-cre expressing littermates did not produce an increase in SWS. Immunostaining in hrGFP-injected mice revealed that PZ VGAT neurons project to several established sleep-wake circuits, including the wake-promoting medial parabrachial nucleus.
Conclusion: These results provide convincing in vivo evidence that GABAergic PZ neurons are SWS-promoting. On the basis of our tracing results, we hypothesize that PZ GABAergic neurons promote SWS via inhibitory projections to wake-promoting nuclei.
Support (If Any): NS0736313, G. Harold and Leila Y. Mathers Foundation and HL095491.

0019

SLEEP FRAGMENTATION IN MICE INDUCES ENDOPLASMIC RETICULUM STRESS AND LEPTIN RESISTANCE IN THE HYPOTHALAMUS

Hakim F, Peris E, Carreras A, Hirotsu C, Zhang J, Wang Y, Gozal D
Pediatric Sleep Medicine, Department of Pediatrics, University of Chicago, Chicago, IL, USA

Introduction: Sleep fragmentation (SF) is highly prevalent and may constitute an important contributing factor to excessive weight gain and the metabolic syndrome. Increased endoplasmic reticulum (ER) stress and activation of the unfolded protein response (UPR) leading to the attenuation of leptin receptor signaling in the hypothalamus leads to obesity and metabolic dysfunction. We hypothesized that SF will induces ER stress, activate the UPR, and downregulate of leptin receptor signaling in the hypothalamus, thereby favoring obesogenic behaviors and metabolic dysfunction.
Methods: Adult male C57/b6 mice were exposed to SF during the light period (from 7:00am to7:00pm) using a custom-designed apparatus based on automated tactile stimulation for 6 hours- 21 days along with matched controls (CO). Daily food intake and weight gain were monitored. Hypothalamic samples were harvested, and subjected to western blots using ATF6, eIF2α, p-eIF2α, p-ERK, HSP 70, HSP90, GRP78, FAT10, SOCS3, PTP1b, ObR, p-STAT3, STAT3, and β-Actin (as loading control), followed by quantitative and statistical analyses.
Results: After 3 days of SF, food intake was increased and sustained thereafter ($p<0.012$). SF induced ER stress from day 3 to day 7 SF (n=6), in 2 of the 3 major pathways, with increased ATF6 ($p<0.04$) and p-eIF2α/ eIF2α ratios($p<0.04$), which were followed by increased immunoreactivity of GRP78 ($p<0.05$), HSP70 ($p<0.05$) , HSP90($p<0.03$) and FAT10 ($p<0.06$) in SF mice. Leptin receptor (ObR) expression showed slight increases in expression, and in parallel p-STAT3/STAT3 decreased ($p<0.034$) suggesting reduced ObR receptor signaling. Although SOCS3 expression remained unaltered by SF, significant increases in PTP1b expression emerged ($p<0.04$) overtime, implicating up-regulation of PTP1b as a putative mechanism underling attenuation of leptin receptor signaling in SF.
Conclusion: Sleep fragmentation in mice induces hyperphagic behaviors and alterations in leptin signaling in the hypothalamus that appear to be mediated by ER stress and activation of the UPR. The increases in PTP1b expression further suggest this pathway as potentially promoting weight gain and metabolic dysfunction in the context of disrupted sleep.
Support (If Any): DG is supported by National Institutes of Health grants HL-065270 and HL-086662.

0020

TRIB1 CONSTITUTES A MOLECULAR LINK BETWEEN REGULATION OF SLEEP AND LIPID METABOLISM -EVIDENCE FROM POPULATION-BASED SAMPLES, EXPERIMENTAL SLEEP RESTRICTION MODEL, AND RESTING STATE FMRI

Ollila HM[1,2,3], Littow H[7], Kronholm E[4], Partonen T[5], Kaprio J[6], Salomaa V[1], Veijola J[7], Kiviniemi V[7], Porkka-Heiskanen T[2], Paunio T[1,3]
[1]Molecular Medicine, National Institute for Health and Welfare, Helsinki, Finland, [2]Physiology, Institute of Biomedicine, University of Helsinki, Helsinki, Finland, [3]Department of Psychiatry, University of Helsinki, Helsinki, Finland, [4]Department of Chronic Disease Prevention, National Institute for Health and Welfare, Turku, Finland, [5]Department of Mental Health and Substance Abuse Services, National Institute for Health and Welfare, Helsinki, Finland, [6]Department of Public Health, Hjelt Institute University of Helsinki, Helsinki, Finland, [7]Department of Psychiatry, Institute of Clinical Medicine, University of Oulu, Oulu, Finland

Introduction: Epidemiological studies show association between sleep duration and lipid metabolism. We hypothesized that regulation of sleep length and lipid metabolism is partially controlled by the same genes and aimed to identify such genes in humans. Furthermore, we elucidated their role in functional connectivity of neuronal networks by using resting state fMRI.
Methods: We studied the association of total sleep time (TST) with 60 genetic variants that had previously been associated with lipid traits. The analyses were performed in a Finnish population based sample comprising 6334 participants and replicated in 2189 twins. RNA expression from mononuclear leucocytes was measured in 10 healthy volunteers before and after partial sleep restriction (4 h sleep per night for 5 days). The most significant variant was studied by analysis of resting state fMRI data from 176 healthy individuals.
Results: The genetic analysis identified two variants near TRIB1 gene that independently contributed to both blood lipid levels and to TST ($P<0.05$ after correction for multiple testing; $P<0.001$ after adjusting for blood lipid levels or BMI, $P<0.05$) in the replication sample and P=8.1*10-6 in meta-analysis of both samples). After the experimentally induced sleep restriction period TRIB1 expression increased by 1.6-fold ($P<0.01$). Resting state fMRI identified activity in distinct brain regions that correlated with the TRIB1 genotypes ($P<0.05$ after correction for multiple testing).
Conclusion: Our results show that allelic variants of TRIB1 are independently involved in regulation of lipid metabolism and sleep. The

finding evidences for pleiotropic nature of TRIB1 and may reflect the shared roots of sleep and metabolism. The shared genetic background and the effect of TRIB1 in functional connectivity of neuronal networks may at least partially explain the mechanism behind the well-established connection between diseases with disrupted metabolism and sleep.
Support (If Any): Jalmari and Rauha Ahokas Foundation Emil Aaltonen Foundation Biomedicum Helsinki Foundation.

0021

DENSE GENOTYPING OF IMMUNE-RELATED MARKERS REVEALS NEW SUSCEPTIBILITY LOCI IN NARCOLEPSY

Faraco J[1], Lin L[1], International Immunochip Consortium T[2], Mignot E[1]
[1]Center for Sleep Science, Stanford University, Palo Alto, CA, USA, [2]Consortium, International, Multi Center, United Kingdom

Introduction: Narcolepsy/ hypocretin deficiency is now firmly established as an autoimmune disorder resulting from highly specific destruction of ~70,000 hypocretin-producing cells in the hypothalamus. The symptoms (exessive sleepiness, disturbed nocturnal sleep, and cataplexy) onset most frequently during childhood or adolescence, and once cell loss has occured, the disorder is life-long. Over 98% of cases (all ethnic groups) carry the HLA susceptibility haplotype DQA1*01:02, DQB1*06:02. Specific T cell receptor alpha variants are also significantly associated across racial groups, as are additional novel immunomodulatory genes (P2RY11 purinergic receptor/ DNMT1 region). Together with the International Immunochip Consortium, we genotyped and analyzed ~2000 narcolepsy samples and ~8000 matched controls to further study immune-related loci in order to identify additional susceptiblity loci missed in previous GWA studies, and to fit the genetic architecture of narcolepsy into a broader context of other known autoimmune diseases.
Methods: Samples were typed on the Illumina Immunochip, containing ~200,000 markers selected for high-density coverage of immune related genes. Narcolepsy cases had clear-cut cataplexy and were DQB1*0602 positive, or had documented hypocretin deficiency (CSF hcrt-1 levels), and came from the USA, Canada and Europe. Control genotypes were provided by consortia members and were from individuals with known single European country of origin. Matched controls were selected through principal component analysis (Golden Helix SVS7). Statistical analysis was performed with the Plink Suite of software.
Results: Preliminary association results provide strong replication of T Cell Receptor alpha polymorphism rs1154155 ($p<10^{-27}$) as has been seen in previous studies. Additional loci showed association with narcolepsy at genome-wide significant levels, and are being tested for replication in additional narcolepsy samples.
Conclusion: The genetic architecture of narcolepsy indicates important roles for a variety of immune-related genes conferring susceptibility to the disease.

0022

MUTATIONS IN DNMT1 CAUSE AUTOSOMAL DOMINANT CEREBELLAR ATAXIA, DEAFNESS AND NARCOLEPSY

Winkelmann J[1,2,3], Lin L[4,5], Schormair B[1,3], Kornum BR[4,5,6], Faraco J[4,5], Plazzi G[7], Melberg A[8], Cornellio F[9], Pizza F[7], Mignot E[4,5]
[1]Human Genetics, Technische Universität München, Munich, Germany, [2]Neurology, Technische Universität München, Munich, Germany, [3]Human Genetics, Helmholtz Zentrum München, Munich, Germany, [4]Center for Sleep Sciences and Medicine, Stanford University, Palo Alto, CA, USA, [5]Psychiatry, Stanford University, Palo Alto, CA, USA, [6]Danish Center for Sleep Medicine, University of Copenhagen, Glostrup, Denmark, [7]Neurological Sciences, University of Bologna, Bologna, Italy, [8]Neuroscience, Uppsala University, Uppsala, Sweden, [9]Instituto Neurologico, Carlo Besta, Milano, Italy

Introduction: Autosomal Dominant Cerebellar Ataxia, Deafness and Narcolepsy (ADCA-DN) is characterized by late onset (30-40 years old) cerebellar ataxia, sensory neuronal deafness, narcolepsy-cataplexy, and dementia. It was first described in 1995 in a Swedish pedigree. We identified three additional kindreds: (i) a large multigenerational autosomal dominant pedigree from the US, with 13 affected individuals, including six living; (ii) a sporadic occurrence of the disease in a 50-year old Italian patient with unaffected elderly parents suggesting the activity of a de novo mutation; (iii) a multiplex Italian pedigree with 4 known affected. Narcolepsy and deafness were the first symptoms to appear in all pedigrees, followed by ataxia.
Methods: We performed exome sequencing in five individuals from three ADCA-DN kindreds and used Sanger sequencing to confirm mutations found in exome sequencing from all available family members of four kindreds.
Results: DNMT1 was identified as the only gene with mutations found in all five affected individuals by exome sequencing. The mutation p.Ala570Val was found in the large multigenerational US family and the sporadic Italian patient; p.Val606Phe was found in the Swedish family; and p.GLY605Ala mutation was found in the multiplex Italian family. Sanger sequencing confirmed the de novo mutation and showed co-segregation of p.Ala570Val, p.GLY605Ala, and p.Val606Phe in all available family members.
Conclusion: DNMT1 is a widely expressed DNA methyltransferase maintaining methylation patterns in development, and mediating transcriptional repression by direct binding to HDAC2. It is also highly expressed in immune cells and required for the differentiation of CD4+ into T regulatory cells. Mutations in exon 20 of this gene were recently reported to cause Hereditary Sensory Neuropathy with Dementia and Hearing loss. Our mutations are located in exon 21 and in very close proximity suggesting distinct/partially overlapping phenotypes depending of the location of the mutation in this gene.

0023

DELINEATING NOTCH PATHWAY REGULATION OF SLEEP-LIKE BEHAVIOR IN C. ELEGANS

Singh K[1], Huang H[1], Bennett HL[2,1], Hart AC[1]
[1]Department of Neuroscience, Brown University, Providence, RI, USA, [2]Molecular Biology, Cell Biology and Biochemistry, Brown University, Providence, RI, USA

Introduction: Sleep is a mysterious behavior observed across species. During development, Caenorhabditis elegans undergo quiescence, a sleep-like state characterized by decreased activity, high arousal thresholds, and rapid reversibility between quiescent and non-quiescent states. Thus, the genetically tractable nematode C. elegans can be used to address genetic and molecular mechanisms underlying sleep-like behavior. The Notch signaling pathway plays a highly conserved role in development and roles for Notch pathway genes in the adult nervous system have been recently identified. Our work supports a role for the Notch pathway in the regulation of quiescence. However, the molecular targets of the Notch pathway that regulate quiescence remain unclear.
Methods: We have developed a microfluidic chamber-based assay and a mechanosensory assay to measure quiescence and arousal thresholds of animals during quiescence, respectively. Additionally, we are using an automated tracking system to perform high-throughput quiescence assays on C. elegans.
Results: Our work has established a role for the Notch signaling pathway in C. elegans quiescence, arousal thresholds, and basal activity. Increasing or decreasing the Notch pathway activity resulted in changes in quiescence with altered arousal thresholds. Over-expression studies suggest that the glp-1 Notch receptor functions in sensory neurons to regulate quiescence.
Conclusion: Studies from our lab and others supports a model in which Notch pathway regulates sleep-like behavior via conserved pathways in C. elegans and Drosophila. We are undertaking a combination of genetic and biochemical screens to identify the downstream targets of Notch in the regulation of quiescence. We are also analyzing the role of various

Notch ligands in the regulation of quiescence, as well as determining the cellular sites where the Notch receptors function in the regulation of quiescence. Collectively, these studies will help us understand the molecular and cellular mechanisms regulating conserved sleep-like behavior across species.

0024

IDENTIFYING REDUCED SLEEP GENES USING A DROSOPHILA MODEL

Li T, Zhang K, Huang L
Heilongjiang University of Chinese Medicine, Harbin, China

Introduction: Sleep is a behavioral state that is a natural part of every individual's life. It has been reported that drosophila rest/activity cycle has features in common with mammalian sleep/wake cycle. The power of drosophila as a model organism can be useful for molecular investigations to understand the regulation and function of sleep. Our research is to select genes that affect the sleep/wake cycle in the fruit fly.
Methods: Fifteen gene deletion stains and Canon S fruit flies was selected. Flies were housed at 25 C,45%-70% humidity, 12 hour Lightness : Darkness cycle. Fruit flies (females, 1-2 days old) were collected by CO2 anesthesia and placed in the Drosophila Activity Monitor System (DAMS,Trikinetics) inside glass tubes with enough food for 1 week of recording. The 24 hours sleep/wake cycle of 7 days old flies were recorded. Sleep was defined as any period of uninterrupted behavioural immobility (0 counts per min) lasting 5 mininutes.
Results: Compared to Canon-S fruit flies, one of fifteen gene deletion strains had significantly reduced sleep duration (383.44±185.69 vs. 813.23±179.11, $p<0.001$).
Conclusion: By screening 15 gene deletion stains, we found that Df(3R) Espl3/TM6c deletion stain fruit fly had sleep duration for one-half of the wild-type amount.
Support (If Any): Chinese National Natural Science Foundation 81073077/H2808.

0025

IDENTIFYING GENES THAT CONFER RESILIENCE/ VULNERABILITY TO SLEEP DISRUPTION IN DROSOPHILA

Suzuki Y[1], Seugnet L[2], Thimgan M[3], Thacher PV[4], Burnham MM[5], Shaw P[1]
[1]Anatomy and Neurobiology, Washington University in St. Louis School of Medicine, St. Louis, MO, USA, [2]Centre de Recherche en Neurosciences de Lyon, Universite Claude Bernard Lyon 1, Faculte de Medecine, Lyon Cedex 08, France, [3]Biological Sciences, Missouri University of Science & Technology, Rolla, MO, USA, [4]Psychology, St. Lawrence University, Canton, NY, USA, [5]Educational Psychology, Counseling, & Human Development, University of Nevada, Reno, Reno, NV, USA

Introduction: While human studies demonstrate that individuals differ in their resilience (R)/vulnerability (V) to sleep loss, little is known about the underlining genetics. We have observed that, like humans, individuals within wild-type populations of flies (Cs) are able to maintain their ability to learn following sleep deprivation. Using gene discovery in flies we have begun identifying genes that confer resilience/vulnerability to cognitive deficits induced by insufficient sleep.
Methods: Learning was evaluated in 5-day old Cs flies using Aversive Phototaxic suppression. Performance was examined during baseline and following three conditions that disrupt learning: 1) 12 h of sleep deprivation; 2) in flies with spontaneously fragmented sleep and 3) in 5-day old flies that had been sleep deprived on their first day of adult life. Within each group, flies that learned (R) and did not learn (V) were separately pooled (~20/group), RNA was extracted from heads, and gene profiles were examined using quantitative PCR.
Results: 100 candidate genes were selected from internal microarray studies. Genes that displayed similar profiles in poor-learning flies during baseline and following sleep disruption (V-flies) were excluded. We identified 15 genes that showed similar profiles in V-flies in all three sleep deprived groups, but differed from baseline. We then used Yeast UAS/GAL4 system to drive gain-of-function or loss-of-function alleles for specific genes to determine if they would alter resilience/vulnerability to sleep loss. We identified two genes that, when manipulated, confer resilience and vulnerability to sleep loss, respectively.
Conclusion: Flies can be used as an effective genetic model to identify and test candidate genes that may contribute to individual differences in the response to sleep loss. Because of the extensive homology in sleep deprivation induced learning impairment between flies and humans; identification of resilience genes has obvious clinical utility.

0026

EARLY-LIFE REM SLEEP DEPRIVATION AFFECTS MRNA EXPRESSION IN FRONTAL CORTEX IN YOUNG ADULT RATS

Shaffery JP[1], Goswami D[1], Austin M[1], Armitage R[2], Sanapureddy P[1], Roffwarg HP[1]
[1]Department of Psychiatry and Human Behavior, University of Mississippi Medical Center School of Medicine, Jackson, MS, USA, [2]Psychiatry, University of Michigan, Ann Arbor, MI, USA

Introduction: Correct development of the CNS depends upon synaptic plasticity mechanisms. These mechanisms are compromised during development by insults such as hypoxia, drugs and deficiencies of sleep. REM sleep (REMS) plays a critical role in brain maturation. Its restriction during early life has been shown to affect central visual system plasticity, maturation of synaptic plasticity mechanisms and glutamatergic signaling proteins in hippocampus. A recent study of young adult rats that were REMS-deprived (REMSD) during a described, critical period of brain development demonstrated lower expression of genes involved in synaptic plasticity in the hippocampus. The present study extends these findings by examining mRNA expression in the frontal cortex (FCx) in these same adult rats that were REMSD early in life.
Methods: Rats were REMSD for 4 h (9:00 - 13:00 h) each day between postnatal day (P) 16 and P19; (RD). Control animals remained in the litter, untreated (NC), or were exposed to similar amounts of shaking outside of REM sleep (SC). Animals survived until P50 to P54. The FCx was harvested, frozen on crushed dried ice, and stored at -80C until samples were prepared for gene expression studies. Total RNA was isolated, and triplicate samples were stored at -80C until assayed using the nCounter Expression Assay Kit (Nanostring Technologies, Inc.). Twenty probes for synaptic plasticity and serotonergic signaling genes were examined in multiplexed probe hybridization reactions. Assay results were converted to an equivalent concentration using a standardized curve and normalized to the mean of reference genes (beta2-microgobulin & GAPDH). Multivariate ANOVA determined differences between groups, and the adjusted Tukey determined pair-wise significance ($p< 0.05$ was accepted for significance).
Results: MANOVA results revealed that mRNA expression levels were significantly different between groups for several genes: CaMKIIa ($p=0.043$), CREB ($p=0.045$), Neuritin ($p=0.04$), polyubiqitin ($p=0.001$), Pgk1 ($p< 0.0001$) and TrkB ($p=0.007$). Pairwise differences at the $p<0.05$ level for these genes included: CaMKIIa (RD<NC), CREB (RD<NC), Pgk1(RD<NC), Polyubiquitin (RD<NC) and TrkB (RD<NC).
Conclusion: These preliminary data indicate that early-life REMSD leads to lower expression of specific synaptic plasticity-related genes in frontal cortex. Unperturbed REM sleep in the first weeks of life appears to be essential for correct brain development.
Support (If Any): Grant # P20-RR-17701 from the National Center for Research Resources (NCRR) of the National Institutes of Health (NIH).

0027

ASTROCYTIC GLT-1 APPOSITION ON SLEEP/WAKE-PROMOTING FOREBRAIN NEURONS IS REDUCED FOLLOWING ACUTE SLEEP DEPRIVATION IN RATS

Briggs CL[1], Hirasawa M[2,1], Semba K[1]
[1]Anatomy and Neurobiology, Dalhousie University, Halifax, NS, Canada, [2]Division of BioMedical Sciences, Memorial University, St. John's, NF, Canada

Introduction: Astrocytes play integral roles in brain functions by clearing synaptically released glutamate and GABA, releasing chemicals (gliotransmission) upon activation, and providing metabolic support to neurons. Thus, astrocytes modulate synaptic activity and neuronal excitability and regulate behaviors such as learning, memory and sleep. It has recently been shown that preventing gliotransmission reduced the normal increase in sleep pressure following 6 h of sleep deprivation (SD), in part via adenosinergic mechanisms. Morphologically, astrocytes have highly dynamic distal processes that can remodel in the order of minutes, and these structural changes can modulate synaptic efficacy. We examined whether changes in astrocytic wrapping of sleep/wake-regulatory neurons occur in response to acute SD.
Methods: Rats were sleep-deprived for 6 h starting at 9:00 AM under a 12:12 L:D cycle with lights on at 7:00 AM. One group of animals was immediately perfused, while a second group was allowed 3 h of ad lib sleep before perfusion. Non-deprived control animals were also perfused at both time points. Brain sections were processed for dual immunofluorescence for glial glutamate transporter 1 (GLT-1) as an astrocytic marker, and neurotransmitter markers of sleep/wake-regulatory neurons. Confocal microscope images were examined to analyze GLT-1 apposition on cholinergic and parvalbumin-containing GABAergic neurons in the basal forebrain (BF), and orexin and melanin-concentrating hormone (MCH) neurons in the lateral hypothalamic area (LHA).
Results: Acute SD resulted in a significant overall decrease (-6.8%) of astrocytic GLT-1 apposition on sleep/wake-regulatory neurons compared to non-deprived controls. The largest change occurred on small parvalbumin BF neurons (-17.8%), followed by MCH neurons (-12.7%) and orexin neurons (-6.6%), with little change occurring on cholinergic neurons. These reductions were mainly due to a decrease in the length of individual GLT-1 contacts rather than the number of contacts. Analyses are in progress for recovery animals and control neuronal populations not known to be involved in sleep/wake regulation.
Conclusion: Astrocytic processes surrounding sleep/wake-regulatory neurons in the BF and LHA exhibit small but significant structural changes (reduced contact with neurons) following an acute period of SD, and the magnitude of these changes differs between neuronal populations. These changes might affect synaptic and glio-transmission to regulate sleep homeostasis.
Support (If Any): CIHR (MOP93673).

0028

THE ABILITY TO RECOVER FROM SLEEP LOSS IS INFLUENCED BY SEX CHROMOSOME COMPLEMENT IN MICE

Paul K, Hesse S, Ehlen J
Neuroscience Institute, Morehouse School of Medicine, Atlanta, GA, USA

Introduction: Sex differences in sleep amount are largely dependent on circulating reproductive hormones. Spontaneous sleep amount in particular is sensitive to systemic androgen and estrogen levels in humans and rodents. However, sex differences in the ability to increase sleep propensity following sleep loss are relatively insensitive to reproductive hormones. This raises the possibly that sex-linked genes may directly regulate some sleep traits. In this study, we sought to determine the role of sex chromosomes on the regulation of the sleep-wake cycle.
Methods: In order to isolate the influences of genetic and phenotypic sex we conducted electroencephalographic (EEG) recording in four core genotype (FCG) mice whose sex chromosome complement (XY, XX) is independent of phenotypic sex (male or female hormonal and urogenital system). Adult FCG mice were gonadectomized and implanted with EEG/EMG recording electrodes and placed in a 12L:12D cycle. After recovery from surgery, they underwent 24 hrs of baseline recording followed by 6 hrs of forced wakefulness and 18 hrs of recovery sleep opportunity.
Results: Phenotypic males had more spontaneous sleep than females during active phase. Increased duration of non-rapid eye movement (NREM) and total sleep bouts in males during the mid-active phase accounted for the majority of this sex difference. Following six hours of sleep deprivation during the rest phase, phenotypic sex differences in total sleep amount were reduced but sex differences in slow wave activity (SWA) were enhanced. Moreover, the sex differences in SWA were predominant during the mid-active phase and were dependent on sex chromosome complement.
Conclusion: These findings indicate that after sleep loss, sex differences in sleep propensity during the active phase are dependent on sex chromosome complement. Further, they suggest that sex differences in the ability to recover from sleep loss during the active phase are driven by genetic factors.
Support (If Any): Supported by NINDS award NS060659 and by the STC Program of the National Science Foundation under Agreement No. IBN-9876754.

0029

TRANSCRIPTIONAL EFFECTS OF SLEEP AND SLEEP DEPRIVATION ON PERIPHERAL TISSUES

Pellegrino R[1,2,3], Anafi R[4], Shockley KR[5], Romer M[1], Hakonarson HH[2], Pack A[1]
[1]Center for Sleep and Circadian Neurobiology, University of Pennsylvania - School of Medicine, Philadelphia, PA, USA, [2]Center for Applied Genomics, The Children's Hospital of Philadelphia, Philadelphia, PA, USA, [3]Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [4]Division of Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [5]Biostatistics Branch, National Institute of Environmental Health Sciences Research Triangle Park, Triangle Park, NC, USA

Introduction: Many groups assume that sleep serves a function only for the brain. To test this assumption, we evaluated the molecular consequences of sleep and sleep deprivation on both lung and heart peripheral tissues. We compared gene expression using microarrays in sleeping and sleep deprived mice sacrificed at the same diurnal time.
Methods: Male mice (n=80, C57BL/6J) were housed in a 12h:12h light/dark cycle. Ten control animals were sacrificed at the initiation of the protocol. The remaining animals were split into two groups: one was allowed uninterrupted sleep, while the other underwent continued deprivation. Deprivation through gentle handling was initiated with light. The animals were sacrificed from each group after 3,6,9, and 12 hours. Total RNA was isolated from tissue samples and transcript levels were assayed with the GeneChip® Mouse Gene 1.0 ST array (Affymetrix - CA). Using ANOVA with an false discovery rate (FDR) cut off of 1% we identified genes in lung and heart that were differentially expressed as a function of behavioral state. NIH: DAVID was used to identify over-represented cellular pathways and gene ontology categories.
Results: Sleep deprivation induced transcriptional changes common to heart and lung along with tissue specific changes. Chaperones and markers of the unfolded protein response were up-regulated with sleep deprivation in both tissues. At an FDR <1%, no class of genes was up-regulated in both tissues during sleep. Tissue specific transcriptional changes with sleep reflected the unique functions of each organ. Immune response transcripts were up-regulated in lung, vasculature development and angiogenesis transcripts were up-regulated in the heart.

Conclusion: Our data do not support the notion that the molecular consequences of sleep deprivation are restricted to the brain. We suggest that sleep has organ specific molecular functions and that sleep deprivation induces a ubiquitous response of cellular stress in both brain and peripheral organs.
Support (If Any): NIH grant AG17628. ASMF Physician Scientist Training Award.

0030

SLEEP DISRUPTION INDUCES ACCELERATED WEIGHT GAIN IN MICE AND IS ASSOCIATED WITH LOSS OF REGULATORY T CELLS IN VISCERAL FAT

Wang Y, Qiao Z, Gozal D, Zhang S
Department of Pediatrics, University of Chicago, Chicago, IL, USA

Introduction: Children with obstructive sleep apnea (OSA) who exhibit increased systemic inflammatory responses also show evidence of selective increased methylation within the CpG islands of the forkhead box P3 (FOXP3) gene. Reduced expression of FOXP3 results in loss of regulatory T lymphocytes (Tregs), the latter being now implicated in the development of obesity in both high fat diet and ob/ob mouse models. We hypothesized that sleep disruption (SD) associated with OSA may lead to loss of Tregs in visceral fat and thus be involved in obesity. The current study was designed to test this hypothesis using a mouse model of SD.
Methods: Freely-behaving male C57BL/6 mice were fed normal chow and maintained under 12-h light-dark cycles. SD was applied using custom-made cages that awakened the animals every 2 min by tactile stimulation during the light cycle. Visceral fat was collected at various time-points for flow cytometry and biochemical analyses.
Results: Mice subjected to SD for 8 weeks showed accelerated gain of body weight and increased visceral fat mass compared to controls. SD-exposed mice also had substantially reduced numbers of CD4+CD25+Foxp3+ Tregs in visceral fat. In contrast, the Treg population in the thymus was unaltered by SD. SD-induced loss of Tregs in visceral fat was accompanied by increased mitochondrial production of reactive oxygen species and signs of apoptosis in remaining Tregs. Interestingly, SD-induced loss of Tregs in visceral fat occurred as early as 2 weeks of SD exposure, at a time when both body weight and VF mass were still similar between the SD and control groups.
Conclusion: Thus, SD leads to visceral fat dysfunction which manifests as mitochondrial-derived oxidative stress and increased Treg apoptosis, all of which may underlie SD-induced obesity.

0031

VISCERAL FAT INFLAMMATION IS INVOLVED IN SLEEP DISRUPTION-INDUCED ACCELERATED WEIGHT GAIN IN MICE

Zhang S, Hirotsu C, Gozal D, Wang Y
Department of Pediatrics, University of Chicago, Chicago, IL, USA

Introduction: Recent studies have shown that obesity in several mouse models, including the high fat diet and the ob/ob models, is characterized by a chronic inflammatory state in visceral fat (VF). Indeed, macrophage infiltration and activation, increased oxidative stress, and expression of inflammatory cytokines have all been reported. Similarly, short or disrupted sleep has also been assigned an obesogenic role. Accordingly, we developed a sleep disruption (SD)-induced obesity model in mice, and assessed the course of body weight accrual and whether VF inflammation occurred in this model.
Methods: C57BL/6 mice were fed normal chow and maintained under 12-h light-dark cycles. SD was induced with a device that employs intermittent (2-min intervals) tactile stimulation of freely behaving mice in a laboratory mouse cage, using a near-silent motorized sweeper just above the cage floor. VF was harvested at various time points for analyses.
Results: Mice subjected to SD showed increased food intake within 4-7 days and accelerated weight gain starting at about 4 weeks of SD exposure when compared to controls. VF inflammation occurred in SD-exposed mice and anteceded the onset of changes in body weight and VF mass trajectories between the 2 experimental groups. For example, increased NADPH oxidase activity occurred at 2 weeks of SD, whereas activation, but not infiltration of macrophages was evident at 3-4 weeks after SD exposure as shown by a shift of the M2 to the M1 macrophage subtype. More severe VF inflammation occurred in mice subjected to SD for 8 weeks, which was characterized by increased numbers of macrophages, increased M1 subtype distribution, and further increased oxidative stress in VF.
Conclusion: SD-induced accelerated weight gain and obesity is associated with VF inflammation, which appears to operate as both a cause and a consequence of VF dysfunction and proliferation.

0032

HYPOCRETINERGIC RECEPTOR TYPE 1, NOT TYPE 2, IS EXPRESSED BY CANCER CELLS OF THE HUMAN COLON

Zhang J[1,2], Fung SJ[1,2], Xi M[1,2], Sampogna S[1], Chase MH[1,2,3]
[1]WebSciences International, Los Angeles, CA, USA, [2]VA Greater Los Angeles Healthcare System, Los Angeles, CA, USA, [3]Department of Physiology, UCLA School of Medicine, Los Angeles, CA, USA

Introduction: Hypocretin 1 and 2 (also called orexin A and B) are neuropeptides that produce an extensive array of diverse functions, processes and effects. The actions of the hypocretins are mediated by hypocretin receptors Type 1 and/or Type 2, which are distributed widely in the CNS and in peripheral organs (Okumura and Takakusaki, J. Gastroenterol. 43:652-660, 2008). In the normal, disease-free gastrointestinal tract, the epithelium of the small intestine contain hypocretin receptors, although they are not expressed by cells that are located in the epithelium of the colon (i.e., large intestine) (Zhang et al., Program No. 191.8. Society for Neuroscience, 2010). However, it has been reported that in human colon cancer cell lines, hypocretin receptor Type 1 is expressed, de novo, and that when this receptor is activated by hypocretin, cell death occurs by apoptosis (Rouet-Benzineb et al., 2004). Accordingly, in the present study, we examined the expression of hypocretin receptors Type 1 and Type 2 in normal and cancerous cells of the epithelium of the human colon.
Methods: Formalin-fixed paraffin-embedded sections from humans containing normal (control) and cancerous cells were stained with antibodies against hypocretin receptor Type 1 and hypocretin receptor Type 2 using established immunohistochemical techniques (Zhang et al., Brain Res. 995:205-217, 2004).
Results: Under bright-field microscopy, cancerous epithelial cells of the human colon were stained by an antibody against hypocretin receptor Type 1, although this antibody did not label epithelial cells in the normal human colon. In contrast, an antibody against hypocretin receptor Type 2 did not stain cells in the epithelium of the normal or cancerous human colon.
Conclusion: These data indicate that neither hypocretinergic receptor Type 1 nor Type 2 is present in the epithelium of the normal human colon. In contrast, hypocretin receptor Type 1, but not Type 2, is expressed by human colon cancer cells. Thus, the apoptotic effects of hypocretins on cancer cells of the human colon are likely mediated by hypocretin receptor Type 1.
Support (If Any): This work was supported by Websciences International and the VA Greater Los Angeles Healthcare System.

0033

CARDIAC REMODELING AFTER OXIDATIVE INJURY IN MICE EXPOSED TO CHRONIC OSA-RELEVANT INTERMITTENT HYPOXIA

Cai J[1], Yin X[1,2], Tan Y[1], Wang B[1], Zheng Y[1,2], Cai L[1]
[1]Pediatrics/KCH Res. Inst., University of Louisville School of Medicine, Louisville, KY, USA, [2]First Hospital of Jilin University, Changchun, China

Introduction: Obstructive sleep apnea (OSA) is a highly prevalent disorder associated with increased upper airway resistance during sleep, which has been emerged as an independent risk factor for cardiovascular diseases. As a hallmark of OSA, chronic intermittent hypoxia (IH) has been reported to cause metabolic disorders, systemic hypertension, atherosclerosis and endothelial dysfunction in both clinical and animal studies. In this study, we hypothesize that long-term hypoxia/reoxygenation events occurring in OSA patients may overdrive the capacity for cardiac compensation to induce ventricular remodeling and oxidative stress could mediate such an etiopathological link between IH and cardiac dysfunction.
Methods: 8 to10-week male FVB wild-type mice and metallothionein overexpression mice (MT mice) were exposed to either IH (8% / 20.9% O2 /120s each cycle/12hrs) or intermittent air (IA) during the light phase for 3 days to 8 weeks. Mice were either assessed for their cardiac function or immediately terminated for heart collection after IA or IH exposures. The molecules relevant to inflammation, apoptosis, oxidative stress, and cardiac hypertrophy, endogenous MT expression, and cardiac function were assessed by means of immunostaining, quantitative real-time PCR, Western blots and echocardiography. The statistical significance was considered as $p<0.05$.
Results: SpO2 changed in a recurrent manner with the nadir hemoglobin oxygen saturations mainly ranging between 60% and 70%, which is similar as observed in moderate to severe OSA patients. Chronic IH significantly decreased the ratio of heart weight to tibia length at 1 week and increased at 4 weeks, followed by a progressive decrease in cardiac function from 4 to 8 weeks. Cardiac inflammation, cell death, inflammation, oxidative damage, and fibrosis were observed after 4 and 8 weeks IH exposures. Endogenous MT expression was up-regulated in response to IH at day 3 and then slightly and significantly decreased at week 4 and 8, respectively. Cardiac overexpression of MT rescued the chronic IH-induced cardiomyopathy.
Conclusion: These findings suggest that chronic OSA-relevant IH can induce cardiomyopathy associated with inflammation, apoptotic cell death, and oxidative stress/damage. The antioxidant MT can protect heart function from such cardiac remodeling.
Support (If Any): This work was supported in part by grants from Sleep Research Society Foundation (J.C.), American Diabetes Association (L.C.), and Wenzhou Medical College Starting-Up Fund for Chinese-American Research Institute for Diabetic Complications (L.C. and Y.T.).

0034

PROTEIN IDENTIFICATION AND CHANGED PROTEIN LEVELS AFTER SLEEP DEPRIVATION

Bjorkum A[1], Nygård I[1], Aarhus Braseth T[1], Kristensen T[2], Kluge B[3], Rosendahl K[4]
[1]Biomedical Laboratory Science Program, Bergen University College, Bergen, Norway, [2]Pattern Solutions Inc.,, Bergen, Norway, [3]Medical Research Centre, University of Bergen, Bergen, Norway, [4]Dept. of Radiology, Haukeland University Hospital and University of Bergen, Bergen, Norway

Introduction: Cell stress might be a consequence of Sleep deprivation (SD). Cellular stress might be reflected in changed protein profiles and amount and type of specific proteins in blood serum after SD. These possible changes might hints to SD-affected cellular structures, -mechanisms and -important signalling pathways. We searched for such changes.
Methods: Humans (n=6-8) was subjected to 3 or 6 hours of SD and blood were sampled before, during and after a SD-night (16 corresponding time points during 48 h). Seldi-Tof-MS (Ciphergen), Maldi-Tof-MS (AutoFlex, Bruker Daltonics) and an Hsp70 ELISA-kit (EKS-700 Stressgen biotechnologies) were used to detect changes in human blood serum proteome and identify changed protein fragments. Protein profile changes (in the m/z spectrum) after SD were searched for by principal component analysis (PCA, Sirius 7.0).
Results: Hsp-70 was reduced 0h, 3h and 9h after 3h SD by the Stressgen-kit measurement. The protein profile from the Seldi-Tof-MS (2.5 - 100 kDa, n=3) measurements also showed changed expression for several proteins. Proteins highly expressed during the control night seem to be reduced after SD and not getting back to basal level the day after SD and vice versa for lower expressed proteins. The protein profile from the Maldi-Tof-MS (0.4 - 15 kDa, n=7) also showed changed expression for several proteins. Several proteins (2.5 - 100 kDa) where differentially expressed after 3 and 6 hours of SD, specifically Hsp-70 was reduced after 3 hours of SD. One of several changed proteins were identified as Inter-alpha-trypsin-inhibitor-family heavy-chain-related protein and verified by Q-Tof-MS of the synthesised protein (by Bejing SBS Genetech Co, Ltd, www.sbsbio.com) and are now being explored together with the change in Hsp-70 with the curated database MetaCore by GeneGo (www.genego.com). The shortest path algorithm gave one route between ITIH4 and Hsp-70 including p38alpha (MAPK14), Btk and Actin cytoskeletal. An increase in ITIH4 gave a postulated decrease in the above mentioned proteins now searched verified with quantitative proteomic by multiple reaction monitoring (MRM).
Conclusion: SD might lead to cell stress. This seems to be reflected in changed protein profile in human serum. To be able to ID changed proteins and their interactions might shed light on the cellular mechanisms, possible affected extracellular matrix and or cellular pathways of interest to identify underlying sleep and/or being disturbed after SD.
Support (If Any): University of Bergen, Bergen University College.

0035

MATERNAL HABITUAL SHORT SLEEP DURATION ALTERS PLACENTAL GENE EXPRESSION

Enquobahrie DA[1,2], Qiu C[1], Tadesse M[3], Reddy C[4], Muhie S[5], Williams MA[1,6]
[1]Perinatal Studies, Swedish Medical Center, Seattle, WA, USA, [2]Department of Epidemiology, School of Public Health, University of Washington, Seattle, WA, USA, [3]Georgetown University, Washington D.C., DC, USA, [4]Wayne State Univesity, Detroit, MI, USA, [5]US Army Medical Research and Materials Command, Fort Detrick, MD, USA, [6]Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA

Introduction: Short sleep duration, a prevalent risk factor in modern society, is associated with maternal and offspring pregnancy complications (including gestational diabetes and preeclampsia). However, underlying mechanisms are largely unknown. We examined the influence of early pregnancy sleep duration on global gene expression profiles in placenta, a major source and site of action of neuroendocrine regulators that determine the course of pregnancy.
Methods: Study participants (N=16) were normotensive women with uncomplicated pregnancies (i.e., not complicated by gestational diabetes or preeclampsia) sampled from a previously completed case-control study. Information on early pregnancy sleep duration was collected using in-person interviews. Global gene expression of placental samples, collected at delivery, was profiled. We used linear regression models and data mining tools to identify differentially expressed (DE) genes in relation to short sleep duration (≤6 hours). Using common sequences in promoter regions of DE genes, we identified transcription factor (TF) binding sites and TFs that may account for co-expressions. Finally we

investigated functions/functional relationships of DE genes using Ingenuity Pathway Analysis.
Results: A total of 112 genes (38 down- and 74 up-regulated) were DE in relation to shorter sleep duration (α=0.01). Correlation based data mining identified additional genes (F2RL2, PDPK1, and CASP1) potentially important in relation to short sleep duration. Further, binding sites for TFs GABPA, ELK1, and MIZF were over represented in promoter regions of DE genes. DE genes participated in cardiovascular system development and function; lipid, carbohydrate, and, nucleic acid metabolism; cell-to-cell signaling; and cellular growth and proliferation.
Conclusion: Short sleep duration in early pregnancy is associated with placental expression of novel (e.g. AKAP10) and previously reported candidate (e.g. GABA receptor) genes, potentially related to pregnancy complications. Similar larger studies have the potential to promote understanding of the impact of short sleep duration on pregnancy and parturition.

0036

GENE EXPRESSION IN MONOZYGOTIC TWINS DISCORDANT FOR HABITUAL SLEEP DURATION

Gharib SA[1,2], Goldberg J[3,4,5], Buchwald D[6,4], Pack A[7,8], Vitiello MV[9,10], Bamshad M[11], Noonan C[6,4], Dansie EJ[4], Delrow J[12], Watson NF[13,2,4,10]
[1]Division of Pulmonary Medicine, Department of Medicine, University of Washington, Seattle, WA, USA, [2]University of Washington Medicine Sleep Center, University of Washington, Seattle, WA, USA, [3]Epidemiology, University of Washington, Seattle, WA, USA, [4]University of Washington Twin Registry, University of Washington, Seattle, WA, USA, [5]Vietnam Era Twin Registry, VA Epideiologic Research and Information Center, Seattle, WA, USA, [6]Medicine, University of Washington, Seattle, WA, USA, [7]Division of Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, PA, USA, [8]Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [9]Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, USA, [10]Center for Research on the Management of Sleep Disturbances, University of Washington, Seattle, WA, USA, [11]Pediatrics, University of Washington, Seattle, WA, USA, [12]Genomics Shared Resource, Fred Hutchinson Cancer Research Center, Seattle, WA, USA, [13]Neurology, University of Washington, Seattle, WA, USA

Introduction: Short sleep duration is associated with adverse metabolic, cardiovascular, and inflammatory effects. Co-twin study methodologies account for familial (e.g., genetics and shared environmental) confounding, allowing assessment of subtle environmental effects, such as the effect of short habitual sleep duration on gene expression. Therefore, we sought to investigate gene expression in monozygotic twins discordant for actigraphically phenotyped habitual sleep duration.
Methods: Twelve monozygotic twin pairs (75% female; mean age 38.8 years; SD=15), selected based on subjective sleep duration discordance, were objectively phenotyped for habitual sleep duration with two-weeks of wrist actigraphy. We used a standard actigraphy scoring algorithm to generate normalized 24 hour sleep durations. Peripheral blood leukocyte (PBL) RNA from fasting blood samples was obtained on the final day of actigraphic measurement and hybridized on Illumina humanHT-12 v4 BeadChips. Differential gene expression was determined between paired samples and mapped to functional categories using Gene Ontology.
Results: The mean 24 hour sleep duration of the total sample was 435.1 minutes (SD=51.7 minutes; range 325.4 to 548.2 minutes). Mean within-pair sleep duration difference per 24 hours was 78.6 minutes (SD=29.7; range 51.5 to 137.1 minutes). The twin cohort displayed several distinct patterns of differential gene expressed in their PBLs depending on sleep duration differences. A number of processes involved in ribosome, mitochondrion and cytoskeletal organization were enriched between twin pairs with discordant sleep durations.
Conclusion: Objectively assessed habitual sleep duration in monozygotic twin pairs appears to be associated with distinct patterns of differential gene expression. By accounting for familial confounding and measuring real life sleep duration, our study shows the transcriptomic effects of short sleep and provide a potential link between sleep deprivation and untoward metabolic, cardiovascular, and inflammatory outcomes.
Support (If Any): This study was supported by grants K23HL083350, P30NR011400, and a University of Washington General Clinical Research Center Pilot Grant.

0037

ASSOCIATION STUDY BETWEEN ANTIPSYCHOTICS-INDUCED RESTLESS LEGS SYNDROME AND POLYMORPHISMS OF MEIS1 GENES IN SCHIZOPHRENIA

Kang S[1], Yoon H[2], Park Y[3], Lee H[2], Kim L[2]
[1]Department of Psychiatry, Catholic University of Daegu School of Medicine, Daegu, Republic of Korea, [2]Department of Psychiatry, Korea University College of Medicine, Seoul, Republic of Korea, [3]Department of Psychiatry, Inje University College of Medicine, Goyang, Republic of Korea

Introduction: The pathophysiology of restless legs syndrome (RLS) has not been fully elucidated, but many promising theories involve genetic causes. The recent genome-wide association studies of RLS indentified variants within intronic or intergenic regions of MEIS1, BTBD9, and MAP2K5/LBOXCOR1. This study aimed to investigate whether the MEIS1 genes are associated with antipsychotic-induced RLS in schizophrenia.
Methods: All of the subjects were diagnosed with schizophrenia by board-certified psychiatrists using the Korean version of the Structured Clinical Interview for DSM-IV. We assessed antipsychotic-induced RLS symptoms in 190 Korean schizophrenic patients using the diagnostic criteria of the International Restless Legs Syndrome Study Group. Genotyping was performed for the rs2300478 and rs6710341 polymorphisms of the MEIS1 gene.
Results: We divided the subjects into two groups: those with RLS symptoms (n=96) and those without RLS symptoms (n=94). The genotype frequencies did not deviate from Hardy-Weinberg equilibrium (rs2300478 $\chi 2$=2.17, p=0.141; rs6710341 $\chi 2$=1.85, p=0.174). There was no significant difference in the genotype (rs2300478 $\chi 2$=1.38, p=0.503; rs6710341 $\chi 2$=1.04, p=0.596) and allele frequencies (rs2300478 $\chi 2$=0.48, p=0.489; rs6710341 $\chi 2$=0.34, p=0.561) of two polymorphisms investigated between these two groups.
Conclusion: These data do not suggest that rs2300478 and rs6710341 polymorphisms of the MEIS1 gene are associated with antipsychotic-induced RLS symptoms in schizophrenia. There is possibility of different genetic mechanism between the antipsychotic-induced RLS and primary RLS. A larger-scale association study is needed in the future in order to confirm these results.

0038

GENOME WIDE ASSOCIATION STUDY AND CONFOUNDERS OF SIGMA POWER AND SLEEP SPINDLES

Warby S[1], Moore HE[1], Carrillo O[1], Faraco J[1], Lin L[1], Peppard PE[2], Young T[2], Mignot E[1]
[1]Center for Sleep Science and Medicine, Stanford, Stanford, CA, USA, [2]School of Medicine and Public Health, University of Wisconsin-Madison, Madison, WI, USA

Introduction: Sleep spindles are brief (0.5 to 2sec) bursts of synchronous cortical activity that occur during stage 2 sleep. Sleep spindles can be identified by visual inspection of the electroencephalogram (EEG) but are most often identified by power in the sigma range (12-16Hz). Spindles play an important role in brain re-organization that occurs during sleep and recently, spindles have been implicated in learning, brain

plasticity, memory consolidation, and arousal thresholds. Significant alterations in spindles are observed in many disorders, such as schizophrenia, autism, epilepsy, mental retardation, and neurodegenerative disorders. Although very little is known about sleep spindles at the genetic level, twin studies suggest that variation in sleep spindles and spindle frequencies are highly heritable traits. The purpose of this study is to identify genetic variation in the normal human population that is associated with variation in sleep spindle characteristics.

Methods: We assess 1,876 polysomnographs (PSGs) in 1,300 adult individuals from the Wisconsin Sleep Cohort (WSC) for sigma power and sleep spindle density in stage 2 sleep. Genotyping in this cohort was performed using Affymetrix 6.0 genechip and direct Taqman genotyping. Bonferroni corrected genetic association is determined using an additive genetic model and linear regression with subject age, sex, BMI, and medications as potential covariates.

Results: The correlation of spindle power over 4 years was high (r2 >0.75) suggesting spindles measurement is stable over time and trait-like. We also show effects of age and significant interactions with several drug categories including benzodiazepines and sedatives. Genome-wide and candidate gene associations identify several loci implicated in the regulation spindles.

Conclusion: Results reveal support for the genetic control of sleep spindles in humans. Further studies are needed for replication and to examine gene-environment interactions on this basic sleep phenotype.

Support (If Any): SCW is supported by a Banting Postdoctoral Fellowship (CIHR) and by the Brain and Behavior Research Foundation (NARSAD). The Wisconsin Sleep Cohort is supported by NIH grants R01HL62252 and 1UL1RR025011.

0039

HLA-DQB1*06:03 IS NOT PROTECTIVE IN NARCOLEPSY WITHOUT CATAPLEXY AND IDIOPATHIC HYPERSOMNIA

van der Heide A[1], Verduijn W[2], Claas F[2], Dauvilliers Y[3], Tafti M[4,5], Lammers G[1]

[1]Neurology, Leiden University Medical Centre, Leiden, Netherlands, [2]Immunohaematology and Blood Transfusion,, Leiden University Medical Centre, Leiden, Netherlands, [3]Neurology, Hopital Gui-de-Chauliac, Montpellier, France, [4]Center for Investigation and Research in Sleep, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland, [5]Center for Integrative Genomics, University of Lausanne, Lausanne, Switzerland

Introduction: Narcolepsy with cataplexy (NC) is in 90-95% of patients associated with HLA-DQB1*06:02, making it the disease with the strongest HLA association. Besides this, recently was demonstrated that HLA-DQB1*06:03 is highly protective against narcolepsy with cataplexy. A trans HLA-DQB1*06:03 haplotype was only seen in 0.2% of NC patients, while 7-13% of the general population carries this haplotype. HLA-DQB1*06:02 is reported to have a slightly higher prevalence (around 40%) in patients with narcolepsy without cataplexy (NwC), while in idiopathic hypersomnia (IH) its prevalence is similar to the general population (15-25%). The prevalence of HLA-DQB1*06:03 in these patients is unknown. Therefore we studied the prevalence of HLA-DQB1*06:03 in NwC and IH, in order to discover a potential protective role in these conditions.

Methods: We included 148 patients with idiopathic hypersomnia and 85 patients with narcolepsy without cataplexy. They all fulfilled the International Classification of Sleep Disorders-2 criteria for both diseases. Genotyping was performed in all patients.

Results: Six out of 85 (7.1%) NwC and 20 out of 148 (13.5%) IH patients carried the HLA-DQB1*06:03.

Conclusion: The prevalence of HLA-DQB1*06:03 in patients with NwC and IH is comparable with its prevalence in the general population. This implicates that this allele is only protective against narcolepsy with cataplexy and not against other hypersomnias.

0040

IDENTIFYING SUSCEPTIBILITY GENES IN KLEINE-LEVIN SYNDROME (KLS) THROUGH GENOME WIDE ASSOCIATION STUDY

Rico TJ, Faraco J, Lin L, Mignot E

Stanford Center for Sleep Sciences, Stanford Univ-Geophysics Dept, Palo Alto, CA, USA

Introduction: Kleine-Levin Syndrome (KLS) is a rare disorder (quoted prevalence~1 for 1million) characterized by relapsing-remitting episodes of profound hypersomnia accompanied by specific cognitive and behavioral disturbances. Episodes typically last 1-3 weeks and recur every few weeks to few months with no symptomatology between episodes. The disease affects primarily adolescent males, with onset in the teens, and subsides within 8-12 years (median durations). An increased risk in first and second degree relatives of KLS cases (5 of 105 cases had an affected family member), and increased prevalence in the Ashkenazi Jewish population suggest the implication of genetic risk factors. We hypothesize that KLS results from an abnormal response to a pathogenic trigger acting on a susceptible genetic background.

Methods: We performed a genome-wide association (GWA) in 222 KLS patients of various ethnic backgrounds and 891 matched controls genotyped on the Affymetrix 500 and 6.0 array. Separate analyses were done on Affymetric 500 and 6.0 specific SNPs, and then the SNPs present in both. Six SNPs of interest were identified, and genotyping of a replication cohort (208 patients, 419 matched controls) was conducted using a TaqMan assay.

Results: Of the six SNPs genotyped in the replication cohort, two of them revealed similar allele frequencies to the discovery cohort. These two SNPs are located in separate genes on Chromosome 11. Limited population size restricts statistical significance, as the p-values lose significance after correction for multiple testing. New samples are being recruited as they are diagnosed, expanding the replication cohort. More samples are needed to confirm this finding as a true genetic risk factor.

Conclusion: Although allele frequencies are similar, our limited population size restricts statistical significance. International collaborations are working to assemble an additional replication cohort to further explore these findings.

Support (If Any): We thank our other collaborators not listed here for contributing samples, cohort genotypes and participating in the genetic analysis. Funded by MH080957-03

0041

CHARACTERISTICS AND CORRELATES OF VARIABILITY IN SLEEP LATENCY, EFFICIENCY, AND DURATION IN OLDER MEN

Paudel ML[1], Taylor BC[1,2,3], Ancoli-Israel S[5,6], Stone KL[4], Redline S[8], Barrett-Connor E[7], Ensrud KE[1,2,3]

[1]Division of Epidemiology and Community Health, University of Minnesota-Twin Cities, Minneapolis, MN, USA, [2]Center for Chronic Disease Outcomes Research, Veterans Affairs Medical Center, Minneapolis, MN, USA, [3]Department of Medicine, University of Minnesota-Twin Cities, Minneapolis, MN, USA, [4]California Pacific Medical Center Research Institute, San Francisco, CA, USA, [5]Department of Psychiatry, University of California, San Diego, La Jolla, CA, USA, [6]Department of Medicine, University of California, San Diego, La Jolla, CA, USA, [7]Department of Family & Preventive Medicine, University of California, San Diego, La Jolla, CA, USA, [8]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA

Introduction: Prior studies have observed substantial variation in night-to-night sleep in middle aged adults and older adults with insomnia; however, little is known about the variability of sleep in a general population of older adults.

Methods: Measures of sleep were assessed via wrist actigraphy, for an average of 5 nights, in a cohort of 2,804 men aged 67 years and older enrolled in the Outcomes of Sleep Disorders in Older Men (MrOS Sleep) study. Sleep measures included sleep duration, efficiency and onset latency, and sleep variability was defined as the standard deviation in these measures. Correlate measures were obtained from clinic visits and/or questionnaires. Linear regression was used to estimate least squared means.

Results: The median(IQR) of variability in the cohort was 43.0 (30.8-58.6) minutes for sleep duration, 4.4 (2.7-6.9)% for sleep efficiency and 15.0 (8.1-30.0) minutes for sleep onset latency. In general, older age, nonwhite race, clinic site and sleep disturbances, including average sleep duration hrs, sleep efficiency<70% and sleep latency>1 hr were associated with greater variability in each of the three sleep measures. In models adjusted for age, clinic site, race and sleep disturbances: lower education, poorer health status, depression, greater BMI, and lower physical activity were associated with greater variability in all three sleep parameters. Living alone, smoking, greater IADL impairments, diabetes, and history of MI were associated with greater variability in sleep duration and efficiency. Cognitive impairment was associated with greater variability in sleep latency, use of sleep medications was associated with greater variability in sleep duration, and use of antidepressants was associated with greater variability in sleep duration and onset latency.

Conclusion: Measures of sleep duration, efficiency and onset latency exhibit significant variability in older men, and greater variability in these parameters is, in general, associated with measures of poorer health, functional status, and demographics.

Support (If Any): The Osteoporotic Fractures in Men (MrOS) Study is supported by National Institutes of Health funding. The following institutes provide support: the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), the National Institute on Aging (NIA), the National Center for Research Resources (NCRR), and NIH Roadmap for Medical Research under the following grant numbers: U01 AR45580, U01 AR45614, U01 AR45632, U01 AR45647, U01 AR45654, U01 AR45583, U01 AG18197, U01-AG027810, and UL1 RR024140. The National Heart, Lung, and Blood Institute (NHLBI) provides funding for the MrOS Sleep ancillary study "Outcomes of Sleep Disorders in Older Men" under the following grant numbers: R01 HL071194, R01 HL070848, R01 HL070847, R01 HL070842, R01 HL070841, R01 HL070837, R01 HL070838, and R01 HL070839.

0042

AGE-RELATED DIFFERENCES IN THE EFFECT OF INTER-STIMULUS INTERVAL AND TIME ON TASK ON PVT RESPONSE TIMES

St. Hilaire MA, Klerman EB

Analytic & Modeling Unit, Division of Sleep Medicine, Brigham and Womens Hospital/Harvard Medical School, Boston, MA, USA

Introduction: Older individuals show less performance impairment compared to younger subjects on the psychomotor vigilance task (PVT) during sleep deprivation (SD), including faster reaction times (RTs) and fewer lapses, (Duffy et al. 2009 J. Am. Geriatr. Soc.). Long RTs/lapses represent a failure to recruit attention and occur at a greater rate following short inter-stimulus intervals (ISI). Anticipations increase during SD, represent a failure to inhibit response until cue onset, and occur at a greater rate with long ISIs. There is also a time on task (TOT) effect on the PVT (Tucker et al. 2009 SLEEP). Here we examined age-related differences in the ISI-response relationship and the TOT effect.

Methods: Data were from healthy older (N=7, range 60-71 yrs, 3F) and younger individuals (N=15, range 18-32 yrs, 9F) scheduled to 28 (N=12) or 52 (N=10) h of SD. Only the first 28 h of the 52-h condition were used. A 10-min PVT was administered every 2h starting ~2h after wake. For each PVT trial, the ISI preceding each response was binned into 1-s bins from 1-9. For TOT, trials were binned into the first or last 2 min; trials from the middle 6 min were not used. A generalized linear model with repeated measures was used for analysis (PROC GENMOD in SAS 9.2). Lapses were defined as response times greater than 2x baseline mean per subject; anticipations as responses less than 100 ms; and normal RTs as responses between these two values.

Results: Older individuals had less anticipations ($p=0.0064$) but not shorter RTs ($p=0.51$) or fewer lapses ($p=0.64$). RTs and lapses were higher at ISIs<4 (all $p<0.0001$); anticipations were higher at all but ISI=1 (all $p<0.0006$). Age-ISI interactions were observed for all three outcome variables (all $p<0.01$); the rate of anticipation increase with ISI increase and the rate of RT/lapse decrease with ISI increase were lower in older individuals. RTs and lapses both increased (both $p<0.0001$) with TOT. There was no main TOT effect ($p=0.34$), but anticipations had a significant negative age-TOT interaction ($p=0.02$).

Conclusion: Our results suggest that older individuals are better able to inhibit anticipations and/or have an impaired ability to execute anticipations. Age-ISI interactions suggest that the mechanisms underlying the ISI-response speed relationship may change with age. Age-TOT interactions with respect to anticipations may reflect age-related differences in the response inhibition ability as task-related fatigue increases.

Support (If Any): NIH P01-AG009975, T32-HL07901 (MSH), RC2-HL101340 and K24-HL105664 (EBK) and NSBRI HFP01603 through NASA NCC 9-58.

0043

AGING IMPAIRMENTS IN NREM SLOW WAVE ACTIVITY AND MEMORY CONSOLIDATION ARE MEDIATED BY PREFRONTAL BRAIN ATROPHY

Mander BA[1], Rao V[1], Lu BS[3], Saletin JM[1], Ancoli-Israel S[4], Jagust WJ[2], Walker M[1,2]

[1]Psychology, University of California, Berkeley, Berkeley, CA, USA, [2]Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, USA, [3]Division of Pulmonary and Critical Care Medicine, California Pacific Medical Center, San Francisco, CA, USA, [4]Psychiatry, University of California, San Diego, La Jolla, CA, USA

Introduction: Aging has independently been associated with brain atrophy, the loss of NREM slow wave sleep and episodic memory impairment. However, that structural brain changes in older adults causally disrupt the generation of NREM slow wave activity (SWA), which in turn, prevents effective overnight memory consolidation remains unknown. Here, we demonstrate that prefrontal gray matter atrophy in old-

er adults predicts the loss of NREM SWA, the extent to which explains the magnitude of sleep-dependent memory consolidation failure.
Methods: High-resolution structural MRI scans were obtained in 31 participants: 15 healthy older adults (72.1±1.7 years) and 16 healthy young adults (20.5±0.5 years); allowing assessment of grey-matter density using voxel-based morphometry. Additionally, both groups performed a sleep-dependent memory consolidation task, with their intervening sleep recorded in-lab full-head (19-channel EEG) polysomnography. Analyses focused on the triangulation between brain structure, sleep physiology (SWA), and overnight memory consolidation effects.
Results: Relative to young adults, older adults showed marked impairments in SWA ($p<0.001$), together with selective but highly significant grey matter atrophy within the medial prefrontal cortex ($p<0.05$, FWE corrected across the whole brain). Additionally, the age-related impairment in SWA was explained by the degree of grey-matter atrophy in medial prefrontal cortex (sobel mediation test, $p<0.005$). Most striking, age and atrophy-related deficits in overnight memory consolidation were explained by the reduction in SWA; a reduction in turn governed by the loss of prefrontal grey-matter density (sobel mediation test, $p=0.001$).
Conclusion: Together, these findings demonstrate that the grey matter atrophy in select regions of the human brain determine the progressive loss of NREM SWA in later life, the functional outcome of which explains the failure overnight consolidation and hence compromised long-term memory retention. Such findings indicate that sleep disruption is an under-appreciated factor potentially governing age-related cognitive decline, caused by organic changes in brain structure.
Support (If Any): Supported by National Institutes of Health; NIH NIA [RO1AG031164] (MPW), [R01AG034570] (WJ), [R01AG08415] (SA), [F32AG039170](BAM).

0044

CELLULAR AGING AND RESTORATIVE PROCESSES: SLEEP QUALITY MODERATES THE ASSOCIATION BETWEEN AGE AND TELOMERE LENGTH IN A SAMPLE OF MIDDLE-AGED AND OLDER ADULTS

Cribbet MR[1], Carlisle M[1], Cawthon RM[2], Uchino BN[1], Williams P[1], Smith TW[1], Gunn HE[1], Light KC[3]
[1]Psychology, University of Utah, Salt Lake City, UT, USA,
[2]Human Genetics, University of Utah, Salt Lake City, UT, USA,
[3]Anesthesiology, University of Utah, Salt Lake City, UT, USA

Introduction: Cellular aging, indexed by shorter telomere length (TL; the length of the repetitive structures at the end of chromosomes that help to promote cellular stability), has been associated with chronological age, age-related diseases, and mortality. Age is also strongly related to sleep quality. Thus, sleep may be a particularly important factor among older adults for recovery from daily stress, including rebuilding resultant cellular damage. The current study examined associations between sleep quality (SQ) and cellular aging in a sample of middle-aged and older adults. It was hypothesized that components of global SQ (i.e., sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction), would moderate the association between age and TL.
Methods: A community sample of 151 healthy middle-aged to older adults (ages 45-80) completed the Pittsburgh Sleep Quality Index (PSQI), and provided blood samples that were analyzed for TL.
Results: Age was negatively associated with TL ($r = -.29$, $p < .001$) and sleep quality ($r = -.20$, $p < .01$). To test the hypothesis that components of SQ would moderate the association between age and TL, separate regression models that included the components of SQ, age, and the age x components of SQ interaction were conducted. Interactions between age and *sleep disturbances* ($b = -.01$, $t = -2.02$, $p < .05$, $\Delta R2 = .02$), *daytime dysfunction*, ($b = -.009$, $t = -2.10$, $p < .05$, $\Delta R2 = .03$) and *self-reported sleep quality* ($b = -.009$, $t = -2.03$, $p < .05$, $\Delta R2 = .03$) significantly predicted TL. Follow-up analyses revealed that better self-reported SQ, $b = -.02$, $p<.05$, less daytime dysfunction, $b = -.019$, $p<.001$, and fewer reports of sleep disturbance, $b = -.018$, $p<.05$, were associated with longer TL among older, but not middle-aged adults.
Conclusion: These findings suggest that better SQ may have a positive effect on health in older adults via reduced cellular aging.
Support (If Any): Support for this research was provided by the National Institute on Aging (R21 AG029239) and the National Center for Research Resources (UL1-RR025764 and C06-RR11234).

0045

INCREASED LEVELS OF MELANIN-CONCENTRATING HORMONE IN THE POSTERIOR HYPOTHALAMUS IN A RAT MODEL OF FETAL ALCOHOL SPECTRUM DISORDERS

Stettner GM, Kubin L, Volgin DV
Animal Biology, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Disrupted sleep and motor hyperactivity are common in patients with fetal alcohol spectrum disorders (FASD). Hypothalamic cells synthesizing melanin-concentrating hormone (MCH) contribute to the regulation of sleep and are responsive to alcohol exposure (AE). We found previously that systemic antagonism of orexin 1 receptor (ORX1R) alleviates motor hyperactivity and cognitive deficits in juvenile rats following early postnatal AE. Since MCH and ORX cells likely interact with each other, we now investigated whether the MCH system is altered following AE with or without antagonism of ORX1R.
Methods: Male rats received 2.625 g/kg of alcohol intragastrically twice daily on postnatal days (PD)4-9, a developmental period equivalent to the third trimester of human pregnancy (AE group; n=27). Control pups were sham-intubated (S group; n=17). On PD12-14, rats received daily injections of either the ORX1R antagonist, SB-334867 (SB; 20 mg/kg, i.p.) or vehicle. On PD18-19, some rats were perfused, posterior hypothalami cut into 30 μm sections and immunohistochemically processed for MCH and c-Fos. Cells were counted in 2-3 sections per animal within a defined region anchored at the fornix. ORX1R and MCH mRNAs were quantified in the posterior hypothalami of other rats using RT-PCR.
Results: Treatment with SB did not alter mRNA levels, the number of MCH cells or the percentage of MCH cells that were c-Fos-positive in the AE group. The AE rats, with or without SB, had significantly higher number of MCH cells per section (719±16 vs. 628±47 in S rats; $p<0.04$), whereas the percentage of c-Fos-positive MCH cells was not significantly changed. MCH mRNA levels were nearly 3-fold lower in AE than S rats, with or without SB ($p<0.05$), whereas ORX1R mRNA levels were not altered.
Conclusion: The increased number of MCH-immunopositive cells following AE with or without antagonism of ORX1R suggests increased synthesis or retention of the peptide which, in turn, may lead to a reduced MCH mRNA expression via a negative feedback. Since MCH cells are active during rapid eye movement sleep (REMS), a decreased MCH utilization is consistent with REMS deficits observed in this model of FASD.
Support (If Any): HL-071097; DFG-Ste1899/1-1.

0046

SLEEP DISTURBANCE IN CHILDREN WITH DOWN SYNDROME INCREASES WITH AGE

Edgin JO, Breslin JH, Spanò G, Bootzin R, Nadel L
University of Arizona, Tucson, AZ, USA

Introduction: Patterns of sleep disturbance may vary across age in Down syndrome (DS), one intellectual disability with high rates of Obstructive Sleep Apnea Syndrome (OSAS). Age-related changes could be due to peripheral factors, such as increasing body mass index (BMI), or progressive neurological involvement, given that DS shows declines in IQ across childhood and early risk for the development of Alzheimer's Disease (AD). Here we examine the relationship between age and polysomnography (PSG) results. BMI and IQ were added to regression models to determine if these factors may mediate any age-related effects.

Methods: Unattended home PSG was collected from children with DS aged 7-18 years (n = 40; M age: 11.15, SD: 3.36) and scored by a registered PSG technician. IQ was measured by the KBIT-II.
Results: Seventy percent of the sample met criteria for OSAS. Despite an overall decrease in time in bed (r =-0.41, p = 0.01), older children had decreased sleep efficiency (r =-0.33, p = 0.04). Sleep architecture also differed across age, with less time spent in slow wave sleep (SWS) (r = -0.45, p <0.01) and more in Stage 1 (r =0.50, p <0.01). There was a trend for a greater number of obstructive events with age (r = 0.30, p = 0.06) and no difference in central events (p > 0.45). BMI attenuated some, but not all age-related effects, limited to sleep efficiency and % time in SWS. IQ did not attenuate any age-related effects.
Conclusion: Older children with DS showed significant increases in sleep disturbance. Some of these effects were mediated by BMI, suggesting one viable treatment option for OSAS in this population is BMI reduction. Given the early onset of AD in this population and increasing sleep disturbance, future research could focus on the cognitive impact of sleep disruption in DS across the life span.
Support (If Any): This research was funded by the Thrasher Research Fund, the Down Syndrome Research and Treatment Foundation, and the Jerome Lejeune Foundation.

0047

CHRONOTYPE IN EARLY CHILDHOOD: ASSOCIATIONS WITH DIM LIGHT MELATONIN ONSET (DLMO), PHASE ANGLE OF ENTRAINMENT, AND PARENT REPORTS OF SLEEP

Simpkin CT[1], Akacem LD[1], Garlo KG[2], Jenni OG[3], LeBourgeois MK[1]
[1]Integrative Physiology, University of Colorado Boulder, Boulder, CO, USA, [2]College of Medicine, Rush University, Chicago, IL, USA, [3]Department of Pediatrics, Growth and Development Center, University of Children's Hospital, Zurich, Zurich, Switzerland

Introduction: Individual differences in chronotype are associated with variations in sleep, mood, and health-related behaviors (e.g., sleepiness, depression, alcohol/substance use, physical activity) in adolescents and adults. Currently, little is known about chronotype in early childhood. This study examined parent-reported chronotype in 2- to 3-year-old children and associations with objective circadian (DLMO, phase angles of entrainment) and subjective sleep measures.
Methods: Data were collected on 19 children aged 30-36 months (33.9+1.9; 42% males). Children slept on a parent-selected schedule for 5 days (measured with actigraphy and sleep diaries), followed by a home-based salivary dim-light melatonin onset (DLMO) assessment during which samples were collected every 30min for 6h concluding one hour past their average bedtime (<10 lux). Saliva was assayed for melatonin, and DLMO was computed as a rise above 4pg/mL. Chronotype was assessed with two measures from the Children's Chronotype Questionnaire (CCTQ), a one-item parental rating and the mid-sleep time on free (unscheduled) days.
Results: Parent-reported bedtime was 19:49(+:38), rise time was 7:13(+:44), and time in bed was 11.3h(+1.1h). DLMO was 19:36(+:42). Bedtime, midsleep, and rise time phase angles were 28min(+:35), 6h(+:33), and 11h33min(+:46), respectively. Children rated as more evening types had (all ps<.001), later DLMOs (r=.54), smaller midsleep phase angles (r=-.66), and smaller rise time phase angles (r=-.62). Children with later free-day midsleep times had later DLMOs (r=.53, p<.05), later bedtimes (r=.72, p<.001), and later rise times (r=.65, p<.001).
Conclusion: Variation in chronotype is evident in early childhood. Similar to adolescents, evening-type young children have later DLMO's, more narrow phase angles, and later bedtimes and wake-times. Our findings of moderate-to-strong associations between chronotype and circadian/sleep parameters suggest both measures may be useful tools in research and clinical settings. Whether early developmental changes in chronotype exist and whether they predict the emergence of poor sleep, health, and mood remain important questions.
Support (If Any): NIH K01-MH074643, NIH R01-MH086566 Grants to MKL.

0048

DEVELOPMENTAL CHANGES IN DAYTIME NAP PHYSIOLOGY ACROSS EARLY CHILDHOOD

Pierpoint L[1], Lassonde J[1], Achermann P[2], Jenni OG[3], Rusterholz T[1], LeBourgeois MK[1]
[1]Department of Integrative Physiology, University of Colorado Boulder, Boulder, CO, USA, [2]Institute of Pharmacology and Toxicology, University of Zurich, Zurich, Switzerland, [3]Child Development Center, University Children's Hospital Zurich, Zurich, Switzerland

Introduction: Early childhood is characterized by significant alterations in sleep as young children's bioregulatory systems mature. One of the most salient changes is a shift from a biphasic to a monophasic sleep schedule. Parent-reports show a decline in napping per week during early childhood; however, no longitudinal studies of nap physiology in young children exist. This study examined longitudinal changes in nap physiology in children aged 2-5 years.
Methods: Healthy children with no sleep problems (n=7) followed an individualized strict sleep schedule for at least 5 days before a daytime nap was recorded after 7h of prior wakefulness. Sleep stages (scored in 30-s epochs), sleep onset latency, and slow-wave activity (SWA, spectral power in the 0.75-4.5 Hz range) were determined. Recordings were made at 30-36months (T1), 42-48 months (T2) and 72-80 months (T3). While all 7 children napped at T1 and T2, only 5 children slept during the nap opportunity at T3. Thus, these longitudinal results are based on the5 children (2 males) who slept at all three time points.
Results: Time in bed (120.6±39.4, 96.9±20.8, 76.0±29.8 min; F(2,8)=8.058, p=0.012), sleep duration (109.4±40.7, 84.2±19.4, 63.9±30.9 min; F(2,8)=0.12, p=0.017) and minutes in slow wave sleep (SWS; 42.5±20.8, 38.9±17.1, 25.0±17.3; F(2,8)=9.86, p=0.007) declined across early childhood. We did not detect changes in other sleep stages (min), in % of time in bed of any sleep stage, sleep onset latency, latency to SWS, or SWA.
Conclusion: The reduction of time in bed, time asleep, and SWS minutes from 2 to 5 years of age is consistent with the hypothesis that the buildup of sleep pressure across the day attenuates in the course of early development.
Support (If Any): NIH K01-MH074643, NIH R01-MH086566, and Sepracor, Inc. ESRC026 grants to Monique K. LeBourgeois and SNSF grant 320030-130766 to Peter Achermann.

0049

ANTERO-POSTERIOR CHANGES OF EEG TOPOGRAPHY DURING THE FIRST THREE YEARS OF LIFE

Novelli L[1,2,3], Marzano C[3], Finotti E[4], Bruni O[2], Barucca M[3], De Gennaro L[3]
[1]Department of Neuroscience, AFaR-Fatebenefratelli Hospital, Rome, Italy, [2]Dept Developmental Neurology, Univ. of Rome "La Sapienza", Rome, Italy, [3]Department of Psychology, University of Rome "Sapienza", Rome, Italy, [4]Department of Neurological Sciences, University of Bologna, Bologna, Italy

Introduction: Sleep EEG frequency bands show striking age-related changes in power and scalp topography; however, most studies have focused on changes occurring during adolescence that is considered to be a period of important cerebral plasticity and reorganization. In particular, it has been recently reported that slow-wave topography during sleep shows an anterior-posterior gradient. Taking into account that sleep and its EEG undergo their most important modifications during the early developmental period, the aims of our study were to evaluate the EEG anterior-posterior differences during the first 3 years of life and to

analyze the eventual interrelationships between these topographic differences and developmental stages.
Methods: Sleep was polygraphically recorded in 29 children aged 0-26 months. A spectral analysis of the sleep EEG was then performed, after a careful rejection of artifact epochs, for the 0.5-25.0 Hz frequency band (step 0.25 Hz). Babies were subdivided into 4 age subgroups: 0-2, 2-4, 4-12, and 12-26 months.
Results: During NREM sleep, a prevalent posterior topography of the delta band was found with no age-related differences. For the theta band, a group x area interaction effect was found: in the 12-26 months group the theta power greatly increased in all brain areas but with a major representation over the central-frontal scalp areas. This anterior predominance in theta power, present during the very early developmental stage, showed a sudden increase and an anterior transposition after 12 months of age.
Conclusion: These results confirm the posterior distribution of the delta band already reported in 3-year-old children (Kurth et al., 2011). The only EEG frequency showing age-related changes was the theta band that increased in power and showed a posterior-anterior shift. All these changes, probably dependent on maturation processes, suggest that the shift and increase in power of the theta band over the frontal regions might be considered as a marker of normal development.

0050

DO THE DYNAMICS OF SLEEP HOMEOSTASIS (PROCESS S) CHANGE ACROSS EARLY CHILDHOOD?

LeBourgeois MK[1,2], Rusterholtz T[1], Jenni OG[3], Carskadon MA[2], Achermann P[4]
[1]Integrative Physiology, University of Colorado Boulder, Boulder, CO, USA, [2]Psychiatry and Human Behavior, The Warren Alpert Medical School of Brown University, Providence, RI, USA, [3]Child Development Center, University of Children's Hospital, Zurich, Zurich, Switzerland, [4]Institute of Pharmacology and Toxicology, Section of Chronobiology and Sleep Research, University of Zurich, Zurich, Switzerland

Introduction: Early childhood is a period characterized by changes in the duration, timing, and quality of sleep. Although attenuation in the buildup of sleep pressure (Process S) influences sleep timing and propensity in adolescence, little is known about Process S in young children. This longitudinal study examined whether the dynamics of sleep homeostasis (i.e., time constants of buildup and decline) change across early development.
Methods: Participants were 7 healthy children (2 males) studied at three time points (2.5-3.0y, 3.5-4.0y, 5.5-6.0y). Children followed a strict sleep schedule for at least 5 days before each of five randomly-ordered, home-based, polysomnographic recordings following 4h, 7h, 10h, 13h, and 16h of prior wakefulness. Mean slow-wave activity (power in the 0.75-4.5 Hz range) per NREM sleep episode (stages 2-4) at episode midpoint served for parameter estimation of Process S. The buildup of Process S during waking was modeled with a saturating exponential function towards an upper asymptote and its decrease during sleep as a decreasing exponential function towards a lower asymptote. Time constants were limited to a physiological meaningful range.
Results: Buildup time constants were 8.1+1.4h, 10.5+1.9h, and 14.4+1.6h for the 3 time points, i.e., showed attenuation with increasing age [$F(2,12)=37.6$, $p<.001$]. The time constants of the decline were similar across ages [2.3+.5h, 2.4+.5h, and 1.9+.4h, $F(2,12)=3.6$, $p=.06$]. Also, the distance between the asymptotes increased as a function of age [287.8+46.9%, 304.3+58.1%, and 398.5+109.2%; $F(2,12)=12.9$, $p=.001$].
Conclusion: This is the first study to show early developmental changes in Process S, including a slowing of the buildup during wakefulness. Furthermore, the increased distance between asymptotes may reflect a greater capacity of the brain to generate slow waves. Whether changes in the dynamics of Process S are related to individual differences in sleep behavior (napping, sleep duration, sleep problems), daytime behavior/emotion, and other physiological processes remain important unanswered questions.
Support (If Any): NIH K01-MH074643, NIH R01-MH086566, and Sepracor, Inc. ESRC026 grants to MKL and SNSF grant 320030-130766 to PA.

0051

THE HOMEOSTATIC RESPONSE TO SLEEP DEPRIVATION DOES NOT CHANGE FROM MID TO LATE ADOLESCENCE: PRELIMINARY ANALYSIS

Tarokh L[1,2,3], Carskadon MA[2,3], Achermann P[1,4,5]
[1]Institute of Pharmacology and Toxicology, University of Zurich, Zurich, Switzerland, [2]Department of Psychiatry and Human Behavior, Alpert Medical School at Brown University, Providence, Providence, RI, USA, [3]Bradley Sleep Lab, Brown University, Providence, RI, USA, [4]Zurich Center for Integrative Human Physiology, University of Zurich, Zurich, Switzerland, [5]Neuroscience Center, University and ETH Zurich, Zurich, Switzerland

Introduction: Few studies have examined the effects of sleep deprivation on the sleep EEG during adolescence. One cross-sectional study reported that the increase in slow-wave activity (SWA) following sleep deprivation was greater in mature as compared to pre/early pubertal adolescents (Jenni et al., SLEEP, 2005). The aim of the current study was to examine the response to sleep deprivation in a longitudinal sample of postpubertal adolescents.
Methods: Baseline (after ~14 hours of wakefulness) and recovery sleep (after ~ 32 hours of wakefulness) was recorded in seven teens (three females) when they were ages 15/16 years (initial) and again two years later (follow-up). Non-rapid eye movement (NREM) sleep spectra were calculated for the first cycle for derivation C3/A2 for five frequency bands: delta (0.6 to 4.8 Hz), theta (5 to 8.4 Hz), alpha (8.6 to 10.8 Hz), and sigma (11 to 16 Hz). A repeated measures ANOVA with factors assessment (initial vs. follow-up) and condition (baseline vs. recovery) was used to examine changes in each band.
Results: We observed a significant decline in power between assessments independent of condition (main effect: assessment) in the delta ($F(1,6) = 12.36$; $p = 0.013$) and theta ($F(1,6) = 18.53$; $p = 0.005$) bands. In addition, power was greater on recovery compared to baseline nights at both assessments (main effect: condition) in the delta ($F(1,6) = 25.93$; $p = 0.002$) and theta ($F(1,6) = 32.05$; $p = 0.001$) bands. There was no interaction between assessment and condition.
Conclusion: We observed an expected maturational decline in NREM sleep EEG power on baseline and recovery nights. On the other hand, the compensatory increase in delta and theta power following sleep deprivation did not change from mid to late adolescence. We intend to examine this issue in a larger group of mid-older adolescents and in younger adolescents.
Support (If Any): This work was supported by the National Institute of Mental Health (Grant MH076969 to M.A.C.) and Swiss National Science Foundation (Grant 320030-130766 to P.A.).

0052

EVIDENCE OF A SUPERFAST SPINDLE IN THE 16 - 19 HZ FREQUENCY RANGE

Nader R[1,2], Smith C[1], Sabbagh MA[2]
[1]Psychology, Trent University, Peterborough, ON, Canada, [2]Psychology, Queens University, Kingston, ON, Canada

Introduction: This study was designed to confirm the existence of a spindle type that has only been documented in one earlier study (Nader et al., 2003). This spindle is thought to exist in addition to the normally studied frequency range for spindles (11 - 16Hz).
Methods: Participants were 32 healthy adolescents (17 female) aged 12 - 19 years (M = 15.36 years). In-home recordings of EEG (C3/C4/FZ/

PZ), EOG, and EMG were obtained using SuzanneTM (Tyco-Healthcare Group LP, Mansfield, MA, USA) portable polysomnographic systems. Sleep spindles were automatically counted using PRANA® (PhiTools, Strasbourg, France). Peak amplitudes of 30 spindles in Stage 2 sleep were identified. Values were used to calculate the mean and standard deviation of peak amplitude for each subject. The minimal amplitude criterion was determined by subtracting 1.96SD units from each mean. Minimum spindle duration was 0.5 seconds; spindles were counted separately in 11-13.5Hz, 13.51-16Hz, 16.01-18.5Hz bins.

Results: At FZ, slow spindle count averaged 1776.09 (SD = 448.5; range=855-2892), fast spindles averaged 365.66 (SD = 280.72; range=58-1501) and superfast spindles averaged 42.31 (SD=54.49; range=2-233). At FZ, slow spindles mean density = 7.14 spindles/min (SD = 1.87), fast spindles mean density = 1.45 spindles/min (SD = 1.05) and superfast spindles mean density = 0.16 (SD=0.18). At FZ, slow spindle mean duration = 1.74sec (SD = 0.19sec), fast spindle mean duration = 1.38sec (SD = 0.12sec) and superfast spindle mean duration = 0.89sec (SD=0.12sec). At FZ, slow spindle mean amplitude = 43.95uV (SD = 8.73uV), fast spindle mean amplitude = 44.84uV (SD = 7.39uV) and superfast spindle mean amplitude = 34.27uV (SD=8.12uV).

Conclusion: The 3 spindle types showed unique characteristics and manifest independently in both sexes. They are most prominent at FZ but are quite evident at the other derivations. Results confirm previous report of existence of superfast spindles observed in young girls.

Support (If Any): Supported by Natural Sciences and Engineering Research Council (NSERC) of Canada and Canadian Institutes of Health Research (CIHR).

0053

SPINDLE DENSITY VARIES WITH AGE AMONG THREE SPINDLE TYPES (11-13.5 HZ, 13.51-16 HZ, 16.01- 18.5 HZ)

Smith C[1], Nader R[1,2], Murkar A[1], Sabbagh MA[2]
[1]Psychology, Trent University, Peterborough, ON, Canada,
[2]Psychology, Queens University, Kingston, ON, Canada

Introduction: This study investigated how spindle density changes with age, with possible differences between 3 spindle types.

Methods: Participants were 32 healthy adolescents (17 female) aged 12 - 19 years (M = 15.36 years). In-home recordings of EEG (C3/C4/FZ/PZ), EOG, and EMG were obtained using SuzanneTM (Tyco-Healthcare Group LP, Mansfield, MA, USA) portable polysomnographic systems. Sleep spindles were automatically counted using PRANA® (PhiTools, Strasbourg, France). Peak amplitudes of 30 spindles in Stage 2 sleep were identified. Values were used to calculate the mean and standard deviation of peak amplitude for each subject. The minimal amplitude criterion was determined by subtracting 1.96SD units from each mean. Minimum spindle duration was 0.5 seconds; spindles were counted separately in 11-13.5Hz, 13.51-16Hz, 16.01-18.5Hz bins.

Results: A 3 (Spindle Type) x 2 (Gender) ANOVA was conducted on spindle density at FZ. There was a main effect of spindle type, $F(2,60) = 300.20$, $p < .000001$. A Tukey post hoc test showed that density was significantly higher for Slow spindles (M = 7.14 spindles/min) than for both Fast (M = 1.45 spindles/min) and Superfast spindles (M = 0.16 spindles/min). Fast spindles had a significantly higher density than Superfast spindles. There were no gender differences. Slow spindle density declined with age at FZ, $r(30) = -.37$, $p < .05$. Fast spindle density increased with age at C4, $r(30) = .35$, $p < .05$. Density of Superfast spindles showed no relationship with age at any of the electrode sites.

Conclusion: The density of sleep spindles declines as the frequency increases; slow spindles have the highest density, followed by fast spindles, and superfast spindles have the lowest density. Slow spindle density decreased, fast spindles increased and superfast spindles showed no changes with age. These distinctions suggest that they all have different developmental trajectories, and likely different functions.

Support (If Any): Supported by Natural Sciences and Engineering Research Council (NSERC) of Canada and Canadian Institutes of Health Research (CIHR).

0054

SPINDLE DURATION VARIES AMONG THREE SPINDLE TYPES AND WITH AGE

Nader R[1,2], Smith C[1], Murkar A[1], Sabbagh MA[2]
[1]Psychology, Trent University, Peterborough, ON, Canada,
[2]Psychology, Queens University, Kingston, ON, Canada

Introduction: This study was designed to investigate whether spindle duration varies according to spindle type and to age.

Methods: The participants were 32 healthy adolescents (17 female) aged 12 - 19 years (M = 15.36 years). In-home recordings of EEG (C3/C4/FZ/PZ), EOG, and EMG were made using SuzanneTM (Tyco-Healthcare Group LP, Mansfield, MA, USA) portable polysomnographic systems. Sleep spindles were automatically counted using PRANA® (PhiTools, Strasbourg, France). Peak amplitudes of 30 spindles in Stage 2 sleep were identified. Values were used to calculate the mean and standard deviation of peak amplitude for each subject. The minimal amplitude criterion was determined by subtracting 1.96SD units from each mean. Minimum spindle duration was 0.5 seconds; spindles were counted separately in 11-13.5Hz, 13.51-16Hz, 16.01-18.5Hz bins.

Results: A 3(Spindle Type) x 2 (Gender) ANOVA was conducted on spindle duration at FZ. There was a significant main effect of spindle type, $F(2, 62) = 345.415$, $p < .000001$. A Tukey post hoc showed that Slow (M = 1.74sec) and Fast (M = 1.381sec) spindles both had significantly longer durations than Superfast spindles (M = 0.892sec). Fast spindles were significantly longer than Superfast spindles.There were no gender differences. Correlations showed that slow spindle duration declined with age at C3, $r(30) = -.38$, $p = .04$; C4, $r(30) = -.48$, $p = .005$; and FZ, $r(30) = -.50$, $p = .003$. Fast spindle duration showed no changes with age. Superfast spindle duration showed no changes with age.

Conclusion: Duration declines with age for slow spindles, and is particularly evident in the frontal and central regions. Fast and superfast spindle duration show no relation to age.

Support (If Any): Supported by Natural Sciences and Engineering Research Council (NSERC) of Canada and Canadian Institutes of Health Research (CIHR).

0055

SPINDLE AMPLITUDE VARIES WITH AGE AMONG THREE SPINDLE TYPES (11-13.5 HZ, 13.51-16 HZ, 16.01 - 18.5 HZ)

Smith C[1], Nader R[1,2], Murkar A[1], Sabbagh MA[2]
[1]Psychology, Trent University, Peterborough, ON, Canada,
[2]Psychology, Queens University, Kingston, ON, Canada

Introduction: This study was designed to investigate whether spindle amplitude varies according to spindle type and to age.

Methods: Participants were 32 healthy adolescents (17 female) aged 12 - 19 years (M = 15.36 years). In-home recordings of EEG (C3/C4/FZ/PZ), EOG, and EMG were obtained using SuzanneTM (Tyco-Healthcare Group LP, Mansfield, MA, USA) portable polysomnographic systems. Sleep spindles were automatically counted using PRANA® (PhiTools, Strasbourg, France). Peak amplitudes of 30 spindles in Stage 2 sleep were identified and used to calculate the mean and standard deviation of peak amplitude for each subject. The minimal amplitude criterion was determined by subtracting 1.96SD units from each mean. Minimum spindle duration was 0.5 seconds; spindles were counted separately in 11-13.5Hz, 13.51-16Hz, 16.01-18.5Hz bins.

Results: A 3(Spindle Type) x 2 (Gender) ANOVA was conducted on FZ spindle amplitudes. There was a significant main effect of spindle type, $F(2, 62) = 45.041$, $p < .000001$. A Tukey post hoc showed that Slow (M = 43.95 uV) and Fast (M = 44.84 uV) spindles both had significantly higher amplitudes than Superfast spindles (M = 34.27 uV). There were

no gender effects. Slow spindle amplitude declined with age at C4, r(30) = -.48, p = .005, and showed non- significant negative relationships at the other sites. Fast spindle amplitude declined with age at C3, r(30) = -.41, p = .026; C4, r(30) = -.56, p .001; FZ, r(30) = -.36, p = .042; and PZ, r(30) = -.49, p = .005. Superfast spindle amplitude declined with age at C4, r(30) = -.39, p = .023 with a similar trend at PZ, r(30) = -.35, p = .056.

Conclusion: Amplitude declines with age for all spindle types, but is particularly strong for fast spindles (13.5 - 16Hz). Least decline occurred in frontal regions.

Support (If Any): Supported by Natural Sciences and Engineering Research Council (NSERC) of Canada and Canadian Institutes of Health Research (CIHR).

0056

AGE-RELATED IMPAIRMENTS OF MEMORY AND FAST SLEEP SPINDLES ARE MEDIATED BY DETERIORATION OF CORTICO-THALAMIC WHITE MATTER PATHWAYS

Mander BA[1], Zhu A[1], Lu BS[3], Saletin JM[1], Ancoli-Israel S[4], Jagust WJ[2], Walker M[1,2]

[1]Psychology, University of California, Berkeley, Berkeley, CA, USA, [2]Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, USA, [3]Division of Pulmonary and Critical Care Medicine, California Pacific Medical Center, San Francisco, CA, USA, [4]Psychiatry, University of California, San Diego, La Jolla, CA, USA

Introduction: A prominent signature of human aging is a dramatic reduction in frontal sleep spindles. However, the underlying neuropathological mechanisms responsible for causing such an impairment remains unknown, as do the functional consequence on learning and memory. Combining diffusion tensor imaging (DTI), whole-head EEG recordings, and memory testing, here we demonstrate that deterioration of human cortico-thalamic white-matter fiber tracts underlie the loss of sleep spindles in older adults, and their concomitant benefit on hippocampal memory.

Methods: DTI scans were obtained in 32 participants: 16 healthy older adults (72.1±1.6 years) and 16 healthy young adults (20.5±0.5 years), allowing assessment of white-matter tractography. Additionally, both groups had a night of sleep recorded in-lab using full-head (19-channel EEG) polysomnography, followed by next-day hippocampal-dependent episodic learning assessment. Analyses focused on the relationship between age-related sleep spindle impairments, memory impairment, and deterioration of white-matter fiber tracts.

Results: Compared to young adults, older adults showed a 40% reduction in fast sleep spindles expressly over prefrontal cortex (p=0.031). Moreover, these age-related impairments in prefrontal sleep spindles were explained by deficits in a fronto-parietal white-matter fiber tract connected through the thalamus (sobel mediation test, p=0.004), which itself connected to the hippocampus. Most striking, the degree of age-related impairment in sleep spindles, mediated by this cortico-thalamic white-matter tract, accurately predicted the extent of next-day deficit in hippocampal learning capacity (p=0.011).

Conclusion: Here we demonstrate that age-related atrophy within a select, fronto-parietal white-matter fiber tract of the human brain represents a neuropathological mechanism explaining the loss of frontal fast sleep spindles in older adults, and with it, the degree of next-day impairment in hippocampal-dependent learning capacity. Therefore, one putative cause of age-related reductions in sleep spindle activity is the breakdown of thalamo-cortical conduction pathways, preventing cortical spindle expression and, consequently, the associated neurocognitive memory benefits.

Support (If Any): Supported by National Institutes of Health; NIH NIA [RO1AG031164] (MPW), [R01AG034570] (WJ), [R01AG08415] (SA), [F32AG039170](BAM).

0057

CHANGES IN EEG FREQUENCY BANDS ACROSS THE SLEEP TRANSITION COMPARING OLDER AND YOUNG ADULTS AS MEASURED BY THE NOVEL SIGNAL ANALYSIS TECHNIQUE EMPIRICAL MODE DECOMPOSITION

Chinoy ED[1], Kaslovsky DN[2], Meyer FG[3], Wright KP[1]

[1]Integrative Physiology, University of Colorado-Boulder, Boulder, CO, USA, [2]Applied Mathematics, University of Colorado-Boulder, Boulder, CO, USA, [3]Electrical Engineering, University of Colorado-Boulder, Boulder, CO, USA

Introduction: The transition from wakefulness to sleep represents a time of dynamic change in EEG activity. We conducted an exploratory analysis of the sleep transition in older and young adults using the novel Empirical Mode Decomposition (EMD) signal analysis technique. EMD does not make assumptions regarding the signal analyzed and thus it can be used to estimate and detect changes in instantaneous frequency in nonstationary EEG signals with greater temporal and frequency resolutions than with a standard spectrogram.

Methods: Sleep transition EEG data from 21 (8 women) healthy young 21.7±3.5y (mean±SD) and 10 (6 women) healthy older 67.9±4.4y (mean±SD) adults were analyzed using sleep episodes scheduled at habitual bedtime. EEG data from C3xA2 were sampled at 256Hz with a 12-bit A-D board. Artifact-free EEG signals from the first 30sec epoch of stage 1 sleep was compared to the prior 30sec epoch of wakefulness. Power was calculated for delta (0.5-4.0Hz), theta (4.0-8.0Hz), alpha (8.0-12.0Hz), sigma (12.0-15.0Hz), beta (15.0-35.0Hz), and gamma (35.0-45.0Hz) bands. Data for percent power were analyzed using repeated measures ANOVA with epoch and age as factors.

Results: EMD detected an increase in delta power, decreases in alpha, sigma, beta, and gamma powers (all $p<0.05$), and a non-significant decrease in theta power across the wakefulness to sleep transition. Decreases in beta and gamma were larger for older than younger adults ($p<0.05$).

Conclusion: EMD analysis was sensitive to changes in EEG bands across the wakefulness to sleep transition as well as differences between older and young adults. The finding that healthy older adults show larger decreases in fast beta and gamma EEG activities than young adults is novel and suggests that healthy older adults may have a greater decrease in cortical arousal during the wakefulness to sleep transition. EMD may represent a novel physiological signal analysis technique to examine physiological oscillations during sleep and wakefulness.

Support (If Any): NIH R01 HL081761, NIH R03 AG024621, T32 AG00279, M01RR00051, and NIH/NCRR Colorado CCTSI Grant Number UL1 RR025780.

0058

RELATIONSHIPS BETWEEN AGE AND INSOMNIA SYMPTOMS

Barilla HE[1], Perlis ML[1], Grandner MA[2], Gehrman P[1,3]

[1]Behavioral Sleep Medicine Program, University of the Pennsylvania, Philadelphia, PA, USA, [2]Center for Sleep and Circadian Neurobiology, Division of Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, PA, USA, [3]Philadelphia VA Medical Center, Philadelphia, PA, USA.

Introduction: Many studies have documented increasing rates of insomnia with age, though few studies have documented whether there are age-related changes in the severity of insomnia. Further, studies of age-related changes in sleep duration are few in number. The present study explores whether a linear or non-linear relationship with age exists for insomnia symptoms, severity of symptoms, and sleep duration.

Methods: Participants with and without insomnia completed an online screening questionnaire. Of n=2911 respondents, n=2687 provided complete data for analysis over the past 32 months, with 59% endorsing subjective insomnia. Presence or absence of insomnia, adequacy/suf-

ficiency of sleep, and daytime impairment were based on single item endorsements. Sleep latency (SL) and wake after sleep onset (WASO) were assessed as minutes/night and number of nights/week. The product of these variables was used as a measure of insomnia severity. Time in bed (TIB) was calculated and total sleep time (TST) was both computed and determined from self-report Linear regression analyses were conducted with covariates for sex, race/ethnicity, education, depression history, and chronic pain. Insomnia variables served as the predictor variables.

Results: Increasing age was associated with increased: likelihood of insomnia (0.7%/yr), WASO in minutes (0.62mins/yr), insomnia severity (4.17 mins/yr), and daytime impairment (0.48%/yr). Increasing age was not, however, associated a worsening of SL, sleep adequacy/sufficiency, or total sleep time. Specifically, SL was found to decrease with age (0.21mins/yr), sleep adequacy/sufficiency increased with age (0.49%/yr), and self-reported TST (0.021hrs/yr), computed TST (1.66mins/yr), and TIB (0.021hrs/yr) increased with age. All reported effects were significant at $p<0.01$.

Conclusion: These data clearly show that with age insomnia occurs more frequently and with greater severity. The effect, however is limited to increased WASO which (as would be predicted by the Spielman Model) appears occur as a progressive tendency with increased time in bed.

Support (If Any): This work was supported by T32HL007713, R01AT003332, and R01MH077900.

0059

PERCEIVED CONSEQUENCES OF NIGHTTIME AWAKENINGS IN ACTIVE MIDDLE-AGE AND OLDER ADULTS

Brown FM[1], LaJambe CM[2]

[1]Psychology, Penn State University, University Park, PA, USA, [2]Larson Transportation Institute, Penn State University, University Park, PA, USA

Introduction: Nighttime awakenings are common in older adults, although there is considerable variability in perceived negative consequences of these awakenings. This study explored physiological, psychosocial, and environmental factors related to nighttime awakenings that might influence the perception of feeling rested upon waking.

Methods: A sample of 542 active individuals ages 35-97 from various local organizations completed a 61-item "Sleep Disruption Survey." Data were analyzed from 229 individuals reporting spontaneous awakenings for more than a few minutes on a near-daily basis. Survey questions included demographics, self-rated health, sleeping environment, psychological state; times, frequencies, and lengths of awakenings; and activities during wake periods. Multiple logistic regression assessed these influences on a binary response to the item "I get enough sleep at night to feel rested the next day.".

Results: Subject proportions by age were: 8.7% (35-44), 19.7% (45-54), 23.1% (55-64), 20.1% (65-74), 22.7% (75-85), and 5.7% (85+); 59.4% were female. Half (n=115) reported "often/nearly always rested" and half felt "not very often/rarely rested" (n = 114) upon morning awakening. Individuals were less "rested" following 3+ nighttime awakenings (OR=0.396, p=.030), > 15 minutes awake before returning to sleep (OR=0.274, p=.006), premature morning awakening (OR=0.054, p=.034), performing nighttime caregiver activity (OR=0.134, p=.040), earlier rather than later nighttime awakenings in the presence of a bed partner (OR=1.010, p=.002), and marginally, more frequent anxiety (OR=0.228, p=.078, R-squared=59.4). Covariate adjustments were made for hours asleep, perceived sufficient sleep, and presence of sleep disorders. Non-significant predictors were age, gender, work status, nighttime activities while awake, light exposure, and mood.

Conclusion: A combination of variables apparently influences perceptions of feeling rested upon waking. Further research is needed to clarify currently inadequate distinctions between disruptive nighttime awakenings and those awakenings that result in feeling rested the next day.

Support (If Any): This study was supported by the Smart Spaces Center and the Social Sciences Research Institute at The Pennsylvania State University.

0060

UNIQUE CHANGES IN FAST-SPIKING INTERNEURON ACTIVITY DURING SLEEP-DEPENDENT CONSOLIDATION OF OCULAR DOMINANCE PLASTICITY

Aton S, Dumoulin M, Seibt J, Coleman T, Watson A, Frank MG
Neuroscience, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Ocular dominance plasticity in the visual cortex (V1) is initiated during a critical period of postnatal development by waking monocular visual experience, and consolidated by subsequent sleep. Our previous work has demonstrated that sleep-dependent consolidation of this form of plasticity involves strengthening of glutamatergic synapses in V1.
Methods: We carried out chronic recordings of individual V1 neurons in freely-moving, freely-sleeping cats, to assess changes in V1 network activity across waking visual experiences and subsequent sleep. To verify these changes, we also assessed neuronal activity in anesthetized cats, either after monocular waking experience alone, or after varying amounts of subsequent sleep.
Results: We observed that monocular deprivation leads to a gradual decrease in activity among fast-spiking (FS) interneurons, which is maintained during the first few hours of subsequent sleep. Similar changes in FS interneuron activity do not accompany normal binocular visual experience (where no functional plasticity is induced), or during ocular dominance changes that do not require sleep. Importantly, non-FS (mainly pyramidal) neurons do not show activity decreases across waking, and become more active during sleep-dependent consolidation of ocular dominance plasticity. Both increases in firing in non-FS neurons, and decreases in firing in FS interneurons, correlate with functional changes in V1 during sleep.
Conclusion: Based on our present data, we hypothesize that depression of interneuron activity, initiated during wakefulness, results in disinhibition of pyramidal neurons during subsequent sleep, which in turn drives sleep-dependent plasticity in V1 circuits.
Support (If Any): This work was supported by funds from the National Institutes of Health (F32EY017766 and K99EY021503), and by a Fellowship For Women In Science from L'Oreal USA and the American Association for the Advancement of Science.

0061

ALTERING NEURONAL FIRING BY CHANGING ASTROCYTE-TO-NEURON RATIO IN VITRO

Jewett K[1,2,3], Sengupta P[1,2,3], Davis CJ[1,2,3], Krueger JM[1,2,3]
[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA, [3]Graduate Program in Neuroscience, Washington State University, Pullman, WA, USA

Introduction: Astrocyte-to-neuron ratios change substantially during development and multiple pathologies. Yet effects of such changes on local network states have not been investigated. Glia release gliotransmitters that act upon neuronal receptors, altering neuronal excitability and function. Thus, altering the astrocyte-to-neuron ratio in vitro will likely affect neuronal firing.
Methods: Cortices were harvested from day 2-4 mice (C57BL/6J). Astrocytes were isolated using magnetic microbeads (MACS, Miltenyi Biotec) attached to antibodies for astrocyte-specific glutamate transporter/astrocyte cell surface antigen-1. Cultures containing only the cells selected for by microbeads were grown on coverslips. Cultures enriched with or depleted of astrocytes were grown on multi-electrode arrays (MEAs) and coverslips. After 10 days in vitro a functional network forms. 13-16 days in vitro electrical signals from the cultures grown on MEAs were recorded, filtered, and analyzed for action potentials (APs) (Multi-Channel Systems). Cells on coverslips were fixed and probed for glial fibrillary acidic protein (GFAP) and neuronal nuclei marker (NeuN) using immunofluorescence techniques.
Results: The cells selected for by microbeads contained many GFAP-positive and no NeuN-positive cells confirming that only astrocytes and no neurons were selected. Cultures with varying amounts of astrocytes displayed different AP firing patterns. For example, a culture with 1:10 astrocytes-to-neurons displayed a constant rate of AP firing over 18 hours of recording. A culture of 10:1 astrocytes-to-neurons had more frequent pauses with no APs and overall the pauses were longer than in the 1:10 culture. At the beginning and end of the recording the pauses were shorter than those during the middle (hours 4-12), hinting at a possible astrocyte-induced rhythm.
Conclusion: The electrical recordings of cultures grown with different ratios of astrocytes-to-neurons display different patterns of AP firing. If these patterns are cyclical remains to be determined.
Support (If Any): NIH NJ025378, NS031453.

0062

SLEEP-REMINISCENT DYNAMICS IN ISOLATED NEURONAL NETWORKS: SPATIAL CHARACTERISTICS

Roy S[2], Krueger JM[1,3], Jewett K[1,3], Sengupta P[1,3], Davis CJ[1,3], Corrigan P[2]
[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Electrical Engineering and Computer Science, Washington State University, Pullman, WA, USA, [3]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA

Introduction: Sleep is posited to be a local and use-dependent phenomenon. Functional units consisting of small groups of neurons maintain local sleep states, which are modulated by use/ activity, coupling with other neuronal groups, and some amount of global regulation. Whole-animal sleep emerges among these loosely-coupled neuronal assemblies. A logical extension of the distributed and use-dependent sleep theory is that neuronal networks grown in isolation exhibit dynamical characteristics that are correlative with in vivo sleep. With this motivation in mind, our group has been engaged in efforts to determine whether functional state evolutions in isolated neuronal networks display properties that are correlative with local sleep, using multi-electrode-array (MEA) and optical-stimulation technologies. The baseline electrical (voltage) measurements from the neuronal assemblies display a modified burst-pause pattern that is reminiscent of (though not identical to) an in vivo sleep state.
Methods: We characterized spatial patterns in data recorded in vitro from co-cultures of neurons/glia grown on MEAs, across the MEA channels. Neurons were transfected with channelrhodopsin-2 for optical stimulation.
Results: In the un-stimulated state, the electrical bursts at spatially-near channels displayed strong correlation, reminiscent of cortical column sleep states in vivo. Stimulation of the neuronal assemblies depressed these between-channel correlations during and just after the stimulation period, and was reminiscent of in vivo waking. Conversely, addition of tumor necrosis factor (TNF) enhanced spatial correlation concurrent with periods of the enhanced sleep-like state.
Conclusion: Stimulation of the neuronal networks drives it to a more wake-like state with greater desynchronization between electrodes for some period after the activity event, but eventually returns to the sleep-like state. Conversely, addition of sleep-regulatory substances (TNF) to the culture medium serves to strengthen the sleep-like state. Cultured neurons and glia exhibit dynamic sleep-like and wake-like states that are inducible by appropriate stimuli.
Support (If Any): NS25378/NS31453 to JMK and NSF-ECCS-0901137/ NSF-ECCS-1058124 to SR.

0063

SUBCORTICAL EEG ASYMMETRY DURING SLOW WAVE SLEEP IN THE FUR SEAL

Kosenko P[1,2], Lapierre J[3], Mukhametov L[1,4], Siegel J[3], Lyamin O[1,3,4]
[1]Utrish Dolphinarium Ltd, Moscow, Russian Federation, [2]Southern Federal University, Rostov on Don, Russian Federation, [3]UCLA and VA GLAHS Sepulveda, North Hills, CA, USA, [4]Severtsov Institute of Ecology and Evolution, Moscow, Russian Federation

Introduction: Slow wave sleep (SWS) in the fur seal (*Callorhinus ursinus*) is characterized by a marked interhemispheric asymmetry in the cortical EEG called asymmetrical SWS (ASWS) or "unihemispheric" SWS. The aim of this study was to examine EEG in subcortical areas during bilateral SWS (BSWS) and ASWS in this species.
Methods: Four seals were implanted with EEG electrodes positioned over symmetrical cortical (frontal and occipital) areas and in the thalamus (3 electrodes in dorsal, 1 in ventral and 1 medial regions). Slow wave activity (SWA; power in the range of 1.2-4.0 Hz) was calculated in cortical and thalamic derivations in 20-sec epochs. Episodes of SWS were subdivided into BSWS and ASWS based on the degree of cortical interhemispheric SWA measured by the asymmetry index (AI=[L-R)/(L+R], where L and R are SWA values in the left and right hemispheres, respectively).
Results: For the SWS episodes selected, the average AI of cortical SWA in frontal-occipital derivations was +0.02±0.02 for episodes of BSWS, +0.52±0.01 for episodes of left ASWS and -0.45±0.05 for episodes of right ASWS (average for 4 seals). During episodes of BSWS (a total of 20 episodes in 4 seals) no difference was found between normalized SWA in symmetrical cortical derivations as well as between SWA in cortical and thalamic (both ipsilateral and contralateral) derivations (one-way ANOVA, $p>0.05$). During ASWS (a total of 10 left ASWS and 7 right ASWS episodes) SWA in thalamic derivations developed synchronously with SWA in ipsilateral cortex. No significant difference ($p>0.05$, pairwise comparison following one-way ANOVA) was found between SWA in cortical and ipsilateral subcortical derivations. At the same time, a significant difference was found between SWA in cortical and contralateral thalamic derivations ($p<0.01$).
Conclusion: These findings indicate that "unihemispheric sleep" /asymmetrical SWS in fur seals is both a cortical and subcortical phenomenon.
Support (If Any): Supported by NSF (0919929), NIH (069640) and Utrish Dolphinarium Ltd.

0064

UNLIKE ACETYLCHOLINE, CORTICAL SEROTONIN RELEASE IS NOT LATERALIZED DURING ASYMMETRICAL SLOW WAVE SLEEP IN THE FUR SEAL

Lapierre JL[1,2,3], Kosenko P[4,5], Kodama T[6], Peever J[3], Mukhametov L[4], Lyamin O[1,2,4], Siegel J[1,2]
[1]Department of Psychiatry and Biobehavioral Sciences, University of California Los Angeles, Los Angeles, CA, USA, [2]Neurobiology Research, Veterans Administration Greater Los Angeles Healthcare System, North Hills, CA, USA, [3]Department of Cell and Systems Biology, University of Toronto, Toronto, ON, Canada, [4]Research Unit, Utrish Dolphinarium Ltd, Moscow, Russian Federation, [5]2nd South Federal University, Rostov on Don, Russian Federation, [6]Department of Dementia and Higher Brain Function, Tokyo Metropolitan Institute of Medical Science, Tokyo, Japan

Introduction: On land, fur seals display predominately bilaterally synchronized electroencephalogram (EEG) activity during slow-wave sleep (SWS), similarly observed in all terrestrial mammals studied to date. In water however, interhemispheric EEG asymmetry significantly increases during SWS (known as asymmetrical SWS), resembling the unihemspheric slow waves of cetaceans (whales and dolphins). The unique sleeping pattern of fur seals allows us to distinguish neuronal mechanisms mediating sleep state from those mediating behavioral quiescence, with its associated reductions in heart rate, muscle tone, respiration, and body temperature. We previously found that cortical acetylcholine (ACh) release was lateralized during asymmetrical SWS, with greater release in the hemisphere displaying lower voltage EEG activity. Findings demonstrated that ACh release is tightly linked to hemispheric EEG activation. The aim of this study was to quantify the release of serotonin (5-HT) in the cortex across the sleep-wake cycle in the northern fur seal.
Methods: Serotonin (5-HT) release was measured bilaterally in four juvenile northern fur seals (Callorhinus ursinus) using in vivo microdialysis, in combination with, polygraph recordings of EEG, electrooculogram (EOG), and neck electromyogram (EMG). 5-HT levels were determined using high-performance liquid chromatography coupled with electrochemical detection.
Results: Consistent with previous findings for terrestrial mammals, cortical 5-HT release was state-dependent. 5-HT levels increased by 126±5% during active wakefulness, decreased by 25±2% during bilateral SWS, and were minimal during REM sleep (decreasing by 50±5%) when compared to quiet wakefulness (QW) as baseline. Unlike ACh, cortical 5-HT release was not lateralized during asymmetrical SWS. 5-HT levels were similar during right and left asymmetrical SWS at levels comparable to those observed during QW.
Conclusion: Unlike acetylcholine, cortical serotonin release is not lateralized during asymmetrical SWS in the northern fur seal. Findings indicate distinct roles of different arousal systems in EEG activation and behavioral control.
Support (If Any): Supported by the NSF (0919929), NIH (069640), the Medical Research Service of the Department of Veterans Affairs, Utrish Dolphinarium Ltd., and NSERC.

0065

MICE TRANSGENIC FOR HUMAN INTERLEUKIN-37 HAVE ATTENUATED SLEEP RESPONSES TO LIPOPOLYSACCHARIDE

Zielinski M[1,2], Dinarello CA[3], Krueger JM[1,2]
[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA, [3]Department of Medicine, University of Colorado-Denver, Aurora, CO, USA

Introduction: Interleukin-37 (IL-37) suppresses the expression of pro-inflammatory molecules, including the sleep regulatory cytokines interleukin-1 beta (IL-1) and tumor necrosis factor-alpha (TNF). Lipopolysaccharide (LPS) is a component of Gram-negative bacterial cell walls that induces the production of several pro-inflammatory cytokines, including IL-1 and TNF. LPS enhances sleep when administered centrally or systematically. Despite a CMV promoter, mice transgenic for human IL-37 (IL-37tg) do not constitutively express IL-37 but do so in response to LPS.
Methods: IL-37tg mice and C57BL/6 wild-type controls were surgically implanted with electroencephalogram (EEG) and electromyogram electrodes. Sleep responses after saline (0.2 mL, i.p.) and LPS (0.1 μg/0.2 mL saline, i.p.) injections at dark onset were determined. Non-rapid eye movement sleep (NREMS), rapid-eye movement sleep (REMS), waking activity, and NREMS EEG slow-wave activity (SWA)(i.e., 0.5-4.0 Hz frequency range) were determined.
Results: IL-37tg and wild-type mice had similar diurnal rhythms in their durations of NREMS and REMS, and NREMS EEG SWA after saline treatment. In response to LPS, IL-37tg mice exhibited an attenuated NREMS response during the dark period compared to wild-type mice. Further, IL-37tg mice slept less during the subsequent light period after LPS compared to saline. Thus, the amount of NREMS in the 24 h period after LPS injection was less than the amount that occurred after saline. REMS responses after LPS injection were similar to those occurring after saline for both strains. In IL-37tg mice but not the wild-type strain,

NREMS EEG SWA was attenuated after LPS injection compared to that occurring after saline.
Conclusion: The reductions in sleep after LPS in IL-37tg mice support the concept that anti-inflammatory molecules can attenuate sleep induced by pro-inflammatory stimuli. Further, these data, coupled with our findings that IL-37tg mice sleep less after sleep loss, confirms that cytokines play a role in sleep regulation during health or pathology.
Support (If Any): NIH NS025378, NS031453, AI 15414.

0066

EVIDENCE FOR A ROLE OF HISTAMINE IN MOTIVATION-DRIVEN WAKEFULNESS, STUDY USING KNOCK-OUT MOUSE MODELS

Guo R, Anaclet C, Buda C, Franco P, Lin J
Integrative Physiology of Brain Arousal System, CRNL, INSERM-U1028, CNRS UMR5292, UCBL-Lyon1,, Lyon, France

Introduction: Histamine (HA) and orexin neurons in the posterior hypothalamus are both considered as brain wakefulness (W)-promoting systems. In order to study their respective role in promoting W associated with the behavioral context of motivation (i.e., motivation-driven W), we have designed a test of motivation and studied during the test the EEG and sleep-wake amount of histidine-decarboxylase (HDC, HA synthesising enzyme) or orexin knockout (KO) mice and their respective wild type (WT) littermates.
Methods: The mice were chronically implanted for simultaneous EEG and sleep-wake monitoring under baseline conditions (Water and food ad libitum, 12 h light/dark cycle with lights on at 7 a.m.) and following the test of motivation, performed either during lightness or darkness. The test consisted of placing into the mouse barrels a piece of hard nougat and caramel and a grain of corn, suspended at a height difficult to reach for mice. In some mice, a pharmacological treatment with alpha-FMH (specific inhibitor of HDC) was also applied before the test.
Results: We found that in WT animals, placement of the palatable food, either during the lightness or darkness, elicited behavioral activation, manifested as an increase in locomotion and numerous attempts to climb, to catch and to consume the food. As a result, these mice remained highly awake during the period where the food was present (4h or more). HDC KO mice showed deficient performance, manifested as less attempts towards the food and a significant decrease in W compared to that of their littermates. Pretreatment with alpha-FMH (specific inhibitor of HDC) prevented the increase in W faced with the palatable food in WT mice but had no effect on the sleep-wake states in HDC KO mice. Finally, when orexin KO mice were subjected to the same test, they showed slightly enhanced performance compared to their WT counterparts in terms of behavioral activation and induced W.
Conclusion: Our data indicate that HA, but not orexins, is involved in maintaining motivation-driven W that is indispensible for further behavioral performance. These results also further support our hypothesis according to which although both HA and orexins are involved in promoting W, their respective roles are distinct under the different behavioral contexts.
Support (If Any): Study supported by Inserm U628.

0067

MODELING THE FINE TEMPORAL STRUCTURE OF RAPID EYE MOVEMENT SLEEP IN RATS

Diniz Behn C[1], Pal D[2], Booth V[2,3]
[1]Mathematics, Gettysburg College, Gettysburg, PA, USA, [2]Anesthesiology, University of Michigan, Ann Arbor, MI, USA, [3]Mathematics, University of Michigan, Ann Arbor, MI, USA

Introduction: Although much progress has been made in identifying neuronal populations involved in the regulation of rapid eye movement (REM) sleep, dynamic interactions among these populations at a network level are not well understood. To investigate the mechanisms underlying these interactions, we used a mathematical model based on a proposed circuitry for REM sleep regulation to explore the fine temporal structure of REM sleep in rats.
Methods: Electrophysiological sleep-wake recordings were conducted in male Sprague-Dawley rats (n=9). Based on electroencephalogram and electromyogram, we scored 4h of sleep-wake behavior during the light period into wake, non-REM and REM sleep. In order to quantify REM sleep, we calculated standard summary statistics and Kaplan-Meier survival distributions. For survival distributions we established 95% confidence bounds using Kolmogorov-Smirnov K- and S-statistics and evaluated goodness-of-fit to several standard distributions. Next, we constructed a mathematical model of the neuronal network regulating sleep-wake behavior. After fitting the model to experimental data, we analyzed parameter sensitivity and the contributions of deterministic and stochastic mechanisms in the model.
Results: Rats spent 13.19±0.01% of the recording period in REM sleep with 47±8 bouts of REM sleep of mean duration 41.64±7.59s. The goodness-of-fit for REM sleep bouts to the exponential distribution was better than that for the power-law distribution (r^2=0.9755 vs. r^2=0.8011, respectively). Simulated REM sleep data were statistically similar to each measure of experimental data when all stochastic components were included in the model. However, they were significantly altered when these components were omitted.
Conclusion: These data suggest that REM sleep bouts in rats follow an exponential distribution. By implementing key stochastic components in a REM sleep-generating mechanism based on the reciprocal interaction hypothesis, our model replicated this distribution. This theoretical approach provides a novel framework for analyzing the interactions among different neuronal populations for the generation and maintenance of REM sleep.
Support (If Any): This work was supported by AFOSR FA9550-08-1-0111, NIH KL2 RR024987-01, and NSF DMS 1121361.

0068

STRUCTURAL BRAIN MORPHOLOGY OF THE HUMAN PREFRONTAL CORTEX PREDICTS INTER-INDIVIDUAL DIFFERENCES IN NREM SLOW WAVE HOMEOSTASIS

Saletin JM[1,2], van der Helm E[1,2], Walker M[1,2,3]
[1]Sleep and Neuroimaging Laboratory, University of California, Berkeley, Berkeley, CA, USA, [2]Department of Psychology, University of California, Berkeley, Berkeley, CA, USA, [3]Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, USA

Introduction: Slow wave activity (SWA) decreases within individuals across the night; a recognized marker of homeostatic sleep drive (Process S). The decay is strikingly stable and trait-like, representing a "fingerprint" EEG signature within individuals. Despite this stability, the factors accounting for such trait inter-individual differences in Process S remain largely unknown. Using high-resolution MRI, here we demonstrate that structural brain morphology, specifically grey matter density, is one powerful explanatory factor explaining inter-individual variability in SWA homeostasis.
Methods: 19 healthy adults (21.3±2.38, 9-males) independently obtained a night of polysomnography (19-channel-EEG), together with high-resolution structural MRI scans. The time-course of NREM SWA across the night was calculated topographically and inter-individual canonical properties of Process S were modeled using an exponential decay function. Homeostatic parameters and estimated SWA in each quartile were entered into regression models with high-resolution MRI grey matter maps.
Results: Homeostatic decay of SWA was significantly and selectively predicted (R-squared = 0.55) by grey matter in ventral medial and ventral lateral prefrontal cortex. Both these medial prefrontal brain correlates of sleep homeostasis were independent of gender. Analysis of SWA by sleep-quartile revealed that the relationship between SWA and

prefrontal grey matter is not constant across the night, instead varying by sleep-quartile.
Conclusion: Together, these findings demonstrate that the structural morphology of the human brain, specifically in midline prefrontal cortex, is a strong predictor of the known inter-individual variability in NREM SWA homeostasis; relevant since these same regions express congruent developmental changes early in life, and pernicious atrophy later in life. More generally, these findings indicate that analysis of human brain structure, beyond function, represents a potentially powerful explanatory method for understanding differences in sleep physiology, including changes that occur across ontogeny, and in disease states.
Support (If Any): This work was supported by NIH NIA [RO-1AG031164] (MPW) and NSF GRFP (JMS).

0069

BRAINSTEM ACTIVITY AND SLOW WAVES IN HUMAN SLEEP EEG/fMRI

Piantoni G[1], Dang-Vu T[2], Van Der Werf YD[1,3], Maquet P[2], Van Someren EJ[1,4]
[1]Dept. of Sleep and Cognition, Netherlands Institute for Neuroscience, Amsterdam, Netherlands, [2]Cyclotron Research Centre, University of Liège, Liège, Belgium, [3]Dept. of Anatomy and Neurosciences, VU University Medical Center, Amsterdam, Netherlands, [4]Dept. of Integrative Neurophysiology, VU University, Amsterdam, Netherlands

Introduction: Tonic firing in the locus coeruleus, the main source of norepinephrine in the brain, is strongly reduced during sleep. However, previous studies have demonstrated phasic activity of the locus coeruleus time-locked to the slow waves. We propose that phasic activity in the locus coeruleus, due to the anteroposterior gradient of its cortically projecting fibers, might prime the cortex for a preferential propagation of slow waves along the anterior to the posterior axis.
Methods: High-density EEG and fMRI data were recorded in 14 young healthy participants during non-REM sleep. Slow waves were automatically detected using the FASST toolbox and classified according to their direction of propagation on the scalp as traveling either in the anterior-to-posterior or posterior-to-anterior direction. These two event types were included as regressors in an SPM analysis on fMRI BOLD activity, with an inclusive mask around the brainstem.
Results: A circumscribed brainstem area compatible with the locus coeruleus was significantly activated in association with slow waves travelling in the anterior-to-posterior direction (P=0.02), but not significantly with slow waves travelling in the opposite, posterior-to-anterior, direction. A subsequent psychophysiological interaction analysis, measuring the combined effect of anterior-to-posterior slow waves and of the activity in the locus coeruleus over the whole brain, revealed significant fMRI activity in the anterior cingulate cortex and the thalamus bilaterally. These two areas are among the main targets of norepinephrine projections from the locus coeruleus.
Conclusion: Using combined EEG/fMRI sleep recordings, we characterized the preferential response of the locus coeruleus to one subtype of slow wave. We propose that phasic activity in the locus coeruleus biases slow oscillations to travel in the anterior-to-posterior direction. The concurrent action of phasic norepinephrine release and slow wave activity may contribute to memory consolidation during slow wave sleep.

0070

WHITE MATTER DIFFUSION CORRELATES WITH SPINDLES AND SLOW WAVES

Piantoni G[1], Poil S[2], Linkenkaer-Hansen K[2], Van Der Werf YD[1,3], Van Someren EJ[1,2]
[1]Dept. of Sleep and Cognition, Netherlands Institute for Neuroscience, Amsterdam, Netherlands, [2]Dept. of Integrative Neurophysiology, VU University, Amsterdam, Netherlands, [3]Dept. of Anatomy and Neurosciences, VU University Medical Center, Amsterdam, Netherlands

Introduction: Spindles and slow waves (SW), two of the most emblematic features of NREM stage 2 and SW sleep respectively, are dynamic phenomena and can promote widespread synchronization of neuronal activity. Interregional synchronization is influenced by white matter connectivity, which can be quantified in vivo in humans using diffusion tensor imaging (DTI). In the current study, we investigated whether white-matter structural properties are predictive of spindle and SW characteristics.
Methods: Whole-night high-density EEG was recorded from 14 young participants and scored according to standard criteria (AASM, 2007). Spindles and SW were automatically detected during stages NREM2 and slow wave sleep, separately. For each participant, we quantified the mean spindle density (the number of spindles per minute) and energy (power multiplied by spindle duration). Slow waves were described by their density, the mean negative peak amplitude and the mean slope between the negative peak and the following rising zero-crossing. Subsequently, we acquired in the same participants 64 diffusion-weighted images, which were analyzed using FSL. DTI parameters were then correlated with the sleep EEG spindle and SW measures, using tract-based spatial statistics, corrected for multiple comparisons.
Results: During NREM stage 2, higher spindle energy, but not density, positively correlated with higher axial diffusion in the forceps minor, in the inferior longitudinal fasciculi, projecting into the temporal lobe, and in the areas surrounding the thalamus bilaterally, including the corona radiata. During SW sleep, a steeper rising slope of the SW was correlated with higher axial diffusion in the forceps minor, the anterior part of the corpus callosum, the anterior part of the superior longitudinal fasciculus and parts of the corona radiata. There was no significant correlation with either SW density or the mean negative peak amplitude. In a case of double dissociation, none of the spindle parameters significantly correlated with axial diffusion during slow wave sleep, while none of the slow wave parameters correlated with axial diffusion during NREM stage 2.
Conclusion: Higher spindle energy and steeper SW slope correlate with higher diffusion along the fiber tract in two partially overlapping networks. This correlation suggests that the synchronization strength of spindles and SW is influenced and might be partially determined by regionally specific white matter connectivity.

0071

AT THE BOUNDARY OF SLEEP AND AWAKENING: AN fMRI STUDY

Tsai P[1], Liu P[6], Wu Y[4], Chen C[5], Lin C[2], Wu CW[3]
[1]Institute of Brain Science, National Yang-Ming University, Taipei, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan, [3]Graduate Institute of Biomedical Engineering, National Central University, Jhongli, Taiwan, [4]Institute of Nuclear Engineering and Science, National Tsing-Hua University, Hsinchu, Taiwan, [5]Department of Medical Imaging and Radiological Sciences, Kaohsiung Medical University, Kaohsiung, Taiwan, [6]Department of Radiology, Hualien Armed Forces General Hosipital, Hualien, Taiwan

Introduction: Sleep inertia is a transitory period that associates with impaired cognitive and sensorimotor performances after sleep. Previous literature showed neuron metabolism following awakening was lower than those observed in wakefulness, and blood flow in different brain ar-

eas was re-established at different rates. However, this issue was seldom explored from the causal perspective among brain regions. Therefore, using functional connectivity as an index, we aimed at investigating how sleep inertia mediated brain networks in this study.

Methods: Twenty-two healthy male subjects (age: 23.7±4.2 years) were instructed to sleep in an MRI environment between 11pm-4am and scanned by a 3T MRI scanner with 32 channel MR-compatible EEG system. The sleep condition lasted for 125 minutes at most. Two 6-min resting-state measurements were collected before and after sleep, respectively. The EEG data were used for stage scoring, while fMRI data were analyzed using seed-based connectivity analysis, focusing on sensorimotor and hippocampus networks to investigate the sleep inertia effect.

Results: Before sleep, functionally connected regions of sensorimotor network involved bilateral primary motor, supplementary motor area and thalamus, and hippocampus connectivity involved bilateral hippocampi, posterior cingulate cortex (PCC), medial-prefrontal cortex (MPFC) and thalamus. We compared functional connectivity between pre-sleep and awakening conditions and found that cortico-cortical connectivity reduced after awakening within sensorimotor networks, but thalamo-cortical connection became stronger in the same network. However, in hippocampus network, the correlation between bilateral hippocampi did not show difference, but its connection to MPFC and PCC increased significantly upon awakening .

Conclusion: Breakdown of cortico-cortical connection could cause poor performance in sleep inertia. Enhanced thalamo-cortical connection may lead to consciousness recovery. In addition, increased connectivity from limbic system to frontal lobe may be associated with onset of self-awareness.

0072

THE EFFECTS OF TRANSCRANIAL MAGNETIC EXCITATION AND INHIBITION ON VIGILANCE

Mensen A[1,2], Gorban C[1,2], Niklaus M[1,3], Kuske E[1,3], Khatami R[1,2]
[1]Sleep, Clinic Barmelwedi, Barmelweid, Switzerland, [2]Neurology, University of Zurich, Zurich, Switzerland, [3]University of Bern, Bern, Switzerland

Introduction: Previous animal and human research has shown that cortical stimulation using transcranial magnetic and electrical stimulation can affect vigilance levels. Both stimulation and inhibition of the prefrontal cortex using transcranial magnetic stimulation (TMS) have a significant effect on subcortical dopamine levels. In this experiment we examined whether excitation and inhibition of the dorso-lateral prefrontal cortex (DLPFC) could have opposing modulatory effects on vigilance levels.

Methods: 24 healthy participants (17 male), restricted a night of sleep to a maximum of 4 hours prior to the experimental day. We used a a combined MSLT/MWT variant to measure the participants ability to fall asleep or to stay awake. A post-nap Psychomotor Vigilance Test (PVT), assessed sustained vigilance performance. Prior to each nap, continuous or intermittent theta-burst TMS was used to either hyper-excite (10 participants) or inhibit (14 participants), the activity of either the DLPFC or a control region of the occipital cortex (OC).

Results: Mixed design ANOVA analysed the differences between TMS-type and target-site order. A significant effect was found for participants' mean sleep latencies to stage N1 and N2 with stimulation being associated with longer latencies and inhibition showing shorter latencies. TMS also significantly affected total sleep duration with longer sleep duration after inhibition of DLPFC. Reaction times on the PVT were also significantly affected. Some measures showed a significant modulation with time of stimulation.

Conclusion: Neuronavigation-guided TMS excitation and inhibition of the DLPFC can have significant opposing effects on participants` ability to fall and remain asleep during a daytime nap test and modulate participants` post nap performance reaction time during a sustained vigilance test. These effects may be mediated by TMS induced subcortical dopamine release.

0073

DAMAGE TO HYPOTHALAMIC AROUSAL SYSTEMS WITH TRAUMATIC BRAIN INJURY

Valko P[1,2], Baumann CR[2], Finn K[1], Reddy H[3], Haybaeck J[4], Weis S[5], Scammell TE[1]
[1]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Neurology, University Hospital of Zurich, Zurich, Switzerland, [3]Neuropathology, Beth Israel Deaconess Medical Center, Boston, MA, USA, [4]Neuropathology, Institute of Pathology, Medical University of Graz, Graz, Austria, [5]Neuropathology, State Neuropsychiatric Hospital Wagner-Jauregg, Linz, Austria

Introduction: Daytime sleepiness, hypersomnia and fatigue are frequent, disabling and persistent problems after traumatic brain injury (TBI). Much research has focused on how TBI injures the cortex and rostral midbrain, but a small pilot study suggested that TBI can directly injure the hypocretin neurons. We hypothesized that TBI injures the hypocretin neurons and other arousal systems in the hypothalamus, contributing to the symptoms encountered in patients with TBI.

Methods: We immunostained the hypothalami of 5 patients with fatal TBI and 9 controls without TBI or other neurological disorders for hypocretin-1, melanin-concentrating hormone (MCH) and histidine decarboxylase (HDC, a marker of the histaminergic neurons of the tuberomammillary nucleus). We used antigen retrieval techniques prior to immunostaining for MCH and HDC. Using stereologic cell counting, we measured the number of immunopositive neurons using Stereo Investigator (MBF Biosciences, Willston, VT).

Results: Mean age was 77 ± 11 for TBI subjects and 69 ± 13 years for controls ($p = 0.30$). TBI patients died 7 to 85 days after severe head trauma. Compared to controls, TBI patients showed a 27% reduction of hypocretin-1 neurons (47,423 ± 11,023 vs. 61,731 ± 11,532, $p = 0.05$). MCH neurons were reduced by 27% (60,982 ± 9,910 vs. 83,822 ± 14,124, $p = 0.005$). Preliminary cell counts in 2 TBI patients and 2 controls suggest a similar (45%) reduction of histamine neurons (67,637 ± 2,885 vs. 122,206 ± 13,647, $p = 0.03$).

Conclusion: Very little prior research has examined the hypothalamus after TBI, but our findings demonstrate that severe TBI injures several types of hypothalamic neurons that play important roles in the regulation of wake and sleep. Moderate loss of hypocretin and histamine signaling may contribute to the sleepiness and hypersomnia common after TBI, and loss of the MCH neurons may affect REM sleep or reward mechanisms.

Support (If Any): The study is supported by the Swiss National Science Foundation, No. 32003B_125504.

0074

NEUROTRANSMITTER CONTENT IN SUPRACHIASMATIC NUCLEI CORRELATES WITH DEGREE OF FRACTAL CONTROL OF ACTIVITY

Hu K[1], Harper DG[2], Shea SA[1], Stopa EG[3], Scheer FA[1]
[1]Division of Sleep Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA, [2]Department of Psychiatry, McLean Hospital, Harvard Medical School, Belmont, MA, USA, [3]Department of Pathology, Brown University School of Medicine, Providence, RI, USA

Introduction: Human motor activity exhibits fractal fluctuations with similar temporal structure and statistical properties over a wide range of time scales. This fractal control is independent of environmental influences but is reduced with aging, in Alzheimer's disease (AD), and in animals after lesioning the suprachiasmatic nucleus (SCN). Because SCN dysfunction occurs with aging and AD, we hypothesized that the

degree of SCN dysfunction correlates with the degree of disturbed fractal activity control.
Methods: We analyzed antemortem actigraphy records and postmortem SCN immunocytochemistry data from 20 dementia subjects (61-79 years old; 15 with AD). The mean (±SE) latency from activity recordings to death was 0.5±0.1 years. The degree of SCN dysfunction was estimated from the number of vasopressin-positive (10.1±0.5) and neurotensin-positive (7.0±0.5) SCN neurons (two primary SCN neurotransmitters in humans). Detrended fluctuation analysis (DFA) of actigraphy records was used to quantify fractal activity control across time scales from 0.5-12 h.
Results: Activity fluctuations in dementia patients possess different fractal correlation properties in two different time scale regions (Region I: <120 minutes; and Region II: >120 minutes) which corroborates our previous AD results. Compared to Region I, activity fluctuations in Region II became more random as characterized by the decrease in a DFA-derived exponent that quantifies the correlation property in activity fluctuations ($p<0.0001$). Notably, patients with a greater degree of the SCN dysfunction (i.e., fewer neuronal counts) had a greater reduction in correlation properties in Region II (vasopressin: $p<0.003$; and neurotensin: $p<0.02$). There were no significant correlations between activity fractal patterns and subjects' ages at times of actigraphy recording or at death.
Conclusion: The degree of SCN dysfunction in dementia correlates with the degree of disturbed fractal activity control in dementia, suggesting that the SCN is important for fractal patterns of activity.
Support (If Any): This research was supported by National Institutes of Health grants K99HL102241, K24-HL76446, and P30-HL101299.

0075

DEFINING NEURAL STATE USING GLOBAL MEASURES OF BRAIN DYNAMICS

Zempel J[2], Politte D[1], Kelsey M[1], Verner R[1,3], Nolan TS[1], Babajani-Feremi A[4], Prior F[1], Larson-Prior L[1]
[1]Radiology, Washington University, St. Louis, MO, USA, [2]Neurology, Washington University, St. Louis, MO, USA, [3]Biomedical Engineering, Washington University, St. Louis, MO, USA, [4]Anatomy and Neurobiology, Washington University, St. Louis, MO, USA

Introduction: Like many complex dynamic systems the brain exhibits scale-free dynamics that follow power law scaling. Broad-band power spectral density of brain electrical behavior exhibits state-dependent power law scaling with a log frequency exponent that varies across frequency domains. In this study, we present results on the ability of this measure to reliably distinguish differences in neural state represented by awake and slow wave sleep EEG.
Methods: Electrocorticography data were obtained over several days in six subjects (2 male, ages 9-17) undergoing invasive monitoring for the surgical treatment of intractable epilepsy. For two sets of artifact free, single state data (5 min/segment in wake, N2 and N3 sleep) the power spectral density (PSD) was calculated in 30-sec non-overlapping intervals for each sensor then averaged across sensors to obtain a global measure of brain spectral power in each state. Two analytic methods were evaluated for their ability to reliably discriminate between states using scale-free dynamics.
Results: Examination of broad-band PSDs across subjects showed that a 4-segment piecewise log-linear approximation provided the most reasonable least-error fit to the data. A Multivariate Maximum Likelihood Analysis of segment slopes shows that the second fitted line segment produced the best state discrimination, exhibiting an average 0.86 steeper negative slope from wake to sleep. An analysis carried out over a continuous 2 hour period containing multiple state changes revealed significant fluctuation in the initial two frequency segments reflective of brain up/down state changes. Additionally, the frequency range that maximally discriminated state was identified using a targeted Minimum Error State Discriminator. This complementary analysis reliably differentiated wake, N2 and N3 sleep states.
Conclusion: An initial step toward methods validation indicates that we can accurately classify neural state as wake, N2 or SWS sleep based on the global dynamics of the brain as assessed by the log PSD.
Support (If Any): McDonnell Center for Systems Neuroscience (LLP).

0076

SUBSTRATES OF CORTICAL ACTIVATION: INTERACTIONS BETWEEN CHOLINERGIC AND GABAERGIC NEURONS IN THE MOUSE BASAL FOREBRAIN

Brown RE[1], McKenna JT[1], Yang C[1], Yanagawa Y[2,3], McCarley RW[1]
[1]Psychiatry/Division of Sleep Medicine, VA Boston Healthcare System/Harvard Medical School, Brockton, MA, USA, [2]Genetic and Behavioral Neuroscience, Gunma University Graduate School of Medicine, Maebashi, Japan, [3]Japan Science and Technology Agency, CREST, Sanbacho, Chiyado-ku, Tokyo, Japan

Introduction: The basal forebrain (BF) constitutes a vital cortical activating system. Currently little is known about the interaction of the cholinergic and GABAergic components of this system, in particular cortically projecting GABAergic neurons containing the calcium binding protein, parvalbumin (PV). Here we study these interactions using neuroanatomical and electrophysiological techniques.
Methods: Immunohistochemistry and electrophysiology were performed in GAD67-GFP knock-in mice. BF was immunohistochemically stained for choline acetyltransferase (ChAT, cholinergic neurons), PV and/or vesicular acetylcholine transporter (VAChT). For electrophysiology, coronal brain slices were prepared from young (14-22 d) mice. Whole-cell patch-clamp recordings were made using a Multiclamp 700B amplifier. The cholinergic agonist, carbachol, was bath-applied.
Results: The majority of PV neurons in the horizontal limb of the diagonal band and magnocellular preoptic nucleus were GFP+ in GAD67-GFP knock-in mice. PV neurons were located in two clusters, a medial cluster, close to the cholinergic neurons in the horizontal limb of the diagonal band and a lateral cluster in the magnocellular preoptic area where cholinergic input from the brainstem terminates. GFP(GABAergic)-PV-positive BF neurons were surrounded by VAChT staining indicating cholinergic inputs. Large, GFP+ neurons with the size, shape and intrinsic membrane properties identical to identified PV+ neurons, responded to carbachol (50 μM) with a significant increase in spontaneous firing frequency which was blocked by either the M1 muscarinic receptor antagonist pirenzepine dihydrochloride (10 μM) or the M3 muscarinic receptor antagonist 4-DAMP (3 μM). Under voltage-clamp, carbachol induced an inward current which reversal potential measurements and ion substitution experiments suggested was mainly due to opening of sodium-permeable cation channels. Carbachol also significantly increased the frequency and amplitudes of spontaneous EPSCs and sIPSCs.
Conclusion: The increased firing of cortically projecting, PV-Positive, BF GABAergic neurons during waking and REM sleep may be mediated by input from neighboring basal forebrain and/or brainstem cholinergic neurons.
Support (If Any): VA Merit award (RWM), NIH MH039683 (RWM), NIH R21 MH094803 (REB), Grants-in-Aids for Scientific Research from MEXT Japan (YY).

0077

OPPOSING EFFECTS OF OREXIN AND DYNORPHIN ON BASAL FOREBRAIN CHOLINERGIC NEURONS - WHOLE-CELL RECORDINGS IN MICE

Ferrari L, Iqbal SZ, Mochizuki T, Yamamoto M, Scammell TE, Arrigoni E
Neurology, Beth Israel Deaconess Medical Center, Harvard Med. Sch., Boston, MA, USA

Introduction: The orexin neurons play a crucial role in promoting arousal and maintaining wakefulness. Loss of the orexin neurons produces narcolepsy, with chronic sleepiness and dysregulation of REM sleep. The basal forebrain is heavily innervated by the orexin neurons and may be a key region through which the orexin neurons promote cortical activation. All orexin-producing neurons also make the endogenous opiate dynorphin which seems paradoxical as orexins excite and dynorphin inhibits target neurons. We studied the effects of orexin-A and dynorphin-A on cholinergic neurons of the substantia innominata (SI).
Methods: We recorded from SI neurons in mouse brain slices from wild-type (WT) mice and from mice lacking the Ox1R and Ox2R receptors. We identified SI cholinergic neurons in vivo by injecting fluorescent antibodies against the p75-receptors (Cy3-p75-IgG) into the lateral ventricle. One to three days later, we prepared SI slices and targeted red-labeled neurons that had internalized Cy3-p75-IgG.
Results: Orexin-A directly excited SI cholinergic neurons and presynaptically increased the glutamatergic input to these neurons. The effect of orexin-A on the glutamatergic input was reduced in both the Ox1R and Ox2R KO mice compared to WT mice, indicating that orexin-A excites these cells through both Ox1 and Ox2 receptors. In contrast, dynorphin-A directly inhibited SI cholinergic neurons and decreased the glutamatergic input to these cells by a presynaptic mechanism. We also observed that the effect of dynorphin desensitized upon repeated applications.
Conclusion: These findings demonstrate that orexin excites whereas dynorphin inhibits SI cholinergic neurons. Both orexin and dynorphin act directly on these neurons and act indirectly by affecting the glutamatergic input that they received. The response to dynorphin desensitizes quickly, suggesting that when the orexin neurons fire, the SI cholinergic neurons may first be inhibited by dynorphin, but over time, the excitatory effects of orexin may have a greater influence.
Support (If Any): NHLBI (1P01HL095491) and NINDS (1RO-1NS061863).

0078

PARVALBUMIN-POSITIVE BASAL FOREBRAIN NEURONS ENTRAIN CORTICAL GAMMA OSCILLATIONS AND PROMOTE WAKEFULNESS

Kim T[1], McKenna JT[1], McNally JM[1], Chen L[1], Kocsis B[2], Deisseroth K[3], Strecker RE[1], McCarley RW[1], Brown RE[1], Basheer R[1]
[1]Department of psychiatry, VA Boston Healthcare System & Harvard Medical School, Boston, MA, USA, [2]Psychiatry, Beth Israel Deaconess Hospital, Boston, MA, USA, [3]Psychiatry & Behavioral Sciences, Stanford Unviversity, Stanford, MA, USA

Introduction: The basal forebrain (BF) modulates cortical activity across sleep-wake cycles via cortically projecting cholinergic and non-cholinergic neurons. Among non-cholinergic neurons in BF, parvalbumin (PARV)-containing, gamma-aminobutyric acid (GABA)-ergic neurons are an important component. PARV neurons project to cortical interneurons and the firing rate of PARV neurons increases during electroencephalographic (EEG) low-voltage fast activity. However, their precise contribution to cortical activation and sleep-wake regulation is not well understood. Therefore, we hypothesize that selective activation of BF PARV neurons will induce cortical EEG activation and promote wakefulness.
Methods: To target channelrhodopsins (ChR2) selectively to BF PARV neurons, adeno-associated viral vectors with double-floxed ChR2-eYFP were injected stereotactically into the BF of transgenic mice expressing Cre recombinase under the control of the PARV promoter (PARV-Cre mice). To evaluate the effect of activation of BF PARV neurons on the EEG, opto-stimulations were delivered to the BF (473nm, 2 to 60Hz). The impact of one hour of optical stimulation (5s light pulse trains at 40 Hz, every 60s) on sleep-wake behavior was also investigated.
Results: Immunohistochemistry confirmed high levels of double labeling of ChR2-eYFP (green) and PARV (red) indicating selective expression of ChR2-eYFP in BF PARV neurons. BF entrainment of the cortical EEG was pronounced when the BF stimulation was in the gamma frequency range, particularly at 40Hz, and could be reproducibly elicited over the course of 1h of stimulation. Notably 20Hz stimulation evoked a robust 40Hz harmonic resonance. In preliminary data, the sleep-wake behavior was altered by optical stimulation, increasing wakefulness from ~9% to ~45 % and decreasing NREM sleep from ~75% to ~44%.
Conclusion: We believe this PARV-specific elicitation of cortical gamma oscillations may represent an important mechanism of BF-mediated cortical EEG activation. We conclude that optogenetic stimulation of PARV-positive BF neurons entrains cortical rhythms, particularly in the gamma range, and enhances wakefulness.
Support (If Any): Dept of Veterans Affairs, HL095451, MH039683.

0079

DESCENDING PROJECTIONS FROM THE BASAL FOREBRAIN TO THE OREXIN NEURONS

Agostinelli LJ[1], Yamamoto M[1], Lowell BB[2], Fuller PM[1], Scammell TE[1]
[1]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Neurons of the basal forebrain (BF) project to the cortex to promote cortical activation and behavioral arousal, but they also have descending projections back to the orexin neurons and to other arousal regions. These descending projections from the BF to the orexin neurons may be an important feedback loop to regulate orexin neuron activity.
Methods: We used a novel cre-lox anatomic technique to map the innervation of the orexin neurons by the three major populations of BF neurons. Using lines of mice that express Cre recombinase selectively in GABA, glutamate, or acetylcholine (ACh) neurons, we microinjected the BF with an adeno-associated viral vector (AAV) coding for Cre-dependent green fluorescent protein (GFP). Four weeks later, we mapped the injection sites and descending projections. To confirm that the injections were limited to the BF and to the correct cell type, we double labeled sections for GFP and ChAT, vGlutT2 or vGAT. Then, we mapped the innervation of the orexin neurons using double immunostaining for GFP and orexin.
Results: This method produced robust and selective anterograde labeling in GABA, glutamate, or ACh BF neurons. While the cholinergic innervation of the orexin neurons was modest, innervation by GABAergic and glutamatergic BF neurons was much more intense.
Conclusion: These descending projections from the basal forebrain may play an important role in regulating the activity of the orexin neurons.
Support (If Any): Support: NINDS/R01 NS055367, NHLBI/P01 HL095491 and NINDS/R01 NS073613.

0080

OREXIN SIGNALING IN THE BASAL FOREBRAIN PROMOTES EEG ACTIVATION AND WAKEFULNESS

Alexandre C, Mochizuki T, Arrigoni E
Neurology, Beth Israel Deaconess Medical Center & Harvard Medical School, Boston, MA, USA

Introduction: Lack of orexin signaling produces excessive sleepiness, marked sleep-wake fragmentation, and reduced locomotor activity. Currently, little is known about the neuronal pathways through which

orexins activate the cortex and maintain wakefulness. We propose that orexins promote EEG activation and wakefulness by exciting basal forebrain neurons, especially those of the substantia inominata (SI) that project to and activate the cortex. We tested whether focal rescue of both orexin receptors in the SI improves the sleepiness of mice otherwise lacking orexin receptors.

Methods: Experiments were conducted using mice in which the orexin receptor genes (Ox1/2R) are preceded by transcriptional disruptor (TD) sequences that prevent expression of functional orexin receptors. These blocking sequences are flanked by loxP sites, and exposure to Cre recombinase deletes the disruptor sequences and normalizes receptor expression. In the absence of Cre recombinase, these mutant mice lack normal Ox1/2R mRNAs and proteins and show behavioral state instability, sleepiness, and decreased locomotor activity compared to WT littermates. To induce focal expression of orexin receptors in the basal forebrain, we bilaterally microinjected an adeno-associated viral vector (AAV8) coding for Cre into the SI of male Ox1/2R TD mice. Other Ox1/2R TD mice received injections of an AAV8 coding for a fluorescent protein (mCherry) as negative (sleepy) controls, and WT mice served as positive (alert) controls. All mice were instrumented for EEG/EMG recordings.

Results: Microinjections of AAV-Cre into the SI increased wake amounts and improved wake maintenance as reflected in longer wake bouts during the dark period, compared to the AAV-mCherry controls. However, locomotor activity remained low in AAV-Cre injected animals.

Conclusion: These findings demonstrate that orexin signaling through the basal forebrain helps drive the cortical activation of wakefulness, but it is insufficient to elicit wake-related behaviors associated with high locomotor activity (such as exploration, foraging, grooming, etc).

Support (If Any): Supported by NIH grant HL095491.

0081

HIGH-FAT DIET IMPAIRS SLEEP QUALITY AND PREPRO-OREXIN MRNA EXPRESSION IN MICE

Terao A, Tanno S, Okamatsu-Ogura Y, Kimura K
Laboratory of Biochemistry, Graduate School of Veterinary Mediceine, Hokkaido University, Sapporo, Japan

Introduction: Numerous studies indicate that obesity is often associated with sleep disorders, including sleep apnea syndrome, excessive daytime sleepiness, and insomnia. Since there is a possible link between sleep and obesity, it is important to understand the nature of physiological and molecular mechanisms that coordinate sleep-wake regulation and metabolic function. Orexins (or hypocretins) are neuropeptides with important hypothalamic roles including sleep-wake regulation and metabolic function. Therefore, in this study, we examined the mRNA expression of prepro-orexin, orexin receptor type 1 and 2 in the hypothalamus and sleep-wake in parallel with high-fat diet (HFD)-induced obesity mice.

Methods: Twenty-four male C57BL/6J mice at the age of 4 weeks were randomly divided into three groups (n=8/group), which were given 1) High-fat diet (HFD) or 2) normal diet for 14 weeks, or 3) normal diet for 7 weeks and HFD for the subsequent 7 weeks. At the age of 18 weeks, mice were chronically implanted with EEG and EMG electrodes for polysomnographic recording of sleep-wake states. The vigilance states were automatically classified by SleepSign ver.3 software. After the sleep recording, all animals were weighed and sacrificed by cervical dislocation. Brains were immediately removed and the hypothalamus was dissected. The mRNA expression of prepro-orexin, orexin receptor type 1 and 2 in the hypothalamus were examined by real-time quantitative PCR.

Results: The body weight of mice fed with HFD scattered between 112-150% of the average body weight of the control group. The daily amount of wakefulness was decreased but that of non-rapid eye movement (NREM) sleep was increased in diet-induced obesity mice. These changes were accompanied by the decrease in both the number and duration of each episode. Rapid eye movement (REM) sleep was not altered. Body weight was negatively correlated with the amount of wakefulness but positively correlated with that of NREM sleep. The expression of prepro-orexin was significantly decreased in obese mice, while that of orexin receptor type 1 and 2 were unaffected. The expression of prepro-orexin was positively correlated with the amount of wakefulness but negatively correlated with that of NREM sleep.

Conclusion: These results indicate that obese animals have increased NREM sleep pressure and difficulties in maintaining NREM sleep and wakefulness concomitant with the impairment of orexin system.

Support (If Any): This work was supported by Grants-in-Aid for scientific research from the Japan Society for the Promotion of Science and Kao Foundation.

0082

RESPECTIVE ROLE OF OREXIN-1 AND OREXIN-2 RECEPTORS IN THE EFFECTS OF A DUAL OX1/2R ANTAGONIST ON SLEEP

Dugovic C, Yun S, Shelton J, Bonaventure P, Shireman B, Lovenberg T
Neuroscience, Janssen Research & Development, San Diego, CA, USA

Introduction: In accordance with the prominent role of orexins in the maintenance of wakefulness via activation of orexin-1 (OX1R) and orexin-2 (OX2R) receptors, various dual OX1/2R antagonists have been shown to promote sleep. We have demonstrated that blockade of OX2R is sufficient to initiate and prolong sleep, and that simultaneous blockade of OX1R attenuates the NREM but enhances the REM sleep promoting effects of a selective OX2R antagonist in rats. The relative contribution of each orexin receptor to the sleep effects induced by a dual OX1/2R antagonist was further investigated in mice deficient for either the OX1R or the OX2R.

Methods: Four separate groups of mice (OX1R KO and WT; OX2R KO and WT) and a group of rats were implanted with telemetric devices for recording EEG/EMG signals, locomotor activity and body temperature. All animals were orally dosed with a dual OX1/2R antagonist (compound A, 30 mg/kg) or vehicle at dark onset and sleep-wake parameters were analyzed during the 12-h dark phase.

Results: The OX1/2R antagonist reduced the time to sleep onset and increased NREM and REM sleep duration during the first 6 h following the treatment in both WT and OX1R KO mice. In contrast, the compound did not produce any sleep-promoting effect in OX2R KO mice, but induced REM intrusion episodes (direct wake to REM transition, DREM). As expected in rats, compound A was effective in promoting NREM and REM sleep. However, the rats showed an abnormally elevated REM/TS ratio and episodes of near immediate wake to REM transition (pre-DREM).

Conclusion: The data indicate that sleep patterns can be differently affected by simultaneous transient (pharmacological) and permanent (knockout) inhibition of either OX1R or OX2R, and further demonstrate the risk of REM intrusion with dual OX1/2R antagonists. These results reinforce the view that selective OX2R antagonists are more suitable for the treatment of insomnia.

0083

EFFECTS OF CORTICOTROPIN RELEASING FACTOR ON SLEEP HOMEOSTATIC RESPONSE AND FOS EXPRESSION IN THE PREOPTIC HYPOTHALAMUS

Gvilia I[1,2,4], Hsieh K[1], Angara B[1], McGinty DJ[1,3], Szymusiak RS[1,2]
[1]Research Service, Veterans Affairs Greater Los Angeles Healthcare System, North Hills, California, CA, USA, [2]Medicine, University of California, Los Angeles, Los Angeles, CA, USA, [3]Psychology, University of California, Los Angeles, Los Angeles, CA, USA, [4]Ilia State University, Tbilisi, Georgia

Introduction: Corticotropin releasing factor (CRF) has a sleep-suppressing effect. We evaluated the hypothesis that suppression of sleep by CRF is mediated through interactions with preoptic sleep-active neurons.
Methods: In Experiment 1, rats were subjected to 2h sleep deprivation (SD) followed by either intracerebroventricular (icv) administration of CRF (0.5µg/3µl, n=6) or saline (n=6). All rats were then allowed 90 min undisturbed sleep, followed by euthanasia and cardiac perfusion. Brain sections cut through the median preoptic nucleus (MnPN) and ventrolateral preoptic area (VLPO) were processed for immunostaining for c-Fos protein and glutamic acid decarboxylase (GAD). In Experiment 2, retrograde tracer injections were placed in the MnPN and VLPO and double-labeling of CRF and tracers was performed in various brain regions.
Results: CRF-treated rats spent significantly less time in both non-REM sleep (28.8±5.5% vs. 54.7±7.9%) and REM sleep (3.7±1.2% vs. 11.1±2.0%) during post-SD recovery, compared to control rats. Also, CRF-treated versus control rats exhibited significantly lower numbers of MnPN Fos+/GAD+ cells (in rostral MnPN: 26.8±3.6 vs. 41.3±4.8; in caudal MnPN: 11.3±1.5 vs. 26±3.7) in the condition of post-SD recovery sleep, whereas Fos+/GAD+ cell counts for VLPO sites did not change significantly, compared to vehicle. Single Fos+ cell counts in both the MnPN and VLPO were significantly increased in CRF-treated versus control rats (in rostral MnPN: 125.2±15.3 vs. 47.3±2.1; in caudal MnPN: 82.2±7.8 vs. 32.5±3.8; in VLPO cluster: 19.2±0.6 vs. 14.2±1.1; in extended VLPO: 45.5±5.6 vs. 23.7±4.3). Retrogradely-labeled CRF neurons were found in the central and medial amygdaloid nuclei, and dorsomedial and ventromedial hypothalamic nuclei.
Conclusion: Our findings suggest that icv CRF injection (1) suppresses Fos expression in MnPN GABAergic neurons and (2) activates MnPN and VLPO nonGABAergic neurons. The changes in preoptic neuronal activity may contribute to CRF-induced suppression of post-SD recovery sleep.
Support (If Any): Supported by the Department of Veterans Affairs and NIH Grant MH63323.

0084

EFFECTS OF ESTROGEN ON FOOD ANTICIPATORY ACTIVITY IN FEMALE MICE

Gerona A[1], Thomas S[1], Pfaff D[2], Ribeiro A[1,2]
[1]Division of Natural Sciences, College of Mount Saint Vincent, Bronx, NY, USA, [2]Neurobiology and Behavior, The Rockefeller University, New York, NY, USA

Introduction: Introduction: The ability of animals to perceive and properly respond to restrictively available food is paramount for survival. The extra demands placed on a female to ensure proper nutrition for herself, and her offspring, make this phenomenon critical for the survival of the species. When food availability, in the wild, or in a laboratory setting, is temporally restricted, mice quickly adjust their circadian rhythms of activity to coincide with the time when food is available. We hypothesize that increased levels of estrogens will be lead to a heightened food anticipatory response in females. To test this hypothesis, baseline running wheel activity and running wheel activity in response to a timed meal were evaluated in ovariectomized mice treated with oil or varying doses of estradiol benzoate (EB), and in males.
Methods: Behavioral Analysis: 48 female ovariectomized mice were implanted with EB (0.125, 1.25 or 50 µg) or oil (control) capsules, and were placed in running wheels under a 12:12h light-dark cycle for 2 weeks, with food and water available ad libitum. Male mice were also used as controls. Following this 2-week period, food availability was gradually decreased to 4h starting at dark onset. Data were analyzed using unpaired t-tests.
Results: Treatment of ovariectomized females with EB significantly increased running wheel activity, from 5387 ± 1294 in oil to 7699 ± 1831 in 0.125 EB mice, confirming that estrogens are involved in promoting arousal. FAA was elevated in all female groups, compared to males, with 0.125 and 50 ug EB being the most effective doses.
Conclusion: The present findings suggest that in addition to increasing voluntary motor activity, EB is also involved in increasing activity in anticipation of a meal. These changes may represent specific evolutionarily adaptive mate- and food-seeking behaviors that accompany hormonal fluctuations in female mice.
Support (If Any): NHLBI F32HL086018.

0085

INTRACEREBROVENTRICULAR INJECTION OF GHRELIN INCREASES WAKEFULNESS IN MICE

Szentirmai
[1]WWAMI Medical Education Program, Washington State University, Spokane, WA, USA, [2]Department of Veterinary and Comparative Anatomy, Physiology and Pharmacology, Washington State University, Pullman, WA, USA, [3]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA

Introduction: In the brain, ghrelinergic mechanisms play a fundamental role in the regulation of feeding and arousal. Arousal responses to food deprivation and novel environment are attenuated in ghrelin receptor knockout mice. Central administration of ghrelin elicits robust increases in wakefulness and feeding in rats. In the present study, we tested the effects of central and systemic administration of ghrelin on sleep-wake activity in a second species, in mice.
Methods: Groups of mice (n= 6, each) received intracerebroventricular injection of isotonic NaCl on the baseline day and 0.2 µg, 1 µg or 5 µg ghrelin on the experimental day. Injections were carried out 10-15 minutes before light onset and sleep-wake activity was recorded for 23 hours. A separate group of mice were injected subcutaneously with NaCl on the baseline day and with 100 or 400 µg/kg of ghrelin on the treatment day. Injections were performed 3 h after light onset and sleep-wake activity, body temperature and locomotor activity were recorded for 12 hours. 2-h food intake was also measured after the systemic injections.
Results: Intracerebroventricular administration of ghrelin elicited dose-dependent increases in wakefulness in the first h after injection. The amount of wakefulness was significantly increased by 29.6 ± 10.4 min, 42 ± 5.6 and 18.5 ± 5.2 min after 0.2, 1 and 5 µg ghrelin, respectively. Changes in the amount of NREMS mirrored that of the wakefulness. REMS was suppressed for 3 h after each dose of ghrelin. Systemic administration of ghrelin increased 2-h food intake but had no effect on body temperature, activity or sleep.
Conclusion: Results are in agreement with the hypothesis that central but not peripheral ghrelinergic mechanisms play a key role in arousal regulation in mice.
Support (If Any): Faculty Seed Grant to Éva Szentirmai awarded by Washington State University.

0086

HYPOTHALAMIC AND MIDBRAIN TARGETS FOR THE AROUSAL- AND FEEDING-STIMULATING EFFECTS OF GHRELIN

Kapas L[1,2,3], Szentirmai [1,2,3]
[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Department of Veterinary and Comparative Anatomy, Physiology and Pharmacology, Washington State University, Pullman, WA, USA, [3]Sleep and Performance Research Center, Washington State University, Washington State University, Spokane, WA, USA

Introduction: Ghrelin signaling is a key component of the brain arousal system. Arousal mechanisms and the integration of thermoregulation and sleep-wake activity are impaired in mice with defective ghrelin signaling. Exogenous administration of ghrelin elicits robust arousal responses in rats. In the present study, we tested the hypothesis that the activation of ghrelin-sensitive mechanisms in the ventromedial hypothalamus (VMH) and the ventral tegmental area (VTA) is sufficient for the wake- and feeding-promoting actions of ghrelin.
Methods: In male rats, sleep-wake activity, body temperature and behavioral activity were recorded for 24 h on the baseline day after vehicle microinjection (100 nl). On the test day, the animals received bilateral injections of 0.2 or 1 μg ghrelin into the VHM or 1 μg ghrelin into the VTA (n = 7-8 per dose). Recordings continued for 24 h after the treatments. One-hour food intake was also measured after the treatments.
Results: Intra-VMH microinjection of ghrelin elicited dose-dependent increases in wakefulness and feeding. In the first 3 h after the injection of the higher dose, the amount of wakefulness increased by ~50% (71.9 ± 9.4 and 104.4 ± 4.7 min, baseline vs. ghrelin, respectively). Increases in locomotor activity paralleled the sleep changes and body temperature was slightly elevated. Food intake increased by ~ 300%, from the baseline of 2.1 ± 0.8 to 6.4 ± 0.9 g/kg body weight. Intra-VTA microinjection of ghrelin elicited similar wake- and feeding-promoting effects. Wakefulness increased from 86.4 ± 7.4 to 110.2 ± 7.3 min and food intake from 1.85 ± 0.9 to 9.23 ± 1.0 g/kg (baseline vs. ghrelin, respectively).
Conclusion: These results are consistent with the hypothesis that ghrelin receptive mechanisms play a key role in the arousal system. In addition to hypothalamic targets, ghrelin is likely to activate the mesolimbic dopamine pathways to induce wakefulness and feeding.
Support (If Any): Faculty Seed Grants to Levente Kapás and Éva Szentirmai awarded by Washington State University.

0087

VIRAL INDUCTION OF CHEMOKINES AND MODULATION OF SLEEP AND TEMPERATURE

Ambrozewicz MA[1], Yang L[1], Breving K[2], Wellman LL[1], Ciavarra RP[2], Sanford LD[1]
[1]Pathology & Anatomy, Eastern Virginia Medical School, Norfolk, VA, USA, [2]Microbiology and Molecular Cell Biology, Eastern Virginia Medical School, Norfolk, VA, USA

Introduction: Intranasal administration of Vesicular Stomatitis Virus (VSV) in mice produces viral encephalitis and significantly alters sleep likely through inductions of chemokines and cytokines. In this study we assayed chemokines and cytokines induced by VSV across the acute and recovery phases of infection and we tested two highly expressed chemokines (CCL7 and CXCL10) for potential effects on sleep and temperature.
Methods: Groups of mice were infected intranasally with a dosage of VSV that produces encephalitis and euthanized at post-infection days 0,1,3,5,7,14 and 28 (PI 0-28). Brains were collected for determining global responses using PCR and protein arrays. On PI 7, when viral encephalitis is fully manifested, select brain regions were analyzed with PCR arrays. Other mice were implanted with transmitters for recording sleep and core body temperature by telemetry and with a guide cannula aimed into a lateral ventricle. After recovery from the surgery and habituation to handling, ICV microinjections of CCL7, CXCL10 (20 and 100 ng) or vehicle alone were administered and sleep and body temperature were recorded for 10 hours.
Results: Global mRNA levels for CCL7 and CXCL10 increased steadily from PI 0 until PI 5 and PI 7, respectively, and then dropped to pre-infection levels at PI 28. Protein levels closely mimicked changes in mRNA. On PI 7, mRNAs for both chemokines were highly expressed in the hypothalamus and dorsal pons, and CXCL10 was also highly expressed in the amygdala and basal forebrain. Both doses of CCL7 increased amount and number of episodes of rapid eye movement sleep (REM) during the first 5 hours after injection, but did not alter temperature. The high dosage of CXCL10 produced a short-term increase in REM amount and increased REM episode duration compared to the low dosage and vehicle. The low dosage of CXCL10 increased temperature.
Conclusion: These data suggest that CCL7 and CXCL10 are significant mediators of sleep and temperature over the course of VSV infection.
Support (If Any): NR11519 and MH061716.

0088

SLEEP AND ACTIVITY DURING VIRAL EENCEPHALITIS IN C57BL/6J MICE

Ambrozewicz MA[1], Breving K[2], Wellman LL[1], Yang L[1], Ciavarra RP[2], Sanford LD[1]
[1]Pathology & Anatomy, Eastern Virginia Medical School, Norfolk, VA, USA, [2]Microbiology and Molecular Cell Biology, Eastern Virginia Medical School, Norfolk, VA, USA

Introduction: Intranasal application of Vesicular Stomatitis Virus (VSV) produces a well characterized model of viral encephalitis in mice. Within two 2 days post-infection (PI), VSV travels to the olfactory bulb and over the course of 7 days it infects regions and tracts extending into the brainstem followed by clearance and recovery in most mice by PI day 14. Infectious diseases are commonly accompanied by excessive sleepiness and sleep may be considered a component of the acute phase response to infection. In this project we studied the relationship between sleep and activity after VSV infection in C57Bl/6J mice.
Methods: Mice were implanted with transmitters for recording sleep and activity by telemetry. After recovery from surgery, baseline sleep was recorded, and afterwards the mice were infected intranasally with a low dose of VSV (5 x 104 PFU). Sleep was recorded for 15 consecutive days and analyzed during baseline and on PI days 0,1,3,5,7,10, and 14 (PI 0-14).
Results: Compared to baseline, amounts of rapid eye movement sleep (REM) were significantly reduced during the light periods of PI 0-14. By comparison, amounts of non-rapid eye movement sleep (NREM) were increased during the dark period of PI 1-5. Total activity was reduced on PI 1-14 compared to baseline and PI 0 and there was a reduction in amount of active wakefulness from PI 1-14.
Conclusion: These data indicate that VSV can begin impacting sleep before virus progresses into the olfactory bulb and well before signs of encephalitis begin to manifest. Alterations in sleep likely involve early inductions of chemokines and cytokines which have been implicated in regulating sleep.
Support (If Any): NR11519 and MH061716.

0089

UP-REGULATION OF GROWTH HORMONE RELEASING HORMONE RECEPTOR AND PATHOGEN PATTERN RECOGNITION RECEPTORS MRNAS IN THE OLFACTORY BULB PRECEDE VIRAL-INDUCED SLEEP RESPONSES

Taishi P[1,2], Zielinski M[1,2], Clinton JM[1,2], Krueger JM[1,2]
[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA

Introduction: Influenza is a respiratory virus that induces a number of cytokines during the acute phase response. The mouse-adapted strain of the human A/PR/834 (PR8) influenza virus invades the mouse olfactory bulb (OB) within 4h of intranasal in¬fection, up regulates OB pro-inflammatory cytokines and enhances sleep for several days in normal mice. In contrast, mice lacking a functional growth hormone release hormone receptor (GHRHR) sleep less, rather than more, after influenza infection and are more morbid than infected normal mice. In this study, we investigated whether PR8 infection changes the expression of GHRHR mRNA in the OB and hypothalamus (HT) along with expression of pathogen recognition receptors that recognize viral double-stranded RNA, Toll-like receptor 3 (TLR3), retinoic acid-inducible gene I (RIG-1), and melanoma differentiation-associated gene 5 (MDA5).
Methods: Adult male C57BL/6J mice were infected intranasally with either live PR8 (2.5 x 10^6 TCID 50) or heat-inactivated virus that served as negative controls. Mice were housed on a 12:12 light-dark cycle and were given food and water ad libitum. Mice were sacrificed 15h post-inoculation, brains dissected, and OBs and HTs collected, snap frozen in liquid nitrogen, and stored at -80oC. Tissues were processed and GHRHR, TLR3, RIG-1, and MDA5 mRNA expressions were quantified with RT-PCR.
Results: RIG-1 and MDA5 mRNAs were enhanced about 4 fold while and GHRHR mRNA was up-regulated about 2-fold in the OB in mice infected with live PR8 compared to controls. GHRHR mRNA expression also increased in the HT of mice that were given live PR8 compared to controls. RIG-1 and MDA5 mRNA levels in the HT were similar between mice given live PR8 and controls. There was no change in TLR3 expression in either OB or HT.
Conclusion: These results suggest a protective role for OB and HT GHRHR following viral infection.
Support (If Any): NIH HD036520 to JMK.

0090

INTERLEUKIN-37 TRANSGENIC MICE ARE RESISTANT TO SLEEP DEPRIVATION-INDUCED IMPAIRMENT OF NOVELTY RECOGNITION

Clinton JM[1,2,3], Davis CJ[1,2,3], Krueger JM[1,2,3]
[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA, [3]Graduate Neuroscience Program, Washington State University, Spokane, WA, USA

Introduction: Interleukin-37b (IL37) is an inhibitor of pro-inflammatory cytokines in vivo and in vitro. Some of these pro-inflammatory cytokines are involved in sleep regulation as well as cognition. We previously showed that transgenic mice expressing human IL37 (IL37tg) have an attenuated sleep rebound with decreased sleep following 6h of sleep deprivation. We sought to determine whether this sleep deprivation resistant phenotype influences performance on a novelty recognition task using a protocol known to be sensitive to sleep deprivation.
Methods: Male adult mice (10-12 weeks) IL37tg and C57BL/6N wild-type controls (which naturally lack IL37) were tested on the novel object recognition task, a single trial, non-reinforced memory task which exploits rodents' tendency to preferentially explore a novel object. Following training with two identical objects, mice were either sleep deprived for 6h or allowed to sleep spontaneously. Twenty-four h after training mice were tested with one familiar object and one novel object. Behavior was recorded and scored offline for object exploration time and locomotor activity (LMA).
Results: Both strains of mice were able to correctly discriminate between the novel and familiar objects following a 24h delay as indicated by increased exploration of the novel object. When subjected to 6h of sleep deprivation post-training, IL37tg mice, but not wild-type mice, maintained the ability to discriminate between novel and familiar objects. This protection was not the result of differences in object exploration or LMA during training in mice subsequently sleep deprived. The IL37tg mice exhibited more total LMA and negative thigmotaxis suggesting reduced anxiety or a tendency for enhanced exploration.
Conclusion: IL37tg mice are resistant to deficits in recognition memory caused by 6h of sleep deprivation after training and with a 24h delay. This resistance may be conveyed by the attenuation of pro-inflammatory cytokines which become elevated during extended wakefulness.
Support (If Any): NS25378/NS31453 to JMK.

0091

ARE TUBEROMAMMILLARY HISTAMINE NEURONS GABAERGIC?

Mochizuki T[1], Oishi Y[1], Yamamoto M[1], Vong L[2], Lowell BB[2], Scammell TE[1]
[1]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Histamine neurons play an essential role in the regulation of wakefulness. These neurons reside only in the tuberomammillary nucleus (TMN) and are immunoreactive for glutamic acid decarboxylase (GAD) and GABA, suggesting they may co-release GABA. This would be remarkable as histamine has generally excitatory effects on postsynaptic neurons and GABA is inhibitory. To determine whether histamine neurons use GABA as a neurotransmitter, we examined expression of the vesicular GABA transporter (VGAT), a molecule necessary for packaging GABA into synaptic vesicles.
Methods: We immunostained wild type mouse brain sections for histidine decarboxylase (HDC), the enzyme that converts histidine into histamine. We also used in situ hybridization to examine expression of GAD or VGAT mRNA in TMN neurons. We then studied VGAT immunoreactivity in mice expressing GFP in GABAergic neurons (Vgat-ires-Cre knockin mice crossed with lox-GFP reporter mice).
Results: In wild type mice, all TMN neurons contained GAD mRNA, but surprisingly, none of them had VGAT mRNA. In VGAT-Cre-GFP-reporter mice, the TMN had a normal appearance, but none of the histamine neurons contained GFP.
Conclusion: Though they have long been thought to signal using GABA, TMN neurons in mice lack VGAT, suggesting that in these cells, GABA is not packaged into synaptic vesicles and cannot function as a neurotransmitter. Possibly, GABA is imported into synaptic vesicles by an unknown VGAT, but we know of no research suggesting one exists. More likely, GAD and GABA in the TMN neurons have non-synaptic functions.
Support (If Any): NINDS/R01 NS055367 and NHLBI/P01 HL095491.

0092

LOCOMOTION- AND STATE-DEPENDENT ACTIVITY OF LATERAL PONTINE TEGMENTUM NEURONS: A PUTATIVE NEUROANATOMIC SUBSTRATE FOR THE MESENCEPHALIC LOCOMOTOR REGION (MLR)

Thankachan S[1,2], Fuller PM[1], Lu J[1]
[1]Neurology, Beth Israel Deaconess Medical Center & Harvard Medical School, Boston, MA, USA, [2]Psychiatry, Harvard Medical School & VA Boston Healthcare System, Brockton, MA, USA

Introduction: Shik and colleagues first demonstrated in 1966 that electrical stimulation of the midbrain pontine reticular formation, including

the lateral pontine tegmentum (LPT) area, induced fictive locomotion in decerebrate cats. This supraspinal motor network was subsequently termed the "mesencephalic locomotor region" (MLR). To date, however, the precise neuroanatomical location and neurochemical composition of the MLR neurons that control locomotion and postural muscle tone remains unresolved. In the present study, we have employed a retrograde tracing method in combination with single unit recordings to identify candidate pontine MLR neurons (i.e., spinally-projecting) as well as characterized the locomotor- and behavioral state-dependent activities of LPT neurons, including presumptive MLR neurons.

Methods: Male Sprague-Dawley rats were implanted with electrodes to record sleep-wake behavior and a microwire assembly to record single neurons from the MLR. A bipolar stimulation electrode was implanted in the spinal cord at the level of C8-T1. Rats (n=4) were injected with cholera toxin B subunit (CTb) in the spinal ventral horn at the C8-T1 level.

Results: Our retrograde CTb-based labeling revealed a group of non-cholinergic neurons, lying just medial to the PPT, which we predict form the neuroanatomic basis of the MLR. 54 recorded neurons from this area were classified into three groups based on their antidromic response to spinal cord stimulation: 1). spinally-projecting neurons (12/17) that were antidromically activated to spinal cord stimulation; 2). non-spinally projecting neurons (25/37) that did not show an antidromic response; and 3). neurons (7/37) that showed a delayed response/orthodromic activation (i.e., presumably receiving spinal projections). We found that the preponderance of these presumptive MLR neurons that were also spinally projecting exhibited burst firing (phasic) activity that correlated with motor behaviors and that some of these neurons were also active during REM sleep. The non spinally-projecting neurons exhibited slow tonic firing (<2 Hz) during AW/REM sleep or only active during REM sleep (REM active/ REM-on), while others exhibited a phenotype of phasic firing activity during REM sleep.

Conclusion: In summary, the present study indicates that non-cholinergic, spinally-projecting neurons of the LPT may comprise the long-sought neuroanatomic MLR.

Support (If Any): Supported by NS062727, NS061841, NS073613 and NS051609.

0093

THE EFFECTS OF CARBACHOL, NOREPHINEPHRINE, AND SEROTONIN ON THE GLUTAMATERGIC NEURONS OF THE SUBLATERODORSAL NUCLEUS

Williams RH, Iqbal SZ, Saper C, Arrigoni E
Neurology, BIDMC & Harvard Medical School, Boston, MA, USA

Introduction: Brain circuits promote muscle atonia during REM sleep. Deficits in REM atonia precipitate REM sleep behavior disorder, characterized by violent dream re-enactment, self-injury, and sleep disruption. The pontine sublateral nucleus (SLD) is critical for generating muscle atonia during REM sleep. It comprises glutamatergic, spinally-projecting SLD neurons (SLDsp) that synapse onto GABA/glycinergic interneurons in the ventral horn of the spinal cord. In rats, neurotoxic SLD lesions reduce REM sleep, while application of the cholinergic agonist carbachol induces a REM-like state. Further, mouse SLDsp neurons are directly activated by carbachol application. These data implicate that integration of cholinergic and glutamatergic signaling activates REM-atonia circuitry.

Methods: As SLDsp neurons are hypothesized to be glutamatergic, we performed whole-cell recordings of SLD cells from Vglut2-GFP mice. In these mice green fluorescent protein (GFP) is expressed in glutamatergic neurons containing the vesicular glutamate transporter 2 (Vglut2). To compare the GFP-positive SLD cells with SLDsp neurons we prepared another cohort of Vglut2-GFP and WT mice which had been injected with retrogradely-tracing fluorescent microspheres into the ventral horn. Comparisons between the underlying electrophysiological fingerprints and responses to carbachol (15 μM), and monoamines (norepinephrine; 100 μM and serotonin; 100 μM) were tested.

Results: Similar to WT SLDsp neurons, carbachol excited glutamatergic GFP-positive SLD neurons by activation of a large inward current. In addition, we found two populations of glutamatergic GFP-positive SLD neurons excited by carbachol: one excited and one inhibited by monoamines.

Conclusion: Carbachol excited glutamatergic SLD neurons comparable to SLDsp neurons. This suggests muscle atonia produced during carbachol-induced REM sleep could be generated by the activation of the SLDsp as well as other glutamatergic SLD neurons. Cells excited by carbachol displayed differing responses to monamines, suggesting there might be two different circuitries within the SLD.

Support (If Any): NINDS (1RO1NS061863) and NINDS Administrative Supplements NS061863-01A1S3.

0094

EXPOSURE TO AN ACUTE PSYCHOSOCIAL STRESSOR TRIGGERS REM SLEEP DISINHIBITION IN A RODENT MODEL OF DEPRESSION

Cano G, Gulrajani S, Breslin KB, Negrin IV, Sved A
Neuroscience, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Insomnia is frequently comorbid with depression and it is one of its diagnostic criteria. REM sleep disinhibition is a distinctive feature of insomnia comorbid with depression, but not of primary insomnia. To explore the link between insomnia and depression, we combined a rodent model of depression with exposure to an acute psychosocial stressor known to induce transient insomnia in rats.

Methods: Rats were exposed to chronic unpredictable mild stress (CMS) for 4 weeks, a paradigm known to induce depression signs in rodents, followed by exposure to a novel acute psychosocial stressor (dirty cage exchange). EEG/EMG activity (24 hour) was recorded at baseline, weekly, and after cage exchange. Rats were subjected to several tests to assess depressive-like behavior: sucrose preference test (anhedonia), open field test (anxiety), and novelty suppressed feeding test (spontaneous motivation).

Results: Sleep architecture after CMS was slightly altered, mainly in the dark phase where fragmentation was pronounced. In the light phase, there was a tendency to increased wakefulness and decreased nREM sleep. Nevertheless, these rats displayed depression-like behavior (increased anhedonia and anxiety, and less spontaneous motivation). Exposure to the acute stressor elicited a pattern of sleep disturbances characterized by the emergence of REM disinhibition (increased % and bouts of REM sleep) and pronounced fragmentation. REM disinhibition was absent in chronically-stressed rats placed in a clean cage (control) and in non-stressed rats exposed to the acute stressor, suggesting that exposure to the acute stressor specifically unmasks underlying REM sleep perturbations in chronically-stressed ("depressed") rats.

Conclusion: REM sleep disinhibition, a characteristic feature of insomnia comorbid with depression, was triggered by acute stress in rats that displayed depression-like behavior induced by CMS, suggesting that combining CMS with the acute psychosocial stressor might be a useful novel model to further explore the neurobiological mechanisms underlying the comorbidity between insomnia and depression.

Support (If Any): HOPE for Depression Foundation Grant # RGA-10-004.

0095

GABA LEVELS IN THE ORAL PONTINE RETICULAR FORMATION (PNO) OF C57BL/6J MOUSE ARE INCREASED BY NEOSTIGMINE

Shatsman A, Watson CJ, Norton CC, Lydic R, Baghdoyan HA
Anesthesiology, University of Michigan, Ann Arbor, MI, USA

Introduction: Interactions between GABAergic and cholinergic transmission in the PnO contribute to the generation of wakefulness and REM sleep (J Neurosci 31:2649, 2011; Neuroscience 156:1, 2008). GABAergic transmission in the PnO promotes wakefulness and inhibits both acetylcholine release in the PnO and REM sleep (J Neurosci 30:12301, 2010). Cholinergic transmission in the PnO promotes REM sleep and activates the EEG (Anesthesiology 103:1268, 2005). The effects of acetylcholine in the PnO on GABA levels in the PnO have not been reported. This study is testing the hypothesis that the acetylcholinesterase inhibitor neostigmine alters GABA levels in the PnO.
Methods: Adult male mice (n=13) were anesthetized with isoflurane and a microdialysis probe was aimed for the PnO. Study 1 determined the time needed for GABA levels to stabilize after placing a probe into the PnO and dialyzing with Ringer's. Study 2 determined the effect of acetylcholine on GABA levels by collecting samples sequentially during dialysis with Ringer's (pre-drug control), Ringer's containing neostigmine bromide (100 μM), and Ringer's. GABA levels were quantified by HPLC-EC. Each mouse was used for one experiment. Histological analysis determined whether 50% or more of the dialysis membrane was in the PnO. Measures of GABA were analyzed using linear regression and repeated-measures ANOVA.
Results: Study 1: GABA levels stabilized 35 min after probe insertion into the PnO (n=5 experiments). Study 2: Neostigmine delivered to the PnO significantly (P=0.007) increased (31%) GABA levels in the PnO (n=5 experiments). Neostigmine did not alter GABA levels during experiments (n=3) in which < 50% of the dialysis membrane was in the PnO.
Conclusion: Increasing acetylcholine in the PnO increases GABA levels in the PnO. These new data from mice support and extend evidence showing that increasing either acetylcholine (Anesthesiology 103:1268, 2005) or GABA (Neuroscience 144:375, 2007) in the PnO activates the EEG.
Support (If Any): National Institutes of Health Grants MH45361, HL65272, HL40881, and the Department of Anesthesiology.

0096

GABAA RECEPTORS IMPLICATED IN REM SLEEP CONTROL EXPRESS A BENZODIAZEPINE BINDING SITE

Marks GA[1,2], Nguyen T[1,2], Liang C[1,2]
[1]Research, Dallas VA Med Ctr, Dallas, TX, USA, [2]Psychiatry, UT Southwestern Med Ctr, Dallas, TX, USA

Introduction: The caudal, oral pontine reticular formation (PnOc) of rat is a site in which local injection of GABAa receptor antagonists result in a long-lasting increase in REM sleep. A mechanism by which antagonizing GABA disinhibits acetylcholine (ACh) release is supported by several findings including: local microdialysis of bicuculine stimulated ACh release; gabazine induction of REM sleep blocked by atropine; and gamma2 GABAa receptor subunit immunoreactivity found in cholinergic terminals in PnOc. The disinhibition of ACh release would result in the well-documented muscarinic receptor-mediated induction of REM sleep. The interface between the gamma2 and certain alpha subunits form the benzodiazepine (BZ) binding site. To test whether the GABAa receptor subtype subserving REM sleep induction expresses a BZ binding site, we injected a BZ inverse agonist into PnOc.
Methods: Rats were surgically prepared for chronic sleep recording and additionally implanted with guide cannulae aimed at sites in the PnOc. After recovery, animals received multiple injections at each site, seven-days apart, with 60 nl of drug solution within one-half-hour before lights-out. Vehicle-controls, non selective, GABAa antagonist, gabazine (GZ, SR95531, 0.1 mM) and BZ inverse agonist DMCM (1, 10, 100 mM) were injected into PnOc. In vitro studies have shown DMCM (0.001mM) to increase IC50 for GABA four-fold, indicating antagonism of GABA's action.
Results: Compared to mean control values, both GZ and DMCM resulted in statistically significant elevations in time in REM sleep for the eight-hours following injection into PnOc. The increase was due to greater episode frequency and not duration of individual REM periods. The dose-response relationship for DMCM was an inverted "U" with the 10 mM dose yielding the greatest increase in REM sleep.
Conclusion: The GABAa receptor subtype in PnOc mediating control of REM sleep expresses a BZ binding site. This may be the mechanism by which BZ-agonist hypnotics reduce REM sleep.
Support (If Any): VA Merit Review and NIH Grant RO1 MH57434.

0097

SELECTIVE BLOCKADE OF NR2B SUBUNIT CONTAINING NMDA RECEPTORS LEADS TO STATE-DEPENDENT ENHANCEMENT OF GAMMA OSCILLATIONS DURING REM SLEEP

Kocsis B
Psychiatry/BIMDC, Harvard Medical School, Boston, MA, USA

Introduction: NMDA receptor antagonists elicit strong, lasting, aberrant gamma oscillations, replicated by preferential blockade of the receptors containing the NR2A subunit, whereas antagonists acting on NR2B receptors were ineffective. Lack of steady gamma hyperactivity, however, did not rule out a positive effect of NR2B blockade limited to short events, states, or behaviors when gamma normally occur. To test this possibility, we analyzed the effect of NMDA antagonists on gamma activity in different vigilant states.
Methods: Six rats were implanted with chronic EEG and EMG electrodes. Electrophysiological recordings started early morning and lasted 10-24 hours. After 4 hr control recording, one of the following compounds were injected: non-selective NMDA-R antagonists ketamine (10 mg/kg) and MK801 (0.2 mg/kg), NR2A-preferring antagonist NVP-AAM077 (20 mg/kg), NR2B-selective antagonist Ro25-6985 (10 mg s/c), and vehicle. Gamma oscillations were assessed in frontal cortex EEG using the average 30-50Hz spectral power during REM sleep, active waking, and quiet waking and slow wave sleep.
Results: Average gamma power was highest in REM sleep, less in active waking, and further decreased in quiet waking and slow wave sleep. NR2B receptor blockade did not disrupt the normal sleep-wake cycle but increased gamma power in REM sleep by 37±10% (p=0.01) with no effect in other states (p=0.38 and p=0.83). The effect had a short onset (<1 hr) and lasted for 12-16 hrs. Strong REM sleep-associated gamma enhancement appeared after MK-801 (100±8%; p<0.001) and NVP-AAM077 (46±5%; p<0.001) injections, as well, >4 hr post-injection, i.e. after the primary gamma elevation started to cease, the performance on gating improved, and the periodic alternation of sleep-wake states returned. Ketamine did not have such a delayed effect on gamma level during REM.
Conclusion: By acting on gamma oscillations in a state-dependent manner, NMDA receptors might have subunit-specific role in REM sleep-associated cognitive processes.
Support (If Any): MH87777, MH83199, Novartis.

0098

SELECTIVE ANTEROGRADE TRACING OF PONTINE CHOLINERGIC NEURONS IN MICE

Yamamoto M[1], Alexandre C[1], Lowell BB[2], Scammell TE[1]
[1]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Cholinergic neurons of the pons play key roles in the control of REM sleep and wake, and most attention has focused on the pedunculopontine (PPT) and laterodorsal tegmental (LDT) nuclei. These two nuclei are often considered together as the source of cholinergic signaling from the pons, but prior research suggests important anatomic differences in the projections of the LDT and PPT. In addition, the pons contains other less appreciated cholinergic populations such as neurons in the lateral parabrachial nucleus (PB) that may also contribute to the control of sleep/wake states.
Methods: We microinjected a Cre-dependent AAV expressing green or red fluorescent protein into the pons of mice that express Cre only in cholinergic neurons. These protein were expressed only in cholinergic neurons.
Results: Small injections into the LDT, PPT, and lateral PB produced partially overlapping but often distinct patterns of anterograde labeling. Both the PPT and LDT innervated midline thalamic nuclei and the periaqueductal gray. In the lateral and posterior hypothalamus, injections into the LDT produced more anterograde labeling than PPT injections. Fibers from the LDT (but not the PPT) labeled a small number of fibers and terminals in the lateral septum, vertical and horizontal limbs of the diagonal band, paraventricular and supraoptic nuclei, lateral habenula, and sublateral dorsal nucleus. Injections into the lateral PB heavily innervated a different set of targets, including the central nucleus of the amygdala and laterodorsal subnucleus of the bed nucleus of stria terminalis.
Conclusion: These observations demonstrate that cholinergic neurons in the pons of mice project to many of the same targets as reported in rats, but these cell groups have distinct patterns of projections that may be more distinct than previously appreciated. Future physiological studies will need to focus more on selective manipulations of each cholinergic population as they likely regulate distinct aspects of sleep/wake behavior.
Support (If Any): NIH NS055367 and HL095491.

0099

LC OPTOGENETIC STIMULATION INCREASES REM PHASIC EVENTS

Poe GR[1,2], Priestley J[1], Kim J[1], Bauer D[1]
[1]Anesthesiology, Univ Michigan, Ann Arbor, MI, MI, USA, [2]Molecular and Integrative Physiology, University of Michigan, Ann Arbor, MI, USA

Introduction: Prominent characteristics of post-traumatic stress disorder (PTSD) include vivid veritical dreaming, increased myoclonic movements, and high noradrenergic tone. The locus coeruleus (LC) noradrenergic cells normally cease firing during REM sleep and prior to each non-REM spindle. We tested the hypothesis that abnormally high noradrenergic tone would contribute to the abnormally high phasic REM sleep events seen in those suffering from PTSD and suppress spindles since noradrenaline suppresses thalamic spindle generation.
Methods: During surgery we injected 1.5 microliters of lentivirus PSRx8-Channel rhodopsin-mCherry promoter targeting TH positive cells bilaterally into the LC in 4 adult male Long Evans rats. Two bilateral fiber optics attached to high powered blue LED lights were implanted into the LC and EEG and EMG electrodes were placed for sleep assessment. After recovery, rats were adapted to the sleep/wake recording setup. On the experimental day the LC was stimulated at 2 Hz (20 ms/stim) during non-REM sleep. Stimulation frequency was increased until the animal reliably aroused from non-REM sleep. Then, during a random subset of sleep periods for ~6 h the LC was activated at sub arousal threshold levels (from 2-4 Hz). Sleep state, spindle frequency, REM theta and EMG power, and phasic movements were assessed.
Results: We found that sub-arousal threshold LC stimulation increased REM myoclonic twitches 3.7 fold ($p = 0.03$, t-test), increasing EMG levels 13, 43, 112, and 1024%. Theta power was decreased by an average of 22% ($p = 0.05$, t-test), consistent with phasic REM events. The number of non-REM sleep spindles was reduced by 66% ($p = 0.0001$, t-test). As in humans with PTSD, the duration and frequency of REM sleep did not change with LC activation.
Conclusion: We found that abnormally high noradrenergic tone during sleep is sufficient to cause PTSD sleep symptoms. Future studies will examine noradrenergic tone in reactivation and extinction of traumatic memories.
Support (If Any): MH60670 and Department of Anesthesiology.

0100

VIRAL-VECTOR MEDIATED GENETIC MANIPULATION OF AN AROUSAL PATHWAY IN THE RAT

Gompf H, Bass C, Fuller PM
BIDMC-Neurology, Harvard Medical School, Boston, MA, USA

Introduction: Much of our current understanding of the neural circuitry regulating sleep and wake has been obtained from studies using the rat model. Despite their predictive value, rats have one substantial drawback, their genetics are resistant to manipulation making it difficult to study how specific neuronal populations and pathways affect sleep-wake behaviors. Therefore we sought to develop a viral vector system that achieves subtype and pathway specific genetic manipulation in rats. We targeted the established Locus Coerleus-Anterior Cingulate Cortex (LC-ACC) arousal circuit to determine the effects of these manipulations on arsoual/waking amounts.
Methods: Rats received intracranial injections of different AAVs and were implanted with EEG/EMG units. Sleep and wakefulness were recorded during a baseline period and then again following injection of ligand. The different AAVs used and in varying combinations included: 1) AAV-10 expressing Cre under the tyrosine hydroxylase (TH) promoter, co-injected with the AAV-FLEX-M3-DREADD viral vector in the LC; 2) AAV-WGA-Cre injected into the ACC and AAV-FLEX-M3-DREADD into the LC; and 3) AAV-WGA-Cre into the LC and AAV-FLEX-M3-DREAD into the ACC.
Results: Experiment 1: Expression of Cre and M3-DREADD was largely restricted to TH-expressing LC neurons. Bolus agonist administration (CNO, ip, 0.3 mg/kg) at the beginning of the rest phase produced a 91.96 ± 5.1 % wakefulness during the subsequent 6 hours as compared to 31.9 ± 5.7 % following saline injections. Robust Fos expression was noted in the LC and throughout the cortex following a second CNO injection. Experiment 2: Cre immunohistorchemistry in the ACC and LC indicated successful WGA-mediated Cre transport. Cre-mediated M3-DREADD receptor expression was also confirmed in the LC. 86.4 ± 8.7 % wakefulness and 61.8 ± 12.3 % wakefulness was recording for the first 2 and 4 hours, respectively, following CNO injection, whereas 22.4 ± 5.8 % wakefulness was recorded following saline. Experiment 3: Cre-labeled neurons were found in the ACC and following CNO injection an increase in wakefulness (67.15 ± 11.2 %) relative to saline injections (31.93 ± 5.66 %) was observed.
Conclusion: Viral mediated genetic manipulation of an established neural arousal pathway provides a hitherto unexplored mechanism for overcoming the limited genetic tractability of the rat model.

0101

YAWNING FREQUENCY IS CORRELATED WITH REDUCED MEDIAL THALAMIC VOLUME

Kipman M[1], Schwab ZJ[1], Weber M[1,2], DelDonno S[1], Killgore WD[1,2]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Although yawning is a universal human experience, its purpose and neurobiological mechanisms remain poorly understood. Some evidence suggests that yawns may occur to reduce cerebral temperature, to increase oxygen intake, or to communicate empathy. Little structural neuroimaging evidence exists to link brain morphology to yawning, but some evidence suggests that patients with lesions to the center-median nucleus of the thalamus show an unusual tendency to yawn when hyperventilating. Here we used voxel-based morphometry (VBM) to explore the link between yawning tendency and gray matter volume.
Methods: Thirty-six healthy participants aged 18 to 45 (20 males) rated their normal frequency of yawning on a scale from 1 (never yawn) to 10 (always yawning) followed by structural magnetic resonance imaging (MRI) at 3T. Structural T1-weighted neuroimaging data were preprocessed using the VBM toolbox in SPM8, including DARTEL-normalization to MNI space, tissue segmentation, and spatially smoothing with an 8mm FWHM Gaussian kernel. Yawning frequency was then entered as a covariate of interest, with age and gender as nuisance covariates, and modulated gray matter volumes as the dependent variable. Data were evaluated at a threshold of $p<.001$, uncorrected, with an empirically defined extent threshold of $k>72$ voxels, based on the statistically expected number of voxels per cluster.
Results: Yawning frequency was negatively correlated with a single cluster (99 voxels) gray matter in the right posterior dorsomedial thalamus. No other regions were positively or negatively correlated with yawning frequency.
Conclusion: Self-reported yawning frequency was associated with reduced gray matter volume within the posterior medial thalamus, even after controlling for age and sex. As yawning is a poorly understood phenomenon, these preliminary findings raise the possibility that yawning may be related to arousal systems mediated by the medial or central nuclei of the thalamus.

0102

RESISTANCE TO INSUFFICIENT SLEEP CORRELATES WITH OLFACTORY CORTEX GRAY MATTER

DelDonno S[1], Weber M[1,2], Kipman M[1], Schwab ZJ[1], Killgore WD[1,2]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Some evidence suggests that resistance to the cognitively degrading effects of sleep deprivation is partially related to prefrontal functioning and executive control. We have previously demonstrated that individuals with greater baseline olfactory identification capacities, a putative index of orbitofrontal cortex integrity, are better able to resist sleep deprivation up to three consecutive days when compared to individuals with poorer ability to discriminate and identify various smells. We hypothesized that individuals with greater self-reported resistance to sleep deprivation would have greater volume of the olfactory region of the orbitofrontal cortex using voxel-based morphometry (VBM).
Methods: Thirty-six healthy participants aged 18 to 45 (20 males) were queried about the threshold of sleep restriction that leads to a noticeable impairment in the ability to function at work (impairment threshold). Structural T1-weighted magnetic resonance images (MRI) were collected at 3T and analyzed using the SPM8 VBM toolbox. Images were DARTEL-normalized, segmented, and spatially smoothed (8mm FWHM). Impairment thresholds were correlated with gray matter volume in the olfactory cortex, using a small volume correction, $p<.05$, FWE for height and extent thresholds.
Results: The self-reported impairment threshold ranged from 2 to 10 hours of minimal sleep necessary to avoid work impairments (M=5.4, SD = 1.4). As hypothesized, gray matter volume in the olfactory cortex was significantly negatively correlated with the impairment threshold, but this was only significant on the right side.
Conclusion: Larger gray matter volume in the right olfactory cortex, an area of the posterior orbitofrontal cortex, was associated with a greater self-reported ability to function effectively despite minimal amounts of sleep. Findings support the notion that prefrontal cortex integrity, including the olfactory cortex, confers some resistance to the degrading effects of sleep loss. Future research could examine the relationship between gray matter volume in this region and resistance to sleep loss under a controlled experimental environment.

0103

GRAY MATTER CORRELATES OF SELF-REPORTED SLEEP DURATION

Weber M[1,2], DelDonno S[1], Kipman M[1], Schwab ZJ[1], Killgore WD[1,2]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: While the National Sleep Foundation recommends that most healthy individuals obtain between 7 to 8 hours of sleep per night, evidence suggests that most people do not routinely obtain the sleep they need. Furthermore, some people seem to need more sleep than others to maintain similar levels of daytime performance. It is currently not known how typical sleep duration is related to structural differences in brain morphology. Here we examined the correlation between self-reported average sleep duration and gray matter volume using voxel-based morphometry (VBM) in healthy individuals.
Methods: Thirty-six healthy participants aged 18 to 45 (20 males) completed a questionnaire about their sleep habits and then underwent structural magnetic resonance imaging (MRI) at 3T. Data were preprocessed using the SPM8 VBM toolbox. Structural T1-weighted images were DARTEL-normalized to MNI space, tissue segmented, and spatially smoothed with an 8mm FWHM Gaussian kernel. Modulated images were used to provide an estimate of voxelwise grey matter volume. Self-reported sleep during the week and during weekends were combined as a weighted average and entered as the covariate of interest to predict gray matter volume, while gender and age were entered as nuisance covariates. Data were evaluated at a threshold of $p<.001$, uncorrected, $k>100$ voxels.
Results: Average nighttime sleep was positively correlated with gray matter volume in bilateral insular cortices (Left 121 voxels; MNI coordinates x=-45, y=-1, z=-6; Right 418 voxels; MNI coordinates x=33, y=-4, z=4). No regions were negatively correlated with average sleep.
Conclusion: Greater self-reported average nightly sleep was associated with greater gray matter volume in the insular cortex bilaterally. This region is associated with integration of somatosensory and visceral sensations with emotional and motivational processes. Because these data are correlational, further research will be necessary to determine whether sleep duration leads to gray matter changes or whether gray matter volume affects sleep duration.

0104

GREATER NOCTURNAL SLEEP TIME IS ASSOCIATED WITH INCREASED DEFAULT MODE FUNCTIONAL CONNECTIVITY

Killgore WD[1,2], Schwab ZJ[1], DelDonno S[1], Kipman M[1], Weber M[1,2], Rauch SL[1]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Sleep deprivation is associated with reduced cerebral metabolic activity, particularly within medial regions of the brain commonly associated with the default mode network. Recent evidence suggests that sleep deprivation also reduces the functional connectivity between the medial prefrontal cortex and the amygdala during emotional processing, possibly explaining some of the mood and emotional changes often associated with sleep loss. Here we examine the correlation between cerebral functional connectivity and the amount of sleep obtained the night preceding the neuroimaging scan among healthy volunteers who slept at home according to their own schedules.
Methods: Thirty-nine healthy individuals (ages 18-45, M = 30.4, SD = 8.7; 21 female) completed a questionnaire asking about their recent sleep habits. Participants underwent resting state functional magnetic resonance imaging (fMRI) for 6 minutes at 3T. Data were preprocessed in SPM8, including slice-time correction, segmentation, realignment, normalization, and spatial smoothing (6mm FWHM). The Functional Connectivity Toolbox (CONN) was used to regress out tissue- and movement-related nuisance covariates and to calculate seed-to-voxel and region-of-interest (ROI) to ROI random effects connectivity analyses. Analyses were corrected for multiple comparisons, $p<.05$, FDR.
Results: Self-reported at home sleep ranged from 5.5 to 9 hours (M=7.4, SD = 0.84). More sleep was associated with significantly enhanced functional connectivity between the medial prefrontal cortex and dorsal posterior cingulate cortex, retrospenial cingulate, amygdalo-hippocampal region, and dorsal prefrontal cortex. Sleep was associated with greater positive connectivity between the posterior cingulate region and anterior prefrontal cortex, anterior cingulate, and medial prefrontal region, and greater anticorrelation with associative visual cortex.
Conclusion: Participants who obtained more sleep at home the night preceding their scan showed significantly enhanced functional connectivity among a network of structures involved in self-reflection, emotional control, and memory processing. The effect of this enhanced functional connectivity on cognitive performance and mood remains to be explored.

0105

GREY MATTER CORRELATES OF DAYTIME SLEEPINESS

Weber M[1,2], DelDonno S[1], Kipman M[1], Schwab ZJ[1], Killgore WD[1,2]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Sleep deprivation has been associated with reduced glucose metabolism within the prefrontal cortex in healthy individuals. Within many of these same regions of the prefrontal cortex, grey matter volume appears to be reduced among patients with narcolepsy, obstructive sleep apnea, and chronic insomnia. It is, therefore, possible that prefrontal grey matter volume may be affected by chronic sleep loss or, conversely, may contribute to symptoms of sleep disorders. There are currently no data on grey matter correlates of daytime sleepiness in healthy individuals. Using voxel-based morphometry (VBM), we investigated the association between self-reported daytime sleepiness and grey matter volume. Based on the findings from experimental sleep deprivation and clinical findings, we hypothesized that daytime sleepiness would be associated with reduced grey matter volume in the prefrontal cortex.
Methods: 36 healthy participants aged 18 to 45 (mean age 30.0±8.9; 20 males) completed the Epworth Sleepiness Scale (ESS) followed by structural magnetic resonance imaging (MRI) at 3T. Using an automated algorithm of the VBM8 toolbox in SPM8, T1-weighted structural images were first DARTEL-normalized to MNI space, segmented into grey matter, white matter and cerebrospinal fluid, and spatially smoothed with an 8mm FWHM Gaussian kernel. Modulated images were used to provide an estimate of voxelwise grey matter volume. Scores of the ESS were correlated with grey matter volume, $p<.001$, uncorrected, with a cluster threshold of 40 voxels. Gender and age served as covariates.
Results: In line with our hypothesis, daytime sleepiness negatively correlated with grey matter volume in a cluster of 48 voxels within the left orbitofrontal cortex (MNI coordinates x=-9, y=27, z=-26).
Conclusion: This is the first VBM study to link self-reported daytime sleepiness with reduced grey matter volume in the orbitofrontal cortex. As the orbitofrontal cortex is involved in decision-making and emotion processing, future studies should also investigate neuropsychological performance in this context.

0106

HABITUAL CAFFEINE CONSUMPTION AND CEREBRAL GRAY MATTER VOLUME

Schwab ZJ[1], DelDonno S[1], Weber M[1,2], Kipman M[1], Killgore WD[1,2]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Although caffeine is the most consumed stimulant in the world, little is known about its effects on brain structure. Some evidence suggests that caffeine may be protective against some types of dementia. One recent study reported that high or low levels of coffee consumption among women may be associated with larger hippocampal volume (Periaki et al., 2011). Here we examined the relationship between habitual caffeine intake and gray matter volume as measured by voxel-based morphometry (VBM).
Methods: Healthy participants (n=36), ranging in age from 18 to 45 (16 females) completed structural magnetic resonance imaging (MRI) at 3T. The T1-weighted scans were normalized to MNI space, tissue segmented, and spatially smoothed with an 8mm FWHM Gaussian kernel. Questionnaire information regarding habitual caffeine intake was transformed into estimated mg of caffeine based on data available from the website for the Center for Science in the Public Interest. Mean caffeine intake was entered as the covariate of interest, with age, gender, and weight as nuisance covariates and used to predict modulated gray matter volumes ($p<.005$, uncorrected, with an empirically defined extent threshold of $k>139$ voxels).
Results: Caffeine intake was positively correlated with gray matter volume (1269 voxels) within the left medial temporal lobe, including the parahippocampal gyrus, hippocampus, amygdala, and fusiform gyrus. Caffeine intake was also associated with reduced gray matter volume in the superior medial prefrontal cortex (142 voxels).
Conclusion: Self-reported habitual caffeine consumption was associated with greater gray matter volume within medial temporal lobe structures critical for memory and emotional processing and reduced volume in a prefrontal region important for executive control and top down regulation of stress responses. Because of the bidirectional nature of the correlations, further research will be necessary to determine whether these differences in brain morphology cause increased consumption of caffeine, or whether the increased consumption produced the observed differences.

0107

DAYTIME SLEEPINESS AFFECTS PREFRONTAL REGULATION OF FOOD INTAKE

Schwab ZJ[1], Killgore WD[1,2]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Over the past few decades, there has been an unprecedented explosion in the rates of overweight and obesity, yet the neurobiological underpinnings of excessive food intake remain poorly understood. Notably, this epidemic corresponds closely with the decline in the average number of hours of sleep obtained each night. Because insufficient sleep has been linked to reduced metabolic activity within the prefrontal cortex and associated declines in inhibitory control, we hypothesized that daytime sleepiness would be related to reduced activation of the prefrontal cortex during perception of appetizing high-calorie foods and that this decline would be correlated with difficulties regulating food intake.
Methods: Forty healthy adults (22 men) aged 18 to 45 underwent functional magnetic resonance imaging (fMRI) while viewing photographs of high- and low-calorie foods in a blocked design. Subjects also completed the Epworth Sleepiness Scale (ESS) and provided a rating to the query "how often do you eat more than you intend to" on a scale ranging from 1 (never) to 10 (always). In SPM5, contrast images of the difference in brain activation derived from the high- versus low-calorie conditions were correlated voxel-wise with scores from the ESS in a second-level regression model ($p<.001$, $k=10$).
Results: Daytime sleepiness correlated with reduced activation in the ventromedial prefrontal cortex during perception of high- versus low-calorie food images for the sample as a whole ($r=-.54$, $p<.001$). Moreover, activation within this cluster was related to the tendency to eat more than intended, but only for women ($r=-.47$, $p=.048$).
Conclusion: When presented with enticing high-calorie food images, greater daytime sleepiness was associated with decreased activation in the prefrontal cortex, a region implicated in emotional and behavioral control. Activation of this region was directly correlated with overeating in women but not men. Normal fluctuations in sleepiness may be sufficient to affect brain regions important for regulating food intake.

0108

EFFECTS OF SLEEP DEPRIVATION AND A2A ADENOSINE RECEPTOR ANTAGONIST ON SINGLE UNIT ACTIVITY IN THE RAT VENTROLATERAL PREOPTIC AREA (VLPO)

Alam MA[1,2], Alam M[1,2,4], Kumar S[1], McGinty DJ[1,4], Szymusiak RS[1,2,3]
[1]VAGLAHS, UCLA, North Hills, CA, USA, [2]Medicine, UCLA, Los Angeles, CA, USA, [3]Neurobiology, UCLA, Los Angeles, CA, USA, [4]Psychology, UCLA, Los Angeles, CA, USA

Introduction: The VLPO is a critical sleep regulatory brain region that contains neurons with sleep-related discharge. VLPO lesions cause chronic sleep insufficiency, suggesting that activation of VLPO neurons is a component of the homeostatic sleep response. Adenosine (AD) is an endogenous somnogen implicated in sleep homeostasis. The present study was designed to determine 1) if discharge of VLPO neurons increases in response to acute sleep deprivation (SD) and 2) if local perfusion of the A2A AD receptor antagonist, ZM24135, alters VLPO neuronal discharge.
Methods: For Experiment 1, male Sprague-Dawley rats were implanted with chronic EEG and EMG recording electrodes, and with a bundle of microwires targeting the VLPO. Baseline sleep-wake discharge profiles were determined for isolated single units, after which rats were subjected to 2 hours of SD, followed by 2 hours of recovery sleep (RS). Unit activity was recorded continuously during SD and RS. For Experiment 2, rats received a chronic guide cannula placed adjacent to the microwire bundle for local drug delivery via microdialysis probe. In these rats, state-dependent VLPO single unit activity was compared during perfusion of aCSF and perfusion of ZM24135 (50µM).
Results: In a group of sleep-active neurons (n=13), anatomically localized to VLPO, waking discharge rates increased significantly following 2 hrs of SD (8.2±2.3 spikes/sec) compared to baseline waking (5.2±1.1 s/s). Discharge rates during RS (12.2±2.2 s/s) were significantly higher than rates during baseline sleep (8.8±2.0 s/s). In a separate group of VLPO sleep-active neurons (n=6), discharge rates decreased during ZM24135 versus aCSF perfusion in waking (5.4±1.5 vs 2.9±0.7 s/s) and nonREM sleep (10.7±2.3 vs 2.8±0.8 s/s).
Conclusion: Findings support the hypothesis that AD-mediated activation of VLPO neurons via A2A receptors is a component of the homeostatic response to SD.
Support (If Any): Supported by the Department of Veterans Affairs and NIH grant MH63323.

0109

EFFECTS OF INTRACEREBROVENTRICULAR (ICV) INFUSION OF AN ADENOSINE A2A RECEPTOR ANTAGONIST ON SLEEP AND PREOPTIC NEURONAL ACTIVITY IN RATS

Kumar S[1], Rai S[1], Alam M[1,2,4], McGinty DJ[1,4], Szymusiak RS[1,2,3]
[1]Research, V A Medical Center, North Hills, CA, USA, [2]Medicine, UCLA, Los Angeles, CA, USA, [3]Neurobiology, UCLA, Los Angeles, CA, USA, [4]Psychology, UCLA, Los Angeles, CA, USA

Introduction: Central administration of adenosine A2a receptor agonists increase sleep and activate GABAergic neurons in the ventrolateral preoptic area (VLPO) and median preoptic nucleus (MnPN). To further evaluate the sleep regulatory functions of A2a receptors, we performed ICV infusion of A2a antagonist ZM 241385 during sleep deprivation (SD) and examined effects on recovery sleep (RS) and on c-Fos expression in preoptic neurons.
Methods: Groups of rats were subjected to 3 hours of SD, initiated 2 hours after lights-on (12/12 light:dark cycle, lights-on at 08:00), Rats received ICV infusion (0.4µl/min) of vehicle (n=6) or ZM 241385, (1.7 µg, n=6 or 8.5 µg, n=6/group) during the last 2 hours of SD . Rats were then left undisturbed for 2 hours and permitted RS, documented with continuous EEG and EMG recordings. After 2 hours, rats were immediately euthanized and brain tissue harvested and processed for immunostaining of c-Fos-protein and glutamic acid decarboxylase (GAD).
Results: ZM 241385- treated rats exhibited significant decreases in time spent in nonREM sleep (Vehicle, 57.9±3.2%; 1.7 µg, 47.9±2.55%; 8.5 µg, 42.3±2.6%) and REM sleep (Vehicle, 10.3±0.9%; 1.7 µg, 5.5±1.0%; 8.5 µg, 3.2±0.4%), and increases in time spent awake (Vehicle, 31.7±2.9%; 1.7 µg, 45.6±2.5%; 8.5 µg, 54.5±2.3%) during the RS period. The percent of GAD+ neurons expressing Fos was reduced in treated rats in the rostral MnPN (Vehicle, 14.7±0.9%; 1.7 µg, 10.5±1.0%; 8.5 µg, 8.3±1.3%), caudal MnPN (Vehicle, 10.8±0.9%; 1.7 µg, 8.0±0.9%; 8.5 µg, 6.5±0.3%), extended VLPO (Vehicle, 18.5±1.6%; 1.7 µg, 11.0±1.6%; 8.5 µg, 9.0±0.6%) and VLPO core (Vehicle, Vehicle, 19.4±1.8%; 1.7 µg, 14.0±1%.5; 8.5 µg, 11.9±0.5%).
Conclusion: These results support the hypothesis that adenosinergic activation of preoptic GABAergic neurons, mediated via A2a receptors, is a component of the homeostatic response to sleep deprivation.
Support (If Any): Supported by the Department of Veterans Affairs and grant MH63323 from the NIH.

0110

GLIAL-SPECIFIC KNOCKDOWN OF ADENOSINE KINASE INCREASES SLOW WAVE ACTIVITY AND SLOWS SWA DECAY

Bjorness TE[1], Dale N[2], Sahin B[3], Fienberg A[4], Suzuki A[5], Mettlach G[1], Bibb JA[1], Greene R[1,6]
[1]Psychiatry, University of Texas Southwestern, Dallas, TX, USA, [2]School of Life Sciences, University of Warwick, Coventry, United Kingdom, [3]Neurology, John Hopkins Medical Institute, Baltimore, MD, USA, [4]Intracellular Therapies, Inc., New York, NY, USA, [5]Molecular Genetics, University of Texas Southwestern, Dallas, TX, USA, [6]Mental Health Research, Veterans Affairs North Texas Health Care System, Dallas, TX, USA

Introduction: Adenosine, acting through the adenosine A1 receptor, mediates homeostatic control of slow wave activity (SWA, a 0.5-4.5 Hz oscillation in membrane potential). SWA increases following prolonged waking and dissipates during subsequent slow wave sleep (SWS). Indeed, SWA is indicative of the homeostatic sleep drive, with sleep drive increasing after long periods of waking and decreasing throughout SWS. We have shown that mice lacking the adenosine A1 receptor show decreased SWA in response to sleep deprivation.
Methods: To better understand the regulation of adenosine levels, we derived mice harboring floxed adenosine kinase (which converts adenosine to AMP) alleles and used a glial fibrilary acidic protein (GFAP) promoter driven Cre-ERT2 to mediate conditional ADK knockout primarily in glial cells. Next, in order to model the decline in SWA during SWS under baseline conditions, SWS episodes of at least 5 min in duration were used and averaged within each animal. SWA was normalized and fit using a single phase exponential.
Results: ADK knockdown in response to tamoxifen injections, resulted in increased SWA under both baseline and recovery from sleep deprivation conditions. In contrast, ADK knockout under the control of CaMKII (expressed in neurons) did not alter SWA compared to tamoxifen treated C57/BL6 wildtype mice and vehicle treated ADKGFAPCreERT2 mice. This increase in SWA occurred throughout the 24 hr cycle maintaining normal circadian distribution of SWA. The SWA decay time constant (tau) was longer in tamoxifen treated ADKGFAPCreERT2 mice compared with tamoxifen treated wildtype C57/BL6 mice and vehicle treated ADKGFAPCreERT2 mice, while SWA decay in adenosine A1 receptor knockout mice could not be fit using a single phase exponential.
Conclusion: Together these results demonstrate an important neuron-glial cell relationship pertaining to energy metabolism in the brain and introduce a new role for glial cell-derived adenosine in sleep homeostasis.

0111

SLEEP DEPRIVATION INCREASES EXTRACELLULAR ADENOSINE SIGNALING IN THE HIPPOCAMPUS AND CORTEX THROUGH AN ASTROCYTE DEPENDENT MECHANISM

Schmitt LI, Haydon PG
Neuroscience, Tufts University, Boston, MA, USA

Introduction: Sleep deprivation causes an increase in sleep drive and deficits in cognition including deficits in declarative memory. These responses involve the activation adenosine A1 receptors (adorA1Rs). Increases in the concentration of extracellular adenosine are observed following sleep deprivation in brain regions such as the basal forebrain, an area involved in the homeostatic sleep response. Our lab has demonstrated that astrocytic glia, which are a major source of extracellular adenosine, play an important role in driving sleep homeostasis and are involved in the effects of sleep loss on memory. It is not known, however, whether the level of astrocyte-derived adenosine increases during wakefulness or whether such elevations occur in brain regions relevant to memory.
Methods: Using a genetic mouse model in which a dominant negative protein disrupting SNARE (dnSNARE) mediated release is expressed specifically in astrocytes, we tested whether sleep deprivation increased adorA1R activation by measuring the effect of inhibiting these receptors on local field potential oscillations in vivo. We also employed biosensor based measurement to determine whether adenosine concentration was elevated in acute hippocampal slice preparations taken following sleep deprivation (SD).
Results: We observe a significant elevation in regulation of slow wave oscillations by adorA1Rs following SD (Undisturbed: 20.5±10.4%, SD: 77.2±9.3% $p<0.05$ Mann-Whitney U) that was absent in dnSNARE mice (Undisturbed: - 20±17.4%, SD: 8±8.2% $p>0.05$ Mann-Whitney U). Adenosine concentration was elevated in the hippocampus following SD in wild type mice (3.1±0.4 μM) compared to dnSNAREs (1.3±0.3 μM, $p>0.01$,Tukey) but was not significantly different following undisturbed sleep.
Conclusion: Our findings indicate that adenosine increases following sleep deprivation in areas associated with memory function through an astrocytic SNARE dependent pathway. These results have important implications for understanding the impact of sleep loss on neurological function and may contribute to understanding the role of sleep in memory consolidation.

0112

ESTROGENS INCREASE GENERALIZED AROUSAL BY MODULATING ADENOSINERGIC (A2A) NEUROTRANSMISSION IN THE VLPO

Enriquez K[1], Modafferi C[1], Pfaff D[2], Ribeiro A[1,2]
[1]Division of Natural Sciences, College of Mount Saint Vincent, Bronx, NY, USA, [2]Neurobiology and Behavior, The Rockefeller University, Ney York, NY, USA

Introduction: Estrogens are involved in the modulation of generalized arousal and sleep-wake cycles in mice, as evidenced by the increased running wheel activity and reduced NREMS and REMS when estrogens are naturally high (proestrus) or when ovariectomized mice are treated with exogenous estrogens. These changes in behavior are accompanied by decreases in prostaglandin D synthase and A2A receptor mRNA levels in the preoptic nucleus and VLPO. To further characterize this signaling cascade, we examined the effects of microinjecting A2A receptor agonist (CGS21680) or antagonist (MSX3) into the VLPO on generalized arousal of estrogen or oil-treated ovariectomized female mice.
Methods: Behavioral Analysis: Female mice were ovariectomized and implanted with EB (1.25 μg) (n=7) or oil capsules (n=9). Following recovery, guide cannulae aimed at the VLPO were implanted, and mice were placed in generalized arousal chambers under a 12:12h light-dark cycle, with food and water available ad libitum. Following acclimation, 24-h home cage activity was recorded following baseline treatments (handling, saline and DMSO), and after CGS21680 and MSX-3 microinjections. All manipulations were performed 4h after lights off. Data (horizontal activity, vertical activity and total distance) were analyzed using unpaired t-tests.
Results: Ovariectomized females with EB had significantly higher home cage activity, predominantly during the dark period, compared to oil-treated animals. In the 1 h period following microinjection of CSG21680 into the VLPO all parameters of generalized arousal were significantly reduced in oil and EB-treated mice. In contrast, VLPO microinjection of MSX-3 significantly increased arousal, predominantly in EB-treated animals.
Conclusion: Our findings are in line with the hypothesis that estrogen's abilities to modulate arousal rely specifically on changes in adenosinergic neurotransmission in the VLPO.
Support (If Any): NHLBI F32HL086018.

0113

EXTRACELLULAR ADENOSINE TRIPHOSPHATE INHIBITS MOUSE BASAL FOREBRAIN CHOLINERGIC AND PARVALBUMIN-POSITIVE LIKE GABAERGIC NEURONS

Yang C[1], McCarley RW[1], Yanagawa Y[2,3], Basheer R[1], Brown RE[1]
[1]Psychiatry, VA Boston Heathcare System and Harvard Medical School, Brockton, MA, USA, [2]Genetic and Behavioral Neuroscience, Gunma University Graduate school of medicine, Maebashi, Japan, [3]Japan Science and Technology Agency, CREST, Sanbacho, Chiyado-ku, Tokyo, Japan

Introduction: Previous work from our lab has found increases in extracellular adenosine (AD) in the basal forebrain (BF) correlate with time awake and infusion of AD causes sleep, implicating AD as a homeostatic sleep factor. However, the source(s) of extracellular AD is unclear. One possibility is adenosine triphosphate (ATP), released from glia or via neurotransmission, and broken down to AD by the action of extracellular ectonucleotidases. The aim of this study was to determine the effect of ATP on BF cholinergic and GABAergic neurons and to test whether its' effect is mediated by breakdown to AD.
Methods: Coronal brain slices were prepared from young (12-22 d) heterozygous GAD67-GFP knock-in mice. Whole-cell patch-clamp recordings were made using a Multiclamp 700B amplifier. Cholinergic neurons were GFP-negative and identified by their distinctive intrinsic membrane properties (confirmed by posthoc immunohistochemistry for ChAT). GABAergic neurons were identified prior to recording based on their expression of green fluorescent protein (GFP) and categorized after recording based on their intrinsic membrane properties. ATP and antagonists were bath-applied.
Results: A 2-3 min application of 100 μM ATP induced a brief depolarization followed by a prolonged hyperpolarization in cholinergic neurons (n=4) in the presence of TTX. The hyperpolarization was blocked by the 5□-ectonucleotidase inhibitor, 100 nM AOPCP (n=3) suggesting it was mediated by breakdown of ATP to AD. In GABAergic neurons with a large Ih current, which we have shown to be cortically projecting and have similar intrinsic membrane properties and morphology as Parvalbumin-positive BF neurons, ATP caused a ~25% decrease in spontaneous firing frequency ($p<0.05$, n=7). Moreover, the inhibitory effect of ATP on these GABAergic neurons was blocked by a specific AD A1 receptor antagonist, 1 μM CPT (n=2).
Conclusion: Increases in extracellular ATP during prolonged waking may cause sleepiness via breakdown to adenosine and an inhibition of cortically projecting cholinergic and GABAergic neurons.
Support (If Any): VA Merit awards (McCarley, Basheer) & NIMH 39683 (McCarley).

0114

DO RGS PROTEINS IN SLEEP-REGULATING REGIONS OF PREFRONTAL CORTEX (PFC) AND PONTINE RETICULAR FORMATION (PRF) OF MOUSE INFLUENCE ADENOSINERGIC AND CHOLINERGIC SIGNALING?

Hambrecht-Wiedbusch VS[1], Bender M[1], Bellefleur M[1], Neubig RR[2], Baghdoyan HA[1], Lydic R[1]
[1]Anesthesiology, University of Michigan, Ann Arbor, MI, USA, [2]Pharmacology, University of Michigan, Ann Arbor, MI, USA

Introduction: Adenosine A1 and A2 receptors in PFC of C57BL/6J mice modulate sleep/wake states and acetylcholine release in the PRF (J Neurosci 29:871, 2009). Adenosinergic and muscarinic cholinergic receptors are coupled to G proteins that are controlled by regulators of G protein signaling (RGS) proteins. This study uses RGS-insensitive mice (GαoG184S) in which a knock-in disr upts Gαo-RGS binding and negative feedback regulation (Mol Pharm 75:1222, 2009). Comparison of heterozygous (Gαo+/GS) and wild type (+/+) mice is testing the hypothesis that adenosinergic and cholinergic activation of G proteins in the PFC and PRF varies as a function of genotype.
Methods: Brains from Gαo+/GS (n=2) and +/+ (n=2) mice were processed for [35S]GTPγS autoradiography (J Chem Neuroanat 37:112, 2009). The amount of G protein activation was quantified as nCi/g tissue by investigators (MCB and MPB) blinded to genotype. Optical density measures from PFC (n=405) and PRF (n=312) were obtained under basal conditions and during G protein activation by the adenosine A1 receptor agonist N6-p-sulfophenyladenosine (SPA) and the cholinergic agonist carbachol.
Results: For both brain regions and all assay conditions the Gαo+/GS mice had decreased G protein activation compared to +/+ mice. Decreases in PFC by condition were: basal (-17%), SPA (-15%), and carbachol (-29%). Decreases in PRF were: basal (-19%), SPA (-11%), and carbachol (-19%).
Conclusion: Power calculations indicate that 10 to 12 additional mice per group will have an 80% power to detect genotype differences (2-tail, alpha=0.05) in G protein activation. Alternatively, rejection of the hypothesis would be consistent with the fact that RGS protein modulation occurs in the biochemical cascade downstream of GTPγS binding. Such a finding would provide an important control for future functional studies aiming to clarify the role of RGS proteins in the regulation of sleep and chemical neurotransmission.
Support (If Any): HL65272, R01GM039561-24, MH45361 and Department of Anesthesiology.

0115

GLUTAMATERGIC SIGNALING FROM THE PARABRACHIAL NUCLEUS IS REQUIRED FOR HYPERCARBIC AROUSAL

Kaur S-, Yokota S, Pedersen NP, Hur EE, Chamberlin NL, Saper C
Neurology, Beth Israel Medical Centre, Boston, MA, USA

Introduction: The mechanisms of arousal from apneas during sleep in patients suffering from obstructive sleep apnea are not known. We hypothesize that chemosensory pathways coalesce on nucleus of solitary tract which mediates awakening by dense inputs to the parabrachial nucleus (PB), which sends glutamatergic projections to a variety of forebrain structures critical to arousal.
Methods: To test the role of PB in hypercarbic arousals we developed a mouse model of repetitive CO2 arousal (RCA). Mice slept in a plethysmograph chamber during the early light phase and received 30 sec pulses of 10% CO2, either with 21% or 10% O2, every 300 s, to mimic the cyclic hypercarbia or hypoxic/ hypercarbia of sleep apnea. To test the role of glutamatergic neurons in PB in hypercarbic arousals, we used mice in which lox P sequences flanked exon2 of the vesicular glutamate transporter 2 (Vglut2) gene. Adeno-associated viral vectors containing genes encoding Cre recombinase and green fluorescent protein (GFP) were microinjected into the PB to permanently and selectively disrupt Vglut2 expression. At 5 weeks post injection; we recorded baseline sleep in these mice and then investigated arousals from sleep in response to CO2. Loss of Vglut2 mRNA in GFP and Cre containing cell bodies confirmed Vglut2 deletions.
Results: Vglut2 deletions that included the external lateral and Kolliker-Fuse subdivisions of the lateral PB more than doubled the latency to arousal and in 30% of trials resulted in no arousal response to CO2 stimulus within 30s. These animals had normal amounts of EEG delta power and sleep and aroused normally to an acoustic tone. By contrast, deletions that involved the medial PB subdivision increased NREM sleep by 20% during light and dark periods, and increased EEG delta power by 50%, but showed normal arousals to CO2 stimulus.
Conclusion: Our results suggest that glutamatergic neurons in the lateral PB are necessary for arousals from sleep in response to CO2, whereas those in the medial PB are important for regulation of spontaneous waking and EEG desychronization.
Support (If Any): NIH grant P01 HL 095491.

0116

MOUSE PARABRACHIAL NEURONS PROJECTING TO THE ROSTRAL VENTRAL RESPIRATORY GROUP, PHRENIC AND HYPOGLOSSAL MOTOR NUCLEI ARE ACTIVATED BY HYPERCAPNIA

Yokota S, Kaur S, Van der Horst V, Saper C, Chamberlin N
Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: In obstructive sleep apnea (OSA) upper airway collapse through an unknown mechanism results in respiratory muscle activation and arousal from sleep. We hypothesize that the parabrachial complex (PB) is a key mediator of these events and that the relevant neurons are activated mainly by hypercapnia. This study tests whether hypercapnia-responsive glutamatergic PB neurons project to phrenic motor and premotor neurons and to hypoglossal motor neurons which control ventilatory drive and upper airway patency, respectively.
Methods: We used a combination of retrograde tracing with cholera toxin b subunit (CTb) and immunohistochemistry for Fos to detect activated neurons following exposure to hypercapnia. We next combined Fos-immunohistochemistry with in situ hybridization to identify hypercapnia-activated, glutamatergic (vesicular glutamate transporter 2; vGluT2) and GABAergic (glutamic acid decarboxylase 67; GAD67) neurons.
Results: After 2 hours exposure to normoxic hypercapnia (10% CO2), higher numbers of Fos-immunoreactive neurons were observed in the rostral KF and the lateral crescent (cr) and the outer potion of the external lateral subnucleus (el) of the PBN compared to room air control. Most neurons were positive for vGluT2 but not for GAD67 mRNA. After CTb injection into the rostral ventral respiratory group (rVRG), CTb-labeled neurons in the PB were found mainly in the KFN, and additionally in the central lateral and the medial subnuclei. On the other hand, CTb-labeled neurons after injection into the hypoglossal motor nucleus were found in the KFN and central lateral subnucleus. By contrast retrogradely labeled neurons from the phrenic motor nucleus were found almost exclusively in the KFN. Hypercapnia produced increases in Fos positive CTb labeled neurons in the KFN after CTb injection into the rVRG, the hypoglossal and phrenic motor nuclei.
Conclusion: Our results suggest that hypercapnia-responsive glutamatergic neurons in the KFN may contribute to respiratory arousal in OSA.
Support (If Any): P01 HL095491.

0117

EXTERNAL LATERAL PARABRACHIAL NEURONS ARE ACTIVATED BY A GLUTAMATERGIC INPUT FROM THE NUCLEUS OF SOLITARY TRACT - A POTENTIAL CHEMOSENSORY PATHWAY FOR HYPERCAPNIA INDUCED ARAOUSAL

Yakota S, Kaur S-, Saper C, Chamberlin N, Arrigoni E
Neurology, Beth Israel Deaconess medical Center, Boston, MA, USA

Introduction: Obstructive sleep apnea (OSA) is characterized by recurrent collapse of the upper airway during sleep which results in hypoxia, hypercapnia, increased respiratory effort and frequent arousals. The mechanisms of these arousals are not well understood. We hypothesize that chemosensory pathways converge on the nucleus of solitary tract (NTS) and the parabrachial nucleus (PB). The PB sends glutamatergic projections to forebrain structures critical for arousal and it is activated by hypercapnia. The glutamate signaling from the external lateral (EL) nucleus of the PB is necessary for CO2-mediated arousal. Here we studied the El neurons in an in vitro brainstem slice preparation.
Methods: We expressed channelrhodopsin-2 (ChR2) in NTS glutamatergic neurons by injecting a Cre-dependent adeno-associated viral vector coding for ChR2 (AAV-ChR2) in the NTS of Vglut2-Cre mice. In these animals the expression of Cre-recombinase is under the promoter of the vesicular glutamate transporter (Vglut2) which drives the expression of ChR2 in glutamatergic neurons. Two weeks after the AAV-ChR2 injections we performed whole-cell patch-clamp recordings on EL neurons in brainstem slices. Photo-release of glutamate from NTS terminals onto EL neurons was evoked by 5-msec blue-light (473 nm) pulses.
Results: We found that EL neurons did not directly respond to changes in extracellular pH (6.9 to 7.5) but they did respond to photo-activation of NTS glutamatergic terminals expressing ChR2. Brief pulses of blue light evoked short latency excitatory postsynaptic currents EPSCs which were blocked by AMPA receptor antagonists.
Conclusion: Our results show that the EL neurons are not intrinsically chemosensitive. Their response to hypercapnia is therefore mediated by a chemosensitive pathway possibly through the NTS. Confirming this hypothesis we found a functional glutamatergic input from NTS to EL neurons which might be responsible for activation of the EL to drive arousal in response to hypercapnia.
Support (If Any): NHLBI (1P01HL095491).

0118

RECURRENT APNEA INDUCES APOPTOSIS IN HYPOGLOSSAL MOTONEURONS IN *IN VIVO* RATS

Fung SJ[1,2], Zhang J[1,2], Xi M[1,2], Sampogna S[2], Chase MH[1,2,3]
[1]VA Greater Los Angeles Healthcare System, Los Angeles, CA, USA, [2]Websciences International, Los Angeles, CA, USA, [3]Physiology, UCLA School of Medicine, Los Angeles, CA, USA

Introduction: Hypoglossal motoneurons play an important role in maintaining the patency of the upper airway. Therefore, we hypothesized that hypoglossal motoneurons may be subjected to apoptosis due to repeated deficits in oxygenation, such as occur in Obstructive Sleep Apnea (OSA). In this regard, apoptosis of hypoglossal motoneurons occurs in humans subsequent to hypoxic injuries (Porzionato et al., 2008). Accordingly, in the present study, we used *in vivo* rats to determine whether hypoglossal motoneurons are subjected to apoptotic processes as a consequence of recurrent periods of apnea.
Methods: Adult rats were anesthetized by α-chloralose and immobilized with Flaxedil. Experimental animals underwent 2 hrs of recurrent periods of apnea (via ventilatory arrest). During each episode of apnea, the SpO_2 was desaturated to 75%, which was followed by re-ventilation until a baseline level of oxygen saturation (95%) was achieved. Sham-operated, control animals were maintained with normal respiration for the same period of time. At the end of each 2 hr session, the animals were perfused for the immunohistochemical analysis of hypoglossal motoneurons using single-stranded DNA as a marker for apoptosis.
Results: In the apneic group of animals, positive labeling for single-stranded DNA was present in both the cytoplasmic and nuclear compartments of hypoglossal motoneurons. Labeled motoneurons were distributed bilaterally throughout the hypoglossal nuclei. Within the hypoglossal nucleus, genioglossus motoneurons (in the ventral region) exhibited prominent positive labeling. There was no evidence of apoptosis in hypoglossal motoneurons in the control animals.
Conclusion: The present results indicate that recurrent apnea results in apoptotic degeneration in motoneurons in the hypoglossal nucleus, including genioglossal motoneurons which are pharyngeal dilators. Consequently, we suggest that the patency of the upper airway may be compromised in OSA, and other sleep related breathing disorders, due to neurodegenerative changes that occur in hypoglossal motoneurons as a consequence of recurrent episodes of apnea.
Support (If Any): VA Grant 1|01BX000819.

0119

DORSAL RAPHE NUCLEUS MEDIATION OF APNEA-INDUCED CORTICAL AROUSALS

McKenna JT[1], Shifflett LB[1], Winston S[1], Bolortuya Y[1], Ferrarini MA[2], Goodhue GD[2], Kocsis B[3], McCarley RW[1], Strecker RE[1]
[1]Dept. of Psychiatry, Research, Harvard Medical School/VA Boston Healthcare System, Brockton, MA, USA, [2]Neuroscience, Stonehill College, Easton, MA, USA, [3]Psychiatry, Harvard Medical School/Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Obstructed sleep apnea (OSA) is quite prevalent, affecting approximately 7% of the adult American population. It is characterized by hypoxia, hypercapnia, and sleep fragmentation. The serotonergic dorsal raphe nucleus (DR) is part of the ascending reticular activating system, and is particularly active during wakefulness. We hypothesize that DR may participate in the cortical arousal response to respiratory challenge, such as seen in OSA, particularly conveying information to upstream arousal-related targets, including the basal forebrain (BF) and midline thalamus.
Methods: Rats were exposed to intermittent hypercapnia (IHCap; 3h of a cycling protocol of 1 min of 20% CO2 infusion alternating with 3 min of room air) or intermittent hypoxia (IHx; 3h of a cycling protocol of 1 min nitrogen infusion alternating with 3 min of room air), mimicking that experienced in OSA. We analyzed c-Fos protein labeling (indicating neuronal activation) of DR serotonergic (tryptophan hydroxylase-positive) neurons following IHCap or IHx.
Results: IHCap increased wakefulness and decreased NREM sleep amounts, although these measures approached pre-exposure levels by the third hour (N=3). Furthermore, rats were awakened on average at 35.7 s into CO2 exposure periods of 1 min (at mean CO2 levels = 6.3%). 8% of serotonergic cells in DR were also labeled with c-Fos following 3 hrs of IHCap, compared to less than 1% in controls.
Conclusion: Our investigations indicate that a subpopulation of DR neurons contribute to respiratory challenge-induced cortical arousals, as shown by c-Fos activation in serotonergic neurons. Such findings may better inform pharmacological intervention (such as serotonergic agents) to treat sleep disordered breathing.
Support (If Any): This research was supported by U.S. Dept. of Veterans Affairs Medical Research Awards to RES and RWM, NHLBI HL095491, and NIMH MH39683.

0120

LONG-TERM EFFECT OF UPPER AIRWAY LOADING ON SLEEP AND GROWTH IN RATS

Tarasiuk A[1], Berdugo-Boura N[1,2], Levi A[1,2], Segev Y[2]
[1]Sleep-Wake Disorder Unit and Department of Physiology, Soroka University Medical Center, Faculty of Health Sciences Ben-Gurion University of the Negev, Beer Sheva, Israel, [2]Shraga Segal Department of Microbiology and Immunology, Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Introduction: Upper airway obstruction (UAO) for 16 days leads to growth retardation associated with reduction of hypothalamic GHRH content in juvenile rats. The latter could explain both the abnormal slow wave sleep (SWS) and impaired growth hormone homeostasis. Little is known about the long-term effect of UAO on sleep and growth in children and animals. In the current study we explored the effect of long-term UAO on sleep, growth, and bone morphology.
Methods: The tracheae of 22-day-old male rats were obstructed and animals were followed for 7 weeks until adulthood. Sleep, growth, and bone morphology were evaluated at the beginning and conclusion of the study.
Results: Body temperature of the UAO group at 2 and 7 weeks were 0.5°C and 1.5°C lower than in controls, respectively ($p<0.001$). At 7 weeks UAO rats group awake for 20% more ($p<0.023$) and had 43% less paradoxical sleep duration during the light period ($p<0.05$). Although SWS duration was similar between groups, deep SWS was reduced by 36% in the UAO group during the first 2 hrs of light period ($p<0.05$). During the dark period UAO animals had 11% less awake ($p<0.001$) and a 50% increase ($p<0.001$) in SWS duration. Food intake was elevated by 20% ($p<0.001$) in the UAO group during weeks 5, 6, and 7. UAO animals demonstrated marked growth retardation; body weight, tibia, and tail length gains all decreased by 40% ($p<0.01$). At 7 weeks intestinal/tail length ratio increased by 15% ($p<0.01$) in the UAO group. Liver and bone IGF-1 mRNA was significantly decreased by 50% in the UAO group. Bone morphometry demonstrated marked histological changes supporting local bone growth retardation.
Conclusion: Prolonged UAO leads to sleep fragmentation and partial sleep deprivation to preserve ventilation during sleep. These sleep abnormalities suppress both global and local GH/IGF-1 axis resulting in substantial growth failure.
Support (If Any): This research was supported by the Israel Science Foundation (grant No. 160/10).

0121

DESTABILIZATION OF SLEEP ARCHITECTURE FOLLOWING IBOTENIC ACID LESIONS OF THE PRIMARY STRUCTURES OF THE BASAL GANGLIA

Buuck L[1], Albers JA[1], Roffler M[1], Anch AM[1], Panneton W[2]
[1]Psychology, Saint Louis University, Saint Louis, MO, USA, [2]Pharmacological and Physiological Science, Saint Louis University School of Medicine, Saint Louis, MO, USA

Introduction: Recent research has indicated that the basal ganglia may play a role in sleep/wake regulation. The present study sought to determine if lesions of the striatum and globus pallidus precipitated changes in sleep consolidation; specifically, a decrease in sleep continuity and an increase in Stage Shift Index.
Methods: Thirteen male Sprague-Dawley rats (300-350g) were implanted with epidural electrodes for electrocorticogram (ECoG) recording. Seven of these rats received left unilateral ibotenic acid (1200nL, 10%) lesions of the globus pallidus. Six rats served as vehicle controls. A 15-20 day recovery period followed surgery, during which rats returned to presurgical weights. Histological verification of the lesion was performed using NeuN IHC and neutral red staining.
Results: A 2x2x4 mixed factorial ANOVA found a significant difference in vigilance state during the light cycle in lesioned rats ($F = 4.34$, $p < .05$), specifically during low voltage (LS) sleep ($F=7.77$, $p=.018$). No significant differences were found for vigilance state during the dark cycle. Stage shifts from high voltage (HS) to LS approached significance in lesioned rats. Significant effects were found in stage shifts from LS to HS ($t(11) = -2.40$, $p = 0.037$) and wake to LS ($t(11) = -2.24$, $p = 0.049$) across the sleep period. Lesioned rats were also significantly more likely to shift from any stage into LS ($t(11) = -2.53$, $p = 0.03$).
Conclusion: Lesions of the basal ganglia contribute to sleep state instability, characterized by increases in stage shifting. Lesioned animals also shifted into LS (an ostensibly lighter stage of sleep) more often, indicative of a dysregulation of sleep intensity characterized by significant reduction in ECoG amplitude. This work suggests a potential neuroanatomical etiology for disruption of sleep seen in disorders of the basal ganglia, such as Parkinson's disease and Huntington's disease.

0122

EFFECTS OF SHORT LIGHT-DARK CYCLES ON SLEEP AND WAKING IN ALBINO MICE WITH LIGHT-INDUCED RETINAL DEGENERATION

Hsiao F[1,2], Liao Y[1], Tsai L[1]
[1]Psychology, Natl Chung Cheng Univ, Chia-yi, Taiwan, [2]Psychology, National Chengchi Univ, Taipei, Taiwan

Introduction: Dark pulses enhance and suppress rapid-eye-movement sleep (REMS) and non-REM sleep (NREMS) respectively in albino

rats, particularly when rats are in sleep. In our previous study, we found that responses of REMS to light-to-dark transitions was well-maintained in albino mice carrying retinal degeneration (rd) gene. However, dark-to-light transitions resulted in prolonged increases of waking in these mice. To furhter confirm that the response of sleep and waking to light and dark transitions is related to retinal degeneration, we studied the sleep and waking patterns in short light-dark cycles (LDc) in albino mice with retinal damage induced by light.

Methods: Seven adult male CD-1 (ICR) mice (11 weeks old) were exposed to light with illuminance at 1700 lux for two days. Daily sleep and waking patterns were recorded and analyzed with standard electrophysiological methods after 2-3 weeks following light exposures. Following 2-day baseline recordings in 12h-12h LDc, 5 min-5 min LDc were applied for 4 hours in the mid-period of both the inactive and active circadian phases for 2 days.

Results: Compared to 8 age-matched control mice, light-induced retinal damage did not result in significant changes in daily sleep and waking patterns in 12h-12h LDc. REMS was more in the 5 min dark periods than in the 5 min light periods in both mice groups. However, only the light damage group showed waking was more in the 5 min light periods than in the 5 min dark periods particularly in active phase.

Conclusion: These results further confirm that the enhancing effect of light-to-dark transitions on REMS was not altered after severe loss of photoreceptors in the outer retina, no matter the retina degeneration occuring during development or in adult. Nonetheless, rod and cone photoreceptors may be important in limiting the alerting effect of dark-to-light transitions.

Support (If Any): National Science Council, Taiwan ROC, Grant No. NSC 95-2413-H-194 -028 -MY2 and NSC98-2410-H-194 -022 -MY2.

0123

IMPAIRED RESPONSE TO PROLONGED WAKEFULNESS IN UPR COMPROMISED MICE

Singletary K, Brown M, Yu M, Naidoo N
School of Medicine, Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Sleep/wake quality and rhythms change as humans age, characterized by increased nighttime awakenings and daytime somnolence. This is likely attributed to age related neuronal dysfunction. Expression of BiP/GRP78, an endoplasmic reticulum (ER) molecular chaperone in wake-active neurons, decreases over age, yielding accumulation of misfolded proteins and an increase in apoptotic factors. Additionally, a 30% reduction in BiP protein levels is seen in the cerebral cortex of aged mice. Low levels of BiP reduces the capacity of the ER to handle protein load. In young animals, but not aged animals, BiP is upregulated in response to an acute stressor such as sleep deprivation. We predicted that young transgenic mice with a reduced BiP (+/-) genotype would have a diminished response to sleep deprivation similar to responses seen in aged wild type mice.

Methods: In 3 month old BiP (+/-) and wild-type mice, EEG recordings and/or beam breaks monitored baseline activity. Animals were either sleep deprived by gentle handling for 6hrs. or undisturbed during the lights-on period. We used Westerns to compare ER stress markers in cortex and pancreas between groups of mice.

Results: In young BiP (+/+) animals, but not young BiP (+/-), BiP is upregulated in response to an acute stressor such as sleep deprivation. In BiP (+/-) mice wakefulness impairments were also seen.

Conclusion: Young mice with a BiP (+/-) genotype exhibit a similar sleep/wake phenotype to wild type aged mice.

0124

MICRODIALYSIS DELIVERY OF THE SEDATIVE/HYPNOTIC ESZOPICLONE TO THE BASAL FOREBRAIN DIFFERENTIALLY INCREASES ACETYLCHOLINE RELEASE IN THE BASAL FOREBRAIN OF LEAN/FIT (HCR) AND OBESE/METABOLIC SYNDROME (LCR) RATS

Hambrecht-Wiedbusch VS, Davidov A, Koch LG, Britton SL, Baghdoyan HA, Lydic R
Univ Michigan, Ann Arbor, MI, USA

Introduction: Obesity has replaced smoking as a major disease burden (Am J Prev Med 38:138, 2010) and projection data indicate that by 2030 half of all Americans may be overweight or obese (Obesity 16:2323, 2008). Sedative use by obese individuals is greater than in the general population (Sleep 34:869, 2011), and obese patients administered sedative/hypnotics are at increased risk for respiratory depression (Anesthesiology 104:1081, 2006). The brain mechanisms underlying these associations with obesity are not understood. A rat model of obesity/metabolic syndrome (Science 307:418, 2005) shows promise for helping to elucidate the neurochemical mechanisms and brain regions by which sedative/hypnotics alter breathing. The present study is testing the hypothesis that microdialysis delivery of eszopiclone to the basal forebrain differentially alters acetylcholine release in the basal forebrain of lean/fit versus obese/metabolic syndrome rats.

Methods: Lean (n=2) and obese (n=2) adult male rats were anesthetized with isoflurane and a microdialysis probe was placed in the basal forebrain. Acetylcholine release (pmol/12.5 min) was measured using HPLC-EC during dialysis with Ringer's (control) followed by Ringer's containing eszopiclone (300 μM).

Results: Histological analysis confirmed that all measures of acetylcholine were from the basal forebrain. Eszopiclone increased acetylcholine release in obese (151%) and lean (97%) rats. Power calculations indicate that with increased sample size the differences between rat strains will be statistically significant. The results encourage measuring acetylcholine in the basal forebrain of non-anesthetized LCR and HCR rats during systemic administration of eszopiclone (Sleep 33:909, 2010).

Conclusion: The finding that eszopiclone caused a greater change in acetylcholine release in obese/metabolic syndrome rats supports the interpretation that the brains of obese/metabolic syndrome rats differ from the brains of lean rats. The likelihood of brain differences is consistent with evidence that sleep and pain processing are altered in the obese/metabolic syndrome rats (Anesthesiology 113:1176, 2010).

Support (If Any): National Institutes of Health Grants HL40881, HL65272, MH45361, RR17718, and the Department of Anesthesiology.

0125

INVOLVEMENT OF THALAMIC NUCLEI IN THE CORTICALLY GENERATED SLOW OSCILLATION IN ANESTHETIZED MICE

Sheroziya M, Timofeev I
Laval University, Québec, QC, Canada

Introduction: During the cortically generated slow oscillation, both pyramidal and non-pyramidal neurons alternate between depolarized (active) and hyperpolarized (silent) states. It is widely accepted that corticothalamic neurons entrain thalamocortical cells from a variety of nuclei into the slow oscillation. The role and involvement of first and second order thalamic nuclei in the thalamocortical slow oscillation remain mainly unknown.

Methods: We performed simultaneous cortical local field potential as well as intracellular recordings and labeling in the thalamus of ketamine/xylazine anesthetized CD1 mice. Thalamocortical cells were identified either by their ability to respond with a characteristic low-threshold spike in response to a hyperpolarizing current pulse or by morphological location. To extract timing of neural activity, we studied the instantaneous phase of PSPs relative to the cortical slow oscillation.

Results: A majority of thalamocortical neurons reveals slow oscillation patterns. We found major differences of appearance of the slow oscillation in the thalamus of mice as compare to cats: (a) we did not observe profound hyperpolarization during cortical silent states, (b) we observed single and spindle-like IPSPs in transition to and during cortical active states in identified VPM neurons, (c) in higher order nuclei we observed prominent depolarization of thalamocortical neurons during transition to and during active states. We observed major differences in expression of intrinsic properties of thalamocortical cells from anesthetized mice: (a) we did not observe spontaneously generated LTSs, (b) at least some morphologically identified thalamocortical cells from non-specific nuclei did not generate LTS. The firing and PSPs of neurons from first order thalamic nuclei revealed different phase relation with slow oscillation as compare to neurons in higher order and intralaminar thalamic nuclei. Higher order and intralaminar cells were activated in transition (prior) to active state and earlier than the first order cells. Thalamic neurons from VPM nucleus revealed uncorrelated excitatory "fast-rising" PSPs likely originating from lemniscal pathways.
Conclusion: Our results suggest that in ketamine/xylazine anesthetized mice, higher order thalamic nuclei may actively contribute to the generation of cortical active states during slow oscillation, while different neurons within specific thalamic nuclei possess variable thresholds for transmitting sensory inputs during slow-wave sleep.
Support (If Any): Supported by NSERC, CHIR and FRSQ.

0126

BMAL1 SIRNA INCREASED WAKEFULNESS AND ADVANCED WAKE CYCLES INITIALLY AND REDUCED WAKEFULNESS SUBSEQUENTLY

Feng P[2,1], Hu Y[1,2], Akladious A[1], Guo Y[1], Smith PJ[1]
[1]Medicine/Pulmonary, Critical Care and Sleep Medicine, Case Western reserve University /VA Med, Cleveland, OH, USA, [2]Research, Louis Stokes Cleveland VA Medical Centersity, Cleveland, OH, USA

Introduction: Sleep wake cycles are regulated by homeostatic and circadian systems. BMAL1/Mop3 is a heterodimeric partner to CLOCK and a key transcription factor in the feedback loop of mammalian circadian genes. Reportedly, BMAL1 knockout mice have an attenuated rhythm of sleep and wakefulness, increased total sleep and shifts of EEG frequency distribution (Laposky et al., 2005). Due to adult alterations of sleep wake cycles can be induced by developmental treatment with drugs, behaviors or living environment, we wonder if adult suppression of BMAL1 gene by brain injection of BMAL1 siRNA produces different effect on sleep wake cycles.
Methods: Adult C57BL/6J mice were implanted with EEG and EMG electrodes and guide cannula for intracerebroventricular injection. After 10 days recovery, mice were injected with either BMAL1 siRNA (Santa Cruz, delivered by rabies virus glycoprotein peptide 9R (RVG-9R), 4 µg of siRNA/mouse) or vehicle (scramble siRNA mixed with RVG-9R). Injection was made at 4:00 pm (Lights: on =8:00am, off =8:00pm). PSG were recorded for 1 baseline and 3 treatment days. PSG were scored by computer (Somnologica Science). Scores were visually confirmed by two technicians and analyzed by two way ANOVA and Holm-Sidak test.
Results: On the first treatment day, suppression of BMAL1 significantly increased wake percentage in the first few hours and advanced the wake cycles. The subsequent sleep cycle, however, was extended. In the second and third day, treated mice had reduced wake percentage during the dark period but no changes in overall wake percentage in the light period. The treated group also had changes in REM sleep and NREM sleep. EEG frequency shifts were observed visually and will be analyzed. Brain orexins and GABA associated enzymes will also be analyzed and reported.
Conclusion: BMAL1 suppression advanced wake behavior on the first day and reduced wakefulness thereafter. This finding is partially different from that of BMAL1 knockout mice.
Support (If Any): Work was supposed by VA Merit Award and Research Service of Louis Stokes Cleveland VA Medical Center.

0127

INHIBITION OF SELECT MICRO RNAS AFFECTS SLEEP AND ELECTROENCEPHALOGRAPHIC SLOW WAVE ACTIVITY

Davis CJ[1,2,3], Clinton JM[1,2,3], Krueger JM[1,2,3]
[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA, [3]Graduate Program in Neuroscience, Washington State University, Pullman, WA, USA

Introduction: Micro RNAs (miRNAs) are small (~22) nucleotide strands that regulate mRNA stability. miRNAs affect about a third of protein coding genes. The regulation of miRNAs is important to virtually every biological process studied. We previously demonstrated that levels of brain miRNAs change with sleep propensity and increasing miRNA-132 levels alters sleep. Herein we use specific miRNA inhibitors to show that manipulating brain miRNA levels changes sleep; thereby establishing causality between miR¬NA and sleep.
Methods: Male Sprague-Dawley rats 275-325 g (n = 7-9) were maintained on a 12 h light/dark cycle and instrumented with intracerebroventricular can¬nula and differential EEG electrodes over the cortex. At light onset, a negative control miRNA sequence was injected and after 24 h, let-7b, miR-138 or miR-125a inhibitor sequences (4 pmoles each) were delivered. EEG was recorded for 4 post-injection days and manually scored as wake, rapid eye-movement sleep (REMS) or non-REMS (NREMS). Power analyses of NREMS EEG slow-wave activity (NR-SWA) were performed and compared with recordings from control days.
Results: Regardless of inhibitor sequence, no changes were observed on treatment day 1. The let7-b inhibitor attenuated NREMS amounts during the light phase and decreased REMS amounts during light and dark phases on treatment days 2 and 3, however, NR-SWA deficits were confined to the light phase on both days. Conversely, during the light period the miR-138 inhibitor decreased NREMS duration and increased REMS duration while NR-SWA was decreased during both light and dark periods on post-injection days 2 and 3. Finally, the miR-125a inhibitor did not signifi¬cantly alter NREMS or REMS amounts or NR-SWA on any treatment day.
Conclusion: These findings show that in vivo manipulation of miRNAs has the capacity to alter sleep phenotypes. It seems likely that miRNAs, that target known sleep-linked mRNAs, are important components in sleep regulation.
Support (If Any): NS25378 NS31453.

0128

CHANGES IN END-EXPIRATORY LUNG VOLUME (EELV) FOLLOWING SLEEP ONSET

Kawar E, Sethi J, Gartman E, Mourad M, McCool FD
Pulmonary, Critical Care and Sleep Medicine, Memorial Hospital of Rhode Island/ Brown University, Pawtucket, RI, USA

Introduction: A reduction in EELV would decrease tracheal radial traction and predispose to obstructive apneas. Within the first 3-5 breaths following sleep onset (SO), obese subjects lower their EELV by an average of 61mL versus only 34mL in controls (JAP 109: 1027, 2010). In this prior study, subjects were instrumented with esophageal and gastric catheters, had tight-fitting nasal masks, and were awakened every 5 minutes following sleep onset. The goal of our study was to assess changes in EELV following SO but in contrast to previous work, we sought to study the subjects without invasive instrumentation and for prolonged periods of sleep.
Methods: Four subjects undergoing standard PSG were fitted with 2 pairs of magnetometer coils placed over the anterior and posterior surfaces of the rib cage (RC) and abdomen (Ab). Tidal volume was calculated using the following model: $VT = \alpha RC + \beta Ab + \gamma Xi$ where: Xi represents the Δ distance between the sternum and umbilicus; and α, β and γ represent volume-motion coefficients. EELV was continuously monitored until body position changed or there was an awakening. Changes in EELV were measured relative to EELV prior to SO. Sleep was staged per AASM standards.
Results: EELV decreased by 248 ± 228 ml (mean ± SD) following SO and took between 10 to 30 minutes to reach its nadir which occurred during N2 or N3. The drop in EELV was similar in magnitude to VT (260 ± 133).
Conclusion: Our finding of a greater reduction in EELV than previously reported may be due to a longer observation period following SO and the lack of subject instrumentation. It may be of sufficient magnitude to predispose to obstructive apnea.

0129

INCREASED GENIOGLOSSUS SINGLE MOTOR UNIT ACTIVITY IN SLOW WAVE COMPARED TO STAGE 2 SLEEP

McSharry DG[1], Saboisky J[1], DeYoung P[1], Trinder JA[2], Malhotra A[1]
[1]Sleep Medicine, Brigham and Womens's Hospital and Harvard Medical School, Boston, MA, USA, [2]Department of Psychological Sciences, The University of Melbourne, Melbourne, VIC, Australia

Introduction: Slow wave sleep (SWS) is associated with fewer obstructive apneas (OSA) than other stages, although mechanisms are unclear. We sought to determine neural influences by which SWS protects against OSA. Characterizing single motor unit (SMU) activity in the genioglossus (chief upper airway dilator) provides insight into the control of the hypoglossal nucleus. We hypothesized that the activity of inspiratory phasic (IP) and inspiratory tonic (IT) SMUs would be increased in SWS compared to Stage 2.
Methods: 27 humans were studied overnight. Genioglossus activity measured using intramuscular electrodes was analyzed for SMU activity. Polysomnography and end-tidal CO2 were recorded. Data analysis identified 15 IP and 11 IT SMUs that remained active during Stage 2 and SWS. The SMU firing durations (% inspiratory time, %TI), the onset, peak and end discharge frequencies (inspiratory) and the tonic discharge frequencies (expiratory) of the SMUs were compared between the 2 stages. All measurements for each individual SMU were made in three consecutive breaths in both sleep stages.
Results: Respectively, IP and IT units had higher peak discharge frequencies during SWS (mean±SEM) (22.2±1.3Hz, 23.3±0.8Hz) compared to Stage 2 sleep (19.7±1.4Hz, 21.0±0.9Hz; P=0.011, P=0.013 between stages). The IT discharge frequencies during expiration were higher during SWS compared to Stage 2 (14.2±0.5Hz versus 12.6±0.9Hz; P=0.035). IP units fired for a longer median duration during SWS (median, interquartile range) (105.6, 67.3-140.7%TI) compared to Stage 2 sleep (86.7, 47.3-115.3%TI) (P<0.001). The CO2 was 38.7±0.8mmHg in Stage 2 compared to 39.2±0.8mmHg in SWS (P<0.001).
Conclusion: IT units discharge faster in inspiration and expiration in SWS compared to Stage 2. IP units discharge faster and longer in SWS compared to Stage 2. These findings should result in enhanced continuous upper airway dilation explaining why SWS protects against apneas. Differences in CO2 between the 2 stages are unlikely to explain these findings.
Support (If Any): AHA 0840159N, AHA 11 POST 5660004, NIH R01 HL085188, R01 HL090897, K24 HL 093218, and P01 HL 095491.

0130

VENTILATORY OSCILLATIONS IN STABLE CONTROL SYSTEMS AS AN INTERACTION BETWEEN EXTERNAL DISTURBANCES AND FEEDBACK STABILITY

Sands SA[1], Nemati S[1], Mebrate Y[2,3], Edwards BA[1], Manisty C[2], Wellman A[1], Willson K[2], Francis DP[2], Malhotra A[1]
[1]Division of Sleep Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA, [2]International Center for Circulatory Health, St. Mary's Hospital and Imperial College, London, United Kingdom, [3]Department of Clinical Engineering, Royal Brompton Hospital, London, United Kingdom

Introduction: Negative-feedback control of ventilation becomes unstable during sleep when chemoreflex sensitivity or circulatory delay are excessive (that is, when loop gain >1.0). Such instability manifests as consistent periodic patterns such as Cheyne-Stokes respiration, which provide a major impediment to continuous sleep. Unlike true instability, patterns of inconsistent "pseudo-oscillatory" variability commonly occur clinically for reasons that are difficult to establish. Here we describe how oscillatory variability develops in stable feedback systems when random ventilatory disturbances, such as wake-sleep transitions and arousals, become amplified into oscillations as determined by feedback stability. We test the hypothesis that oscillations in stable systems exhibit irregularity of amplitude and duration between successive cycles. We further examine whether stability can be practically quantified from the characteristics of ventilatory variability.
Methods: A mathematical ventilatory control model was continuously disturbed with random (white) noise across a broad range of disturbance amplitudes and LG levels. Accompanying theory shows that the feedback system amplifies ongoing disturbances by the factor $1/(1-LG)$.
Results: Oscillatory amplitudes rose linearly with the disturbance and hyperbolically as LG approached the threshold for instability (1.0). Clinically-significant oscillations occurred even with LG<1; LG=0.8 induced a central apnea-hypopnea index of >5 events/hour with a modest random disturbance (SD=20% of eupneic ventilation). Irregularity of amplitude (SD>25% of mean amplitude) and timing (SD>10% of mean cycle duration) between successive peaks discriminated between oscillations in stable versus unstable conditions. Frequency-based estimation of LG using LG=1−(underlying disturbance amplitude)/(peak amplitude) provided LG estimates within ±0.1 of true LG.
Conclusion: Irregular oscillatory patterns emerge from random external disturbances to stable systems in a manner that is uniquely determined by stability; paradoxically, distinct irregularity of amplitude and timing implies greater feedback stability. Such patterns may be particularly resistant to treatment since the variability arises from unpredictable disturbances rather than feedback instability alone.
Support (If Any): Dr. Sands is the recipient of an American Heart Association Postdoctoral Fellowship.

0131

THE ROLE OF ENDOTHELIN RECEPTOR ANTAGONIST IN THE PREVENTION OF RIGHT VENTRICULAR HYPERTROPHY IN AN ANIMAL MODEL OF OBSTRUCTIVE SLEEP APNEA

Suwannakin A[1], Jaimchariyatam N[1], Sanguanrungsirikul S[2], Chantranuwatana P[3]

[1]Division of Pulmonary and Critical Care Medicine, Department of Medicine, Faculty of Medicine, Chulalongkorn university, Bangkok, Thailand, [2]Department of Physiology, Faculty of Medicine, Chulalongkorn university, Bangkok, Thailand, [3]Department of Pathology, Faculty of Medicine, Chulalongkorn university, Bangkok, Thailand

Introduction: Obstructive sleep apnea (OSA) has become an important risk factor for cardiovascular morbidity. On the basis of the published evidences made the patients with OSA have the potential to develop pulmonary hypertension (PH). Chronic intermittent hypoxia (CIH), a major component of OSA, is found to be responsible for the development of PH indicated by increased pulmonary arterial pressure and/or right ventricular hypertrophy (RVH). Additionally, there were evidences of the involvement of endothelin in CIH-associated PH. We examined the effect of Bosentan, endothelin receptor antagonist, on RVH and pulmonary vascular remodeling in an animal model of OSA.

Methods: Eighteen Wistar rats were randomly divided into 3 groups (6 rats in each group), including one control group and two CIH groups. Rats in both CIH groups were exposed to alternating cycles of normoxia (30 seconds at 21% O2) and hypoxia (30 seconds at 10% O2), repeated continuously for 8 h/day during the light portion of the cycle for 14 days. Bosentan 100 mg/kg/day was given to one CIH group throughout the study. Hearts and lungs sections were processed for histopathology at the end of study.

Results: RVH was found in CIH group, compared with that seen in control and CIH group exposed to Bosentan (mean right ventricle to left ventricle plus septum weight ratio of 0.19, 0.13, and 0.18 respectively; p=0.015). Histopathological studies revealed non-significant difference in percent wall thickness of pulmonary arteriole (50-100 micron in diameter) among 3 groups (30.7, 20.2, and 26.2 respectively; p=0.231).

Conclusion: CIH induces RVH and pulmonary vascular remodeling, the potential complications of PH. The beneficial effect of Bosentan on the prevention of RVH suggests it as possible therapeutic option in OSA-associated PH. Our ongoing studies focusing on hemodynamic changes and smaller pulmonary arteriole (20-50 micron in diameter) in animal model of OSA may provide additional information.

0132

REM SLEEP AND METABOLIC SATIETY PATHWAYS

Olson CA[1,2], Hamilton N[1], Somers VK[2]

[1]Department of Psychology, University of Kansas, Lawrence, KS, USA, [2]Division of Cardiovascular Diseases, Department of Internal Medicine, Mayo Clinic, Rochester, MN, USA

Introduction: Sleep plays a role in energy homeostasis. Although epidemiological evidence links sleep and obesity, the mechanism remains poorly understood. Hormones which regulate appetite, including leptin, an adipocyte derived hormone which suppresses appetite, may be a possible mechanism linking sleep to weight gain. The present study examined the relationship between sleep and serum leptin in a sample of healthy adults.

Methods: Participants were 58 healthy adults who underwent polysomnography. Leptin was measured before and after sleep. The relationship between sleep and leptin was analyzed using hierarchical linear regression.

Results: No significant relationship was observed between total sleep time and change in leptin levels (p >.05). However, percentage of REM sleep was significantly related to change in leptin during sleep (p<.01). This effect was independent of age, gender, percent body fat and total sleep time. Individuals who spent a greater portion of sleep in REM had a greater decrease in leptin from night to morning.

Conclusion: Results of this study suggest that there are significant interactions between REM sleep, adipokine regulation, and obesity. Further research on the relationship between REM sleep and adipose functioning is needed.

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SLEEP DURATION AND PLASMA LEPTIN CONCENTRATIONS IN EARLY PREGNANCY AMONG LEAN AND OVERWEIGHT/OBESE WOMEN

Qiu C[1], Frederick IO[1], Sorensen TK[1], Enquobahrie DA[1,2], Williams MA[1,3]

[1]Perinatal Studies, Swedish Medical Center, Seattle, WA, USA, [2]Department of Epidemiology, School of Public Health, University of Washington, Seattle, WA, USA, [3]Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA

Introduction: While we and others have reported that short maternal sleep duration during early pregnancy are predictive of gestational diabetes and preeclampsia, potential mechanisms for these associations are unknown. Leptin, an adipocyte-derived peptide involved in regulating food intake and energy expenditure, may play a role in these observed associations. Given inconsistent reports of associations between short sleep duration, and leptin, and that prior studies did not include pregnant women; we examined the association of maternal sleep duration with plasma leptin concentrations in early pregnancy. We also examined the extent to which, if at all, this association differs by maternal pre-pregnancy lean or overweight/obesity status.

Methods: This cross-sectional study included 830 pregnant women who reported early pregnancy sleep duration during in-person interviews. Plasma leptin, measured in samples collected <16 weeks gestation, were determined using enzyme immunoassays. Sleep duration was categorized as: ≤5, 6, 7-8, and ≥9 hours. Differences in leptin concentrations across categories were estimated using linear regression. Analyses were completed for lean and overweight/obese women (pre-pregnancy BMI <25 and ≥25 kg/m2), respectively.

Results: There was no association of leptin with sleep duration among lean women. Among overweight/obese women, a reverse J-shaped relation between leptin and sleep duration was observed. Mean early pregnancy leptin was greatly elevated (β=24.99 ng/ml, P<0.001) among women reporting ≤5 hour of sleep compared with controls who reported 7-8 hours of sleep. Compared with the same control group, women reporting ≥9 hours of sleep also had elevated leptin (β=4.61 ng/ml, P=0.11).

Conclusion: Early pregnancy sleep duration was not related with leptin in lean women. However, short sleep duration, and to a lesser extent long sleep duration, were associated with elevated leptin among overweight/obese women. Further studies are needed to understand the consequences of sleep duration on altered leptin synthesis and release in lean and overweight/obese pregnant women.

0134

IMPAIRED SLEEP-PROMOTING MECHANISMS IN BROWN ADIPOSE TISSUE DEFICIENT MICE

Ames C[1], Kapas L[1,2,3], Szentirmai [1,2,3]

[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Department of Veterinary and Comparative Anatomy, Physiology and Pharmacology, Washington State University, Pullman, WA, USA, [3]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA

Introduction: We hypothesize that the interaction among circadian factors, prior sleep loss and metabolic signals is the key factor in determining the amount and quality of sleep. Brown adipose tissue (BAT) plays

a central role in the regulation of metabolism. The metabolic actions of BAT are due to the presence of uncoupling protein-1 (UCP-1), which is found exclusively in brown adipocytes. The aim of the present study was to test the significance of BAT-related metabolic processes in sleep regulation. We tested spontaneous sleep and sleep responses to sleep deprivation and increased ambient temperature in UCP-1 knockout (KO) mice which have metabolically inactive BAT.
Methods: Male UCP-1 KO and C57BL/6 mice (n = 15-16 per genotype) were used. In the first experiment, we studied the effects of 6 h sleep deprivation by gentle handling at thermoneutral (30°C) temperature. In the second experiment, we determined the effects of 5-day exposure to 35°C ambient temperature on sleep, metabolism and feeding.
Results: Under baseline conditions, sleep of UCP-1 KO mice was more fragmented and they had decreased NREMS during the light and increased REMS during the dark period as compared to controls. NREMS and REMS rebounds after sleep deprivation were significantly attenuated by ~50% in the KO animals. There was no difference in the EEG slow-wave activity (SWA) responses to sleep deprivation between genotypes. Exposure to warm ambient temperature elicited a daily increase of ~140 min in NREMS and a decrease in SWA in control animals. In KO mice, the sleep increases were about half of that seen in controls; there was no difference in the SWA responses. In both groups, warm exposure suppressed VO2, respiratory exchange ratio and feeding.
Conclusion: Present results support the hypothesis that the metabolic activity of BAT is crucial in maintaining normal sleep-wake activity and metabolism in mice.
Support (If Any): Faculty Seed Grants to Levente Kapás and Éva Szentirmai awarded by Washington State University.

0135

INTACT WAKE-PROMOTING MECHANISMS IN UCP-1 KNOCKOUT MICE

Szentirmai
[1]WWAMI Medical Education, Washington State University, Spokane, WA, USA, [2]Department of Veterinary and Comparative Anatomy, Physiology and Pharmacology, Washington State University, Pullman, WA, USA, [3]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA

Introduction: Brown adipose tissue (BAT) has a key role in regulating metabolism. It is specialized for metabolic heat production due to the unique presence of the uncoupling protein 1 (UCP-1) in the brown fat cell mitochondria. There is a well-studied relationship between metabolism and sleep. UCP-1 KO mice are cold-sensitive and show attenuated homeostatic sleep responses to sleep deprivation and diminished sleep increase when placed in warm ambient temperature. We hypothesized that intact BAT is also required for generating normal arousal in response to wake-promoting stimuli such as new environment and cold exposure.
Methods: Male UCP-1 KO and control mice (n = 8 per genotype) were used in the experiments. In Experiment 1, baseline sleep, body temperature and locomotor activity were recorded for 24 h in the animals' home cages where they had been for at least one week before the experiment. On the test day, all animals were placed into new cages with fresh bedding and food at dark onset and recordings were continued for 24 h. In Experiment 2, baseline sleep, body temperature and locomotor activity were recorded for 2 consecutive days at 30°C ambient temperature. On the third day, ambient temperature was reduced to 25°C for 1 day and data collection continued.
Results: Exposure to novel environment induced increases in wakefulness and locomotor activity with the concomitant suppression of sleep for 6 h in control and UCP-1 KO mice. The responses of KO and control animals were indistinguishable. Reduction in ambient temperature induced significant increase in wakefulness and decrease in NREMS, REMS and body temperature in both genotypes. These effects were more robust and longer-lasting in UCP-1 KO mice.
Conclusion: Present results indicate that UCP-1 KO mice have intact wake-promoting mechanisms and they show increased sleep and thermoregulatory sensitivity to cold challenge.
Support (If Any): Faculty Seed Grant to Éva Szentirmai awarded by Washington State University.

0136

MALE ADULT MICE WITH LOW BIRTH WEIGHT SHOW AN INCREASED SLEEP PRESSURE

Shimizu N[1], Chikahisa S[1], Iwaki Y[1], Kitaoka K[2], Sei H[1]
[1]Department of Integrative Physiology, Institute of Health Biosciences, The University of Tokushima Graduate School, Tokushima-city, Japan, [2]Department of Physiology, Institute of Health Biosciences, The University of Tokushima Graduate School, Tokushima-city, Japan

Introduction: Nutritional state during pregnancy and/or lactation period in mother affects fetal growth and infant development. It is reported that extreme calorie restriction (CR) during pregnancy induce low birth weight (LBW) in newborn infant. LBW accompanied by accelerated post-natal or catch-up growth (CUG) in infant is known to increase a risk factor for type 2 diabetes and metabolic syndrome. However, little is known about whether the LBW would affect higher brain function including sleep, anxiety and/or depression. In the present study, we investigated the effect of LBW on sleep, anxiety and/or depression in offspring mice.
Methods: We first developed a mouse LBW model by CR against pregnant female mice. Pregnancy was dated with vaginal plugs (day 0.5), then pregnant female mice were performed CR (0% for control or 50%) from day 12.5 to 18.5. After the parturition, dams were assigned to ad libitum chow. In their adulthood (8-9 weeks of old), we carried out the sleep recording and behavioral tests to evaluate the anxiety and depression level. Furthermore, we measured the monoamine concentration and mRNA level related to monoamine metabolites pathway using by microdialysis and real time RT-PCR in several brain regions respectively.
Results: We found that CR mice showed LBW accompanied by CUG and a marked increase in anxiety- and depression-like behavior compared with control mice in their adulthood. Furthermore, the EEG delta/theta ratio during NREM sleep in the CR mice was significantly augmented compared with the control mice over 24 hours. CR mice also showed an enhancement of rebound after 6-hour sleep deprivation. Spontaneous activity was significantly decreased in the first half of the dark period in CR mice. In addition, we observed, in CR mice, an increase in 5-HIAA, a metabolite of serotonin, and a decrease in mRNA expression of Slc6a4, a serotonin transporter, after the forced swim test.
Conclusion: Malnutrition during pregnancy causes LBW and affects the sleep homeostasis in adult offspring mice. An impairment of monoamine dynamics caused by alternation of metabolic state during fetal or CUG period may induce an abnormality of neurobehavioral functions in adulthood.

0137

HIGH FAT DIET FEEDING INCREASE ACTIVE-PERIOD SLEEP AND SLEEP FRAGMENTATION IN RATS

Mavanji V[1], Teske J[2,3,4,6], Billington C[1,3,4,5], Kotz C[1,2,3,4]
[1]Minnesota Obesity Prevention Training Program, School of Public Health, University of Minnesota, Minneapolis, MN, USA, [2]Food Sciences and Nutrition, Univ. of Minnesota, Minneapolis, MN, USA, [3]Research Service, Veterans Affairs Medical Center, Minneapolis, MN, USA, [4]Minnesota Obesity Center, University of Minnesota, Minneapolis, MN, USA, [5]Department of Medicine, University of Minnesota, Minneapolis, MN, USA, [6]Department of Nutritional Sciences, University of Arizona, Tucson, AZ, USA

Introduction: Obesity in humans is characterized by excessive daytime sleepiness. Earlier, we showed an association between resistance to weight gain and reduced active-period sleep in obesity-resistant (OR)

rats. However, it is unknown if high fat diet induced body weight gain alters sleep in rats. We hypothesized that HFD-induced body weight gain in rats promotes active period sleep and examined the effect of HFD feeding on body weight and sleep in Sprague-Dawley (SD) rats.
Methods: Three month old SD rats were implanted with transmitters for recording sleep/wake behavior. Sleep wake cycle was monitored for 24h before and after rats were fed HFD (45% of fat) or control diet for 8 weeks. Recordings were scored as wakefulness (W), slow-wave-sleep (SWS) and rapid eye movement sleep (REMS). Total number of transitions between stages, food intake and changes in body weight were also documented.
Results: Feeding HFD for 8 weeks significantly ($P<0.05$) increased body weight. The 24h sleep/wake analysis showed that time spent in in SWS was significantly ($P<0.001$) increased and time spent in W ($P<0.01$) was reduced compared control diet fed rats. Excess body weight induced by HFD also increased the number of transitions ($P<0.001$) between stages during 24h recording in the HFD fed animals. The observed increase in SWS and decrease in W was mainly due to sleep/wake alterations occurring during active phase, as the percent time in sleep/wake states were not different between control and HFD fed rats during the light phase. Indeed rats fed HFD spent significantly more time in SWS ($P<0.001$) and less time in W ($P<0.001$) in the dark phase as well as exhibited more number of transitions between states ($P<0.001$) compared to control diet fed rats.
Conclusion: High fat diet intake promotes weight gain in rats, which is associated with excessive active period sleep and sleep fragmentation. These data support the hypothesis that weight gain is associated with excessive active period sleep, however, a HFD pair-fed group is needed to determine whether the high fat diet itself or the weight gain due to increased caloric intake alters active period sleep.

0138

TESTOSTERONE AND SLEEP SCHEDULES

Tompkins L[1], Jackson ML[2], Banks S[3], Belenky G[1]
[1]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA, [2]School of Social Sciences and Psychology, Victoria University, Melbourne, VIC, Australia, [3]Centre for Sleep Research, University of South Australia, Adelaide, SA, Australia

Introduction: Testosterone has been the focus of several studies, but the specifics of how testosterone changes with varying sleep schedules has yet to be reported. This study examined the effect of divided (split) sleep as well as consolidated daytime and consolidated nighttime sleep on testosterone.
Methods: N=53 healthy males (26.6±4.0y) participated in a controlled in-residence laboratory experiment. All participants underwent 2 baseline days (10h; TIB 22:00-08:00) before being randomized to a 5 day work week with either a daytime sleep (N=17; TIB 10:00-20:00), split sleep (N=17; split-shift work with morning and afternoon sleep periods; TIB 03:00-08:00 and 15:00-20:00) or nighttime sleep (N=19; TIB 22:00-08:00). All subjects then had a recovery sleep of 10h TIB (22:00-08:00). Blood was taken by intravenous catheter on the second baseline day and after the recovery sleep at 09:00, 10:00, 12:00, 14:00, 16:00, 18:00, and 20:00. Samples were assayed for testosterone by Quest Diagnostics. Mixed-effects ANCOVA was performed to examine the effect of sleep condition (daytime, split, nighttime), work week (pre, post) and time of day on testosterone levels, controlling for age and BMI.
Results: Sleep condition alone did not differentially affect testosterone ($F[2, 47.99]=2.43$, $P=0.10$). There was a significant main effect of time of day on testosterone levels, with highest levels at the 09:00 draw compared to the rest of the day for all sleep conditions ($F[6,146.84]=66.64$, $P<0.001$). There was a significant interaction of condition by week ($F[2,559.96]=8.24$, $P<0.001$). Testosterone levels were higher in the daytime sleep condition after the work week.
Conclusion: Overall there was no effect of sleep condition on testosterone. However, testosterone did show the expected daytime rhythm. This data confirms and extends previous findings that there is a peak level of testosterone in the early morning, and that this pattern is not influenced by prior sleep schedule.
Support (If Any): FMCSA award DTMC75-07-D-00006.

0139

EARLY EXPOSURE TO GONADAL HORMONES ORGANIZES SLEEP BEHAVIOR IN ADULT RATS

Cusmano D[1], Hadjimarkou MM[1,2], Viechweg SS[1], Mong JA[1]
[1]Department of Pharmacology and Experimental Therapeutics, University of Maryland, School of Medicine, Baltimore, MD, USA, [2]Department of Psychology, University of Cyprus, Nicosia, Cyprus

Introduction: Sex differences in sleep have been reported in a number of species, including humans, non-human primates and rodents. Although gonadal hormones can modulate sleep, little is known about the development of these sex differences. Perinatal exposure to gonadal hormones can permanently organize steroid sensitive neural substrates and influence adult behaviors. More recently, puberty has been suggested to be a second organizational window. We have previously shown that neuronal activation of the ventrolateral preoptic (VLPO) area, a critical sleep nucleus, is regulated by estradiol (E2; Hadjimarkou et al. 2008). Therefore, in rodents, we tested whether the sleep circuitry is sensitive to the masculinizing effects of early gonadal hormone exposure and whether peripubertal hormones are necessary for adult sleep patterns.
Methods: First, neonatal female rat pups received either testosterone propionate (TP; 100µg; masculinized females, n=6) or oil (100 µl, n=6) and males (n=6) received oil on the day of birth and postnatal day 1 (PN1). Second, a new cohort of animals was allowed to develop normally until they were gonadectomized (GDX) on PN24 to prevent the peripubertal rise in hormones. In adulthood, all animals were GDX and given sex-specific hormones: genetic females received two injections of E2 (5µg then 10µg), while genetic males received two injections of TP (500µg), 24-hours apart. Sleep-wake patterns were quantified during baseline (absence of hormones) and hormone replacement periods. VLPO activation was quantified using fos-immunoreactivity.
Results: In the absence of hormones, no sex differences were found in sleep-wake totals across all groups in each cohort. In the first cohort, hormone replacement increased wakefulness at the expense of REM sleep in control females but not masculinized females, who, like the males, did not show alterations in sleep-wake behavior. Furthermore, control females express more fos+ cells in the VLPO than males or masculinized females. In the second cohort, peripubertal E2 in females may organize adult wake and NREM sleep behavior, but not REM sleep, as E2 significantly attenuated REM sleep without affecting wake or NREM in females GDX prior to puberty.
Conclusion: Together, our data suggest that sex differences in sleep result from organizational/activational effects of gonadal hormones. Sexually differentiated sleep circuitry is activated by the adult hormonal milieu, which results in sex differences in sleep.
Support (If Any): NIH 1RO1HL85037.

0140

SEX DIFFERENCES IN THE SLEEP-WAKE DEPENDENT VARIATION OF BODY TEMPERATURE AND THEIR RELATIONSHIPS TO SUBJECTIVE ESTIMATES OF SLEEP ONSET LATENCY

Yeh W[1,2], Boudreau P[1,2], Shechter A[1,2], Boivin DB[1,2]
[1]Department of Psychiatry, McGill University, Montreal, QC, Canada, [2]Integrated Program in Neuroscience, McGill University, Montreal, QC, Canada

Introduction: Prior evidences indicate that heat loss at the extremities is important for sleep initiation. Mozaffarieh et al. (2010) also reported that women are more likely than men to complain of cold extremities. Given the greater prevalence of insomnia in women, our goal was to

compare body temperature changes surrounding sleep-wake transitions and their relationships to subjective estimates of sleep onset latency between sexes.
Methods: Ten healthy men (mean age ± SD: 25.77 ± 4.48 years) and 10 healthy women in their follicular phase (26.01 ± 3.06 years) participated in a 72-hour ultradian sleep-wake cycle (USW) procedure (60-minute wake alternating with 60-minute nap episodes). Participants maintained a semi-recumbent posture in time-isolation and were served iso-caloric snacks (1x/2hrs). Measures included core body temperature (CBT, 4x/min), distal skin temperature (DT, 1x/min), calculated distal-core temperature gradient (DCG), and subjective sleep onset latency (S-SOL) after each nap. Statistical analyses included non-linear mixed model with a dual-harmonic regression component and Spearman's rank correlation.
Results: Women had higher DT and DCG than man during wake ($p<.05$) but not nap episodes ($p=.14$ and $p=.11$, respectively). During nap episodes, women showed a greater rate of increase of DT and DCG than men ($p<.05$). During wake episodes, women showed a greater rate of decrease of DT and DCG than men ($p<.05$). For women, SOL only correlated with CBT ($\rho=.258$, $p<.01$). For men, SOL correlated with CBT ($\rho=.380$, $p<.01$), DT ($\rho=-.171$, $p<.05$), and DCG ($\rho=-.217$, $p<.01$).
Conclusion: Our results demonstrate that healthy women have greater and comparable DT to that of men during wake and nap episodes, respectively. The rate of change of DT and DCG differed from that of men following both wake-to-nap and nap-to-wake transitions. DT and DCG correlated with S-SOL for men only. Our results suggest that body temperature changes affect subjective estimates of sleep onset latency differently between sexes.
Support (If Any): This research was supported by a CIHR operating grant, and salary support from the Faculty of Medicine of McGill University (AS), the IRSST (PB) and the FRSQ (DBB).

0141

SLEEP-STAGE STRATIFICATION PATTERN IN CARDIO-RESPIRATORY PHASE SYNCHRONIZATION

Bartsch RP[1], Schumann AY[3], Kantelhardt JW[4], Penzel T[5], Ivanov PC[1,2]
[1]Division of Sleep Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA, [2]Center for Polymer Studies and Department of Physics, Boston University, Boston, MA, USA, [3]Complexity Science Group and Department of Physics and Astronomy, University of Calgary, Calgary, AB, Canada, [4]Institute of Physics, Martin-Luther-University Halle-Wittenberg, Halle (Saale), Germany, [5]Sleep Center, Charité University Hospital, Berlin, Germany

Introduction: Multiple-component physiologic systems, such as the cardiac and respiratory system, exhibit complex dynamics that are further influenced by intrinsic feedback mechanisms controlling their coupling. The nature of the cardio-respiratory interaction, and whether it changes with transitions across physiologic states and conditions is not understood. Since key scale-invariant, linear and nonlinear properties of the cardiac and the respiratory system change across different sleep stages, a plausible hypothesis is that also the cardio-respiratory coupling would be influenced by sleep-stage transitions. Further, we hypothesize that this coupling may change with healthy aging.
Methods: We analyze continuous 8-hours polysomnographic recordings of 200 healthy subjects age range 20 to 95 years old. To probe cardio-respiratory coupling, we apply a phase synchronization analysis method to quantify the adjustment of rhythms between heartbeat and breathing signals and to probe for consistent occurrence of heartbeats at the same relative phases within consecutive breathing cycles. We investigate how cardio-respiratory synchronization (CRS) changes with sleep-stage transitions and under healthy aging.
Results: We find a statistically significant difference in the degree of CRS during different sleep stages for both young and elderly subjects and a significant decline of synchronization with age. Specifically, CRS abruptly changes up to 400% with transition from one sleep stage to another. Moreover, the degree of CRS strongly depends on the specific sleep stage, forming a robust sleep-stage stratification pattern observed for all subjects and over all age groups.
Conclusion: Sleep-stage transitions are associated with rapid adjustment of CRS despite continuous fluctuations in heartbeat and respiratory intervals. We demonstrate that CRS and the traditionally studied respiratory sinus arrhythmia (RSA) represent different and unrelated aspects of the cardio-respiratory coupling, and that key physiologic variables related to neuroautonomic mechanisms of the cardiac and respiratory systems which influence RSA do not affect CRS.
Support (If Any): We acknowledge support from NIH Grant 1R01HL098437-01A1, Office of Naval Research Grant 000141010078, the Brigham and Women's Hospital BRI Fund and the German Academic Exchange Service (DAAD).

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PHYSIOLOGIC NETWORKS: TOPOLOGICAL AND FUNCTIONAL TRANSITIONS ACROSS SLEEP STAGES

Ivanov PC[1,2], Bartsch RP[1], Bashan A[3], Kantelhardt JW[4], Havlin S[3]
[1]Division of Sleep Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA, [2]Center for Polymer Studies and Department of Physics, Boston University, Boston, MA, USA, [3]Department of Physics, Bar-Ilan University, Ramat-Gan, Israel, [4]Institute of Physics, Martin-Luther-University Halle-Wittenberg, Halle (Saale), Germany

Introduction: The human organism is a complex network of interconnected organ systems, where the behavior of one system affects the dynamics of other systems. Due to these interactions, failure of one system can trigger a breakdown of the entire network. With transitions across physiologic states (e.g., sleep-stages), the dynamics of physiologic systems as well as their interaction may change. Identifying and quantifying dynamical networks of diverse systems under varied physiologic conditions is a challenge. We hypothesize that during a given physiologic state the physiologic network may be characterized by a specific topology and coupling strength between systems that change in response to transition from one physiologic state to another.
Methods: We introduce the concept of time delay stability to identify and quantify dynamic links among physiologic systems. We analyze continuously recorded multi-channel physiologic data from 36 healthy young subjects (18 female, 18 male, age 20-40 yrs) during 8 hours nighttime sleep. This allows us to track the dynamics and evolution of the physiologic network during sleep stages and sleep-stage transitions. We study the network of interactions for an ensemble of key integrated physiologic systems (cerebral, cardiac, respiratory, ocular and muscle activity). We focus on the topology and dynamics of the network and their relevance to physiologic function.
Results: We find that each physiologic state is characterized by a specific network structure, demonstrating a robust interplay between network topology and function. Across physiologic states the network undergoes topological transitions associated with fast reorganization of physiologic interactions on time scales of a few minutes, indicating high network flexibility in response to perturbations.
Conclusion: Changes in the physiologic state lead to complex network transitions associated with a remarkably structured reorganization of network connectivity and topology that simultaneously occurs in the entire network as well as at the level of individual network nodes, while preserving the hierarchical order in the strength of individual network links. In the context of sleep stages, network transitions are characterized by a specific stratification pattern where network connectivity and link strength are significantly higher during light sleep compared to deep sleep and during wake compared to REM. This system-wide integrative approach may facilitate new dimensions to the field of systems physiology.
Support (If Any): Supported by: NIH Grant 1R01HL098437-01A1, Office of Naval Research Grant 000141010078, Brigham and Women's

Hospital BRI Fund, US-Israel BSF Grant 2008137 and the German Academic Exchange Service (DAAD).

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TIME DOMAIN AND FREQUENCY DOMAIN OF HEART RATE VARIABILITY IN DIFFERENT SLEEP STAGE: AN INDICATOR OF DISEASE SEVERITY

Wang C[1,2,4], Ting H[1,3], Huang R[1,3], Yang C[2,4]
[1]Psychology, National Chengchi University, Taipei, Taiwan, [2]Sleep Medicine Center, Chung Shan Medical University Hospital, Taichung, Taiwan, [3]Clinical Medicine, Chung Shan Medical University Hospital, Taichung, Taiwan, [4]Sleep Lab, National Chengchi University, Taipei, Taiwan

Introduction: Obstructive sleep apnea (OSA) is common among adults. Research showed that the severity of OSA was more associated with changes in QT interval variability during sleep than with standard measures of heart rate variability (HRV). This study tries to identify time domain and frequency domain indices of HRV changes during different sleep stage associated with severity of OSA, and to compare the HRV changes following different subtypes of apnea.
Methods: 112 participants with a mean age of 44.83(±13.09) were recruited from a hospital in Taichung, Taiwan. OSA was identified by polysomnography (PSG).According to AHI, participants were divided into non-OSA (AHI < 5), mild OSA (5<AHI<15), moderate OSA (15<AHI<30), and sever OSA (AHI >30)group. They were also categorized, according to the percentage of apnea types, into control, obstructive apnea (OA), and central apnea (CA) group for compare HRV change in different sleep stage. ANOVA with repeat measure was applied to compare their HRV variables.
Results: For frequency domain, there were significant difference among different severity groups in LF/HF-ratio during NREM sleep and REM sleep (F=18.04, P<.001), but not during awake stage (F=1.67, P=.177). OSA severity was significant related to LF/HF. Similar to frequency domain, QTVi reached significant difference (F=31.88, P<.001) in REM and NREM sleep but not in awake stage, also can indicated severity of OSA. When comparing different subtypes of apnea, LF/HF of CA was significantly higher (5.60±2.91) than the other groups (F=12.96,P<.001) but no difference between OA and control . QTVi was also found to be sensitivity to different subtypes and normal control (F=24.45, P<.001).
Conclusion: The results showed that different HRV domains are associated with different aspects of sleep apnea. LF/HF-ratio and QTVi during sleep can differentiate OSA severity, while QTVi seems more sensitive to different subtypes of sleep apnea.

0144

PREMENSTRUAL SYNDROME AND AUTONOMIC MODIFICATIONS DURING SLEEP ACROSS PHASES OF THE MENSTRUAL CYCLE

de Zambotti M[1], Nicholas CL[2], Colrain IM[2,3], Trinder JA[2], Baker FC[3,4]
[1]Department of General Psychology, University of Padova, Padova, Italy, [2]Department of Psychology, University of Melbourne, Melbourne, VIC, Australia, [3]SRI International, Menlo Park, CA, USA, [4]School of Physiology, University of the Witwatersrand, Johannesburg, South Africa

Introduction: Impairment in autonomic functioning is hypothesized to play a key role in the etiology of premenstrual syndrome (PMS). There is evidence to suggest that autonomic nervous system activity is modulated by fluctuations in several hormones across the menstrual cycle, at least during wakefulness. Given that sleep is an advantageous state in which to assess neurovegetative system functioning, we aimed to assess the influence of menstrual cycle phase and severe premenstrual symptoms on autonomic activity during sleep in women with and without PMS.
Methods: Time and frequency domain heart rate variability (HRV) analyses were performed to assess sympathovagal balance and vagal autonomic modulation of the myocardium during sleep in 11 women with severe PMS (age: 31.3 ± 6.5 years) and 12 controls (age: 33.0 ± 6.0 years) in the mid-follicular, mid-luteal, and late-luteal phases of the menstrual cycle.
Results: All women showed elevated heart rate ($p < 0.05$) and respiratory rate ($p < 0.01$) in mid-luteal phase compared to the mid-follicular phase. Women with PMS exhibited lower high frequency, reflective of reduced vagal activity, during REM sleep in the mid-luteal phase, where progesterone and estradiol levels were highest, compared to the mid-follicular ($p < 0.01$) and late-luteal phases ($p < 0.001$) whereas high frequency power did not vary significantly across the menstrual cycle in controls. In the mid-luteal phase, progesterone was positively correlated with the low frequency/high frequency ratio (index of sympathovagal balance) in both NREM ($r = 0.46$; $p < 0.05$) and REM sleep ($r = 0.56$; $p < 0.01$).
Conclusion: Our findings provide evidence of reduced vagal activity selectively during REM sleep in the mid-luteal phase in severe PMS. These findings support the hypothesis that an imbalance in autonomic control is a component of the etiology of severe PMS.
Support (If Any): This study was supported by National Institutes of Health, Bethesda, MD, USA; Grant HL088088 to FCB.

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QUANTITATIVE ANALYSIS OF AUTONOMIC SLEEP PATTERNS WITH POLYSOMNOGRAPHY

Sano A[1], Picard RW[1], Stickgold R[2]
[1]Media Lab, Massachusetts Institute of Technology, Cambridge, MA, USA, [2]Center for Sleep and Cognition, Harvard Medical School, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: We analyzed sleep patterns using both polysomnography (PSG) and a wrist-worn Affectiva Q™ sensor measuring electrodermal activity (EDA), to better characterize the relationship between EDA and PSG.
Methods: Seven healthy university students (ages 18-22) were measured one night in a sleep laboratory. EDA "storms" were identified when EDA exhibited >6 peaks per minute. Delta power was computed from the EEG (C3, C4, O1 and O2).
Results: Six out of 7 participants had EDA storms, 93% of which occurred in Non-REM2 and SWS. EDA storms tended to occur during the second quarter of the night. EDA amplitude was largest in SWS and decreased as the sleep stage became shallower for all 7 participants. Delta power in C3 and in O1, during times with EDA storms, was significantly higher than during times without EDA storms ($p < 0.05$). We also computed the correlation coefficient and the cross correlation for smoothed, detrended and normalized time-series EDA amplitude and delta power. The correlation coefficient between EDA amplitude and delta power was higher in the first cycle of sleep than in later cycles in 2 or more channels for 6 of the 7 participants. The cross-correlation between EDA amplitude and delta power was higher in the first cycle than in later cycles for all 7 participants. We also computed the time lag between the EDA amplitude and the delta power to obtain the highest cross-correlation. Three participants showed no time lag, 1 participant showed 78 minutes and 3 participants showed a 5-10 minute delay in delta power.
Conclusion: EDA "storms", measured over 7 nights in healthy college students, occurred in Non-REM2 and SWS, usually in the second quarter of the night. The EDA amplitude was most highly correlated with delta power of the EEG early in the night.

0146

HEART RATE VARIABILITY IN DIFFERENT SLEEP STAGES OF DIFFERENT SUBTYPES OF SLEEP APNEA SYNDROME

Zhang Y[1,2], Jin H[1,2], Wu Y[1,2], Chung S[1,2]
[1]Applied Psychology, Harbin Engineering University, Harbin, China, [2]Sleep Laboratory, Harbin Engineering University, Harbin, China

Introduction: Heart rate variability (HRV) test is an important method indicating the state of the autonomic nervous and the cardiac function. It has been recognized the HRV of patients with sleep apnea syndrome (SAS) is abnormal, but the report hasn't be found that compares the HRV in different stage of various subtypes SAS which be evaluated in this study.
Methods: 252 adults were recruited in south China which comprise 95 obstructive sleep apnea (OA) patients, 68 central sleep apnea (CA) patients, and 89 adults as control. The three groups underwent overnight polysomnography (PSG). EKG signal was transformed into time domain and frequency domain and divided into awake stage before sleep and after sleep, the second sleep stage, the early and late rapid eye movement stage (REM). One-way ANONA and post hoc test were applied to examine the difference of various apnea subtypes.
Results: In HRV index, all three groups reached significant difference in late REM stage including VLF (F=3.271, P=0.040), RRI (F=5.949, P=0.003). This difference was also found in awake including RRI (F=3.172, P=0.044), SDNN and SDSD. Post hoc test indicated the RRI of OA in late REM stage was lower significantly than that of the CA (P=0.003) and the control group (P=0.005) .
Conclusion: HRV can be good indicator of many physical and mental disorders. This study showed different apnea subtypes have various HRV index during different sleep stages especially in awake and late REM stage. It may lead to different vulnerability to some disorders for different apnea subtypes. Second, the RRI of OA was lower obviously than CA and normal participants, which might indicate the increase of the risk of the cardiovascular disease. Third, the VLF showed significant difference in all three groups in many sleep stages. But the real meaning of this index need be further explored.

0147

USE OF THE FORCED OSCILLATION TECHNIQUE TO MEASURE UPPER AIRWAY RESISTANCE THROUGHOUT THE RESPIRATORY CYCLE

Owens R[1], Campana LM[2], Sands SS[1], Suki B[2], Malhotra A[1], Wellman A[1]
[1]Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Department of Biomedical Engineering, Boston University, Boston, MA, USA

Introduction: Introduction: The upper airway changes shape and cross-sectional area during the breathing cycle. In obstructive sleep apnea (OSA) patients during wakefulness, a previous study using computed tomography showed the most significant narrowing of the upper airway occurred during end-expiration, with slight dilation during early inspiration. This finding has led to the belief that the airway collapses during expiration in OSA. However, another study (using endoscopy) showed the opposite: the most significant narrowing occurred during inspiration in both wakefulness and sleep. Thus, there is debate about the phasic changes in cross-sectional area of the upper airway. We used the forced oscillation technique (FOT), a non-invasive measure of resistance, to measure upper airway resistance across the respiratory cycle during wakefulness and sleep.
Methods: Methods: Subjects with and without OSA were instrumented with an epiglottic catheter and a nasal mask connected to a pressure transducer and pneumotachometer. A custom made FOT system consisting of a speaker was placed in-line with the nasal mask. 8Hz pressure oscillations were applied over normal breathing both during wakefulness and sleep. Resistance at four different time points across the respiratory cycle (end-expiration, mid-inspiration, end-inspiration, and mid-expiration) was assessed during wakefulness, during non-REM sleep, and during hypopneas/apneas in OSA.
Results: Results: Data obtained during wakefulness and sleep have been analyzed in 4 subjects (1 OSA). During wakefulness, mean (±standard deviation) upper airway resistance was 1.4±0.8, 6.5±4.8, 2.1±1.4, and 3.2±1.6cmH2O/L/sec at end-expiration, mid-inspiration, end-inspiration, and mid-expiration, respectively. The corresponding values during sleep were: 2.5±1.3, 10.8±4.4, 5.1±2.6, and 4.7±2.6cmH2O/L/sec. In all subjects during sleep upper airway resistance was highest during mid-inspiration and least at end-expiration.
Conclusion: Conclusions: In subjects with and without OSA, both awake and asleep, mean upper airway resistance is maximal during mid-inspiration, and lowest at end-expiration. These preliminary data suggest that inspiratory narrowing is an important feature of OSA.

0148

REDUCED GENIOGLOSSUS INSPIRATORY PHASIC SINGLE MOTOR UNIT ACTIVITY IN RAPID EYE MOVEMENT SLEEP VERSUS STAGE 2 SLEEP

McSharry DG[1], Saboisky J[1], DeYoung P[1], Trinder JA[2], Matteis P[1], Guo M[1], Malhotra A[1]
[1]Sleep Medicine, Brigham and Womens's Hospital and Harvard Medical School, Boston, MA, USA, [2]Department of Psychological Sciences, The University of Melbourne, Melbourne, VIC, Australia

Introduction: The genioglossus is pivotal to airway patency. Obstructive sleep apnea often worsens during REM particularly in women. Despite the importance of REM related apneas, the exact mechanisms underlying these events remain elusive. Phasic REM (associated with rapid eye movements) induces more apneas than tonic REM (when no rapid eye movements occur). Single motor unit (SMU) techniques provide insight into the activity of the hypoglossal nucleus. We hypothesized that inspiratory phasic (IP) SMUs would discharge slower and for a shorter duration during REM (particularly phasic REM) than during stage 2.
Methods: 27 humans were studied overnight. Genioglossus activity was measured using intramuscular electrodes and analyzed for SMU activity. Polysomnography and end tidal CO2 were recorded. We identified 5 IP units (to date thus far) that remained active during Stage 2, Phasic REM and Tonic REM. The duration of SMU firing was calculated relative to inspiration (%TI). The peak discharge frequencies of the SMUs were calculated. All measurements for each individual SMU were made in 3 consecutive breaths in each stage.
Results: IP units had significantly lower peak discharge frequencies during phasic REM (mean±SEM) compared to stage 2 sleep (10.1±2.9Hz versus 19.2±1.4Hz; P=0.02). IP discharge frequencies during tonic REM were 14.0±2.6Hz. IP units fired for a significantly shorter duration during phasic REM compared to stage 2 (42.8±17.3%TI versus 125.0±12.5%TI; P=0.02). IP firing duration during tonic REM was 73.2±22.1%TI. CO2 was not significantly different between the 3 conditions.
Conclusion: In Phasic REM, IP units have reduced discharge frequencies and fire for shorter durations. These data suggest a vulnerability of the upper airway to collapse particularly during inspiration. A diminution of genioglossus inspiratory phasic activity is one potential mechanism for REM related apneas. Further data analyses are required and ongoing.
Support (If Any): AHA 0840159N, AHA 11 POST 5660004, NIH R01 HL085188, R01 HL090897, K24 HL 093218, and P01 HL 095491.

0149

MATERNAL EXPOSURE TO INTERMITTENT HYPOXIA DURING SLEEP LEADS TO HYPOXIC AND OXIDATIVE STRESS IN FETAL MOUSE BRAINS

Cai J[1,2], Tuong C[1], Cai L[1], Gozal D[3]
[1]Pediatrics/KCH Res. Inst., University of Louisville School of Medicine, Louisville, KY, USA, [2]Anatomical Sciences and Neurobiology, University of Louisville School of Medicine, Louisville, KY, USA, [3]Pediatrics, University of Chicago, Louisville, IL, USA

Introduction: Pregnancy has emerged as an important risk factor for sleep-disordered breathing (SDB). Growing evidence indicates an increased frequency of adverse maternal and fetal outcomes as a result of gestational SDB. We hypothesize that maternal SDB during gestation will result in hypoxic/oxidative stress on fetal brains. Hypoxic status/inflammation/oxidative response in fetal brains and newborn somatic growth were examined in maternal mouse models of SDB-associated intermittent hypoxia (IH).
Methods: Timed pregnant C57BL/6 mice (between 8.5-18.5 day-post-coitus) were exposed to either IH (8% O2/20.9% O2/120s switch/12hrs during the light cycle), or intermittent air (IA) for 3 to 10 days. After gestational IA or IH exposures, pregnant mice were immediately terminated for embryo collection or transferred to room air conditions for delivery. The molecules relevant to hypoxia, inflammation, and oxidative stress were assessed by means of immunostaining, quantitative real-time PCR, and Western blots. The statistical significance was considered as $p<0.05$.
Results: SpO2 changed in a recurrent manner with the nadir hemoglobin oxygen saturations mainly ranging between 60% and 70%. The receptor of EPO, an indicator to augment oxygen delivery by increase of fetal erythropoiesis, was significantly up-regulated in fetal brain tissue experiencing maternal IH exposures. However, hypoxic cells in fetal cortex were still detectable with pimonidazole hydrochloride. Consistently, a significant increase of LDH A subunit but not B subunit suggested a lactate accumulation in hypoxic fetal brains. Furthermore, expressions of two pro-inflammatory genes TNF-α and COX-2, but not iNOS or nNOS, were enhanced in maternal IH-insulted fetal brains. CD68+ microglia were observed after maternal IH exposures, coinciding with increased endogenous apoptosis in multiple brain regions. More intriguingly, p67phox, the cytosolic component of NADPH oxidase, was significantly elevated in fetal brains subjected to maternal IH exposures. As clinical observation, somatic growth for maternal IH- exposed neonates was retarded after birth.
Conclusion: The findings suggest that pro-inflammatory pathways and oxidative response may play an important role in the pathogenesis of adverse fetal outcomes.
Support (If Any): NIH 2P20RR017702-061A1 (R.M.G., J.C. is CO-BRE supported junior faculty and co-investigator), University of Louisville Research Initiation Grant (J.C.), and NIH HL-086662 (D.G.).

0150

EFFECTS OF DRONABINOL ON VAGALLY MEDIATED RESPIRATORY REFLEXES AND UPPER AIRWAY MOTOR OUTPUT

Topchiy I[1,3], Waxman J[4], Radulovacki M[1,5], Carley DW[1,2,3]
[1]Center for Narcolepsy, Sleep and Health Research, University of Illinois at Chicago, Chicago, IL, USA, [2]Department of Biobehavioral Health Science, University of Illinois at Chicago, Chicago, IL, USA, [3]Medicine, University of Illinois at Chicago, Chicago, IL, USA, [4]Department of Electrical and Computer Engineering, University of Illinois at Chicago, Chicago, IL, USA, [5]Department of Pharmacology, University of Illinois at Chicago, Chicago, IL, USA

Introduction: Vagal afferent tone has been implicated in apnea-genesis as an inhibitor of upper airway motor output. Dronabinol, a cannabinoid agonist, reduced apnea severity both in an animal model and in human subjects with obstructive sleep apnea (OSA). We hypothesize that dronabinol reduces inhibitory vagal feedback by binding at CB1 receptors in the nodose ganglia, thus stabilizing respiratory pattern and increasing hypoglossal motor outputs to upper airway muscles. The aim of this study was to determine the effects of dronabinol injection into the nodose ganglia on genioglossus muscle activity and on vagally-mediated apneic reflexes.
Methods: Six male Sprague-Dawley rats were anesthetized with ketamine/xylazine (80:5 mg/kg) and tracheostomized. Dronabinol was injected into both nodose ganglia. Vagal volume feedback was tested by end-expiratory tracheal occlusions. Vagally mediated reflex apnea was assessed by IV serotonin (5-HT) infusion (0.5 ml/kg; 0.05 M). These tests were conducted before and after dronabinol administration.The phasic respiratory amplitude of genioglossus EMG (EMGg) and the duration of EMGg pre-activation prior to inspiratory airflow were determined for every breath.
Results: End-expiratory airway occlusion produced a significant 94±3.5 percent increase of EMGg ($p=0.019$) and a decrease of 141±24 ms in the EMGg pre-activation time ($p=0.029$). These effects associated with airway occlusion were eliminated by intra-nodose dronabinol administration ($p > 0.05$ for each). Further, following injection of dronabinol into the nodose ganglia the amplitude of EMGg tended to increase. Intravenous infusion of 5-HT evoked immediate apnea with a duration of 13.08±3.9 seconds. Dronabinol administration eliminated 5-HT induced apnea in 2 of 6 animals and reduced the apnea duration to 3.26±0.48 seconds in the remaining animals ($p = 0.04$).
Conclusion: Cannabimimetics (dronabinol) blunt the afferent vagal activation at the level of the nodose ganglia and this may contribute to the observed reduction of apnea frequency following dronabinol administration to animals and patients with OSA.
Support (If Any): Supported by the grant AG16303-S01.

0151

SYSTEMIC ADMINISTRATION OF ESZOPICLONE DEPRESSES VENTILATION IN A RAT MODEL OF METABOLIC SYNDROME

Sanford DT, Filbey WA, Koch LG, Britton SL, Baghdoyan HA, Lydic R
Anesthesiology, University of Michigan, Ann Arbor, MI, USA

Introduction: Sedative/hypnotics have a wide margin of safety when administered alone to normal weight patients without sleep apnea. Obese patients have increased risk of respiratory problems during sedation (Br J Anaesth 106:617, 2011) that is disproportionately related to levels of sedation (Chest 138:1489, 2010). The importance of this problem is emphasized by the increased use of sedatives among obese individuals compared to the general population (Sleep 34:869, 2011). We are using an obese rat model of metabolic syndrome (Science 307:418, 2005) to elucidate brain mechanisms linking obesity, sleep, and respiratory depression (Anesthesiology 113:1176, 2010). This study is testing the hypothesis that intraperitoneal administration of the sedative/hypnotic eszopiclone (ESZ) causes greater respiratory depression in obese/metabolic syndrome (LCR) rats than in lean/fit (HCR) rats.
Methods: Rats (obese/LCR, n=3; lean/HCR, n=3) were conditioned to whole body plethysmography chambers. On separate days and in randomized order, each rat received an injection of vehicle (control), ESZ (3 mg/kg), or ESZ (10 mg/kg). Breathing was measured for 60 min post-injection. Two-way ANOVA and post-hoc comparisons evaluated the effect on breathing of rat strain, drug, and time post-injection.
Results: Minute ventilation (MV) did not differ between obese/LCR and lean/HCR rats after vehicle injections. ANOVA revealed a significant main-effect of time for each strain, and no interaction. Both doses of ESZ caused a significantly greater decrease in MV in obese/LCR than in lean/HCR rats. Effect sizes of ESZ on MV were -32.2% (3 mg/kg) and -28.7% (10 mg/kg).
Conclusion: These data are consistent with evidence that the sedative/hypnotic dexmedetomidine depresses breathing in obese/LCR rats (Soc Neurosci Abst 502.01, 2011). The results support the conclusion that

obese/LCR rats provide a novel model for studies aiming to elucidate the mechanisms linking obesity and state-dependent respiratory depression.

Support (If Any): NIH Grants HL40881, HL65272, MH45361, RR17718 and Department of Anesthesiology.

0152

DEVELOPMENT OF AUTONOMIC DYSFUNCTION WITH INTERMITTENT HYPOXIA IN A LEAN MURINE MODEL

Chalacheva P[1], Thum J[1], Yokoe T[2], O'Donnell CP[2], Khoo MK[1]
[1]Biomedical Engineering, University of Southern California, Los Angeles, CA, USA, [2]Department of Medicine, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Using a lean, chronically instrumented murine model to eliminate the confounding effects of obesity, Yokoe et al. (J Physiol 586:899-911, 2008) found that intermittent hypoxia (IH) produced sustained hypertension and reversed the diurnal variation of blood glucose (BG). Concomitant glucose infusion attenuated the hypertension but exacerbated the BG fluctuations. Using Yokoe's continuous arterial blood pressure recordings (ABP), we conducted analyses of cardiovascular variability to track the development of autonomic dysfunction in this animal model.

Methods: Each animal was exposed to either air or IH, in addition to continuous infusion of either saline or glucose. From ABP, we deduced pulse interval (PI), and using the beat-to-beat time-series, we derived baroreflex sensitivity (BRS) and high-frequency power of PI (HFP_{PI}), reflecting vagal activity, and low-frequency power of ABP (LFP_{BP}), representing sympathetic activity, in consecutive 1-min segments over 4 days. The overall change in autonomic activity over time was determined by fitting linear trends to ABP, BRS, HFP_{PI} and LFP_{BP}. Cosinor and power spectral analyses were applied to determine the relative contributions of the diurnal and ultradian (~12 h) rhythms, as well as the day-to-day change in diurnal amplitude of each signal.

Results: ABP showed a decreasing trend in all animals, but the trend was slower in IH vs air. BRS decreased in all animals, except in the control (air+saline) group. HFP_{PI} decreased more rapidly in glucose relative to saline while LFP_{BP} decreased more slowly in IH relative to air. The IH groups showed substantially less ultradian rhythmicity compared to air. The diurnal amplitude of LFP_{BP} in IH decreased over time.

Conclusion: IH with or without glucose infusion increased sympathetic activity, whereas glucose infusion by itself progressively lowered ABP. Glucose infusion and/or IH led to reduced parasympathetic activity. IH combined with hyperglycemia exerts progressively adverse effects on autonomic control independent of obesity.

Support (If Any): This work was supported by NIH Grants HL090451, EB001978 and HL077785.

0153

ASSOCIATIONS BETWEEN STAGES OF SLEEP AND THE CORTISOL AWAKENING RESPONSE

Elder GJ, Ellis JG, Wetherell MA
Northumbria Centre for Sleep Research, Northumbria University, Newcastle upon Tyne, United Kingdom

Introduction: Cortisol is a marker of hypothalamic-pituitary-adrenal axis activity and may have a role in insomnia. REM sleep has been associated with hippocampal activation and inhibited cortisol secretion, and awakening with hippocampal deactivation. However, no studies have examined the effects of the stage of sleep preceding wake upon the cortisol awakening response (CAR) in a highly controlled environment. The current study examined the CAR in normal sleepers over three days in a sleep laboratory.

Methods: Healthy normal sleepers ($n = 18$) were screened for sleep disorders, shift work or recent trans-meridian travel, and completed sleep diaries and actigraphy for two weeks. Participants remained in bed in dim ultraviolet light and saliva was sampled immediately upon waking, 15, 30, 45 and 60 minutes later across three days. Three CAR parameters were examined: mean waking levels, the individual maximal response, and total secretion in the period following waking, expressed as the area under the curve (AUC). The stage of sleep in the 30-second epoch preceding the waking sample was also recorded.

Results: Following exclusion due to excessive cortisol levels or missing samples ($n = 3$), typical CAR patterns (an increase in the 60 minutes following waking) were observed on all three days. ANCOVAs, controlling for age and gender, showed the stage of sleep prior to the waking sample (wake & S1, S2 & S3, and REM) had no effect on mean waking levels ($F_{(2,40)} = .76$, $p > .05$), the maximal response ($F_{(2,40)} = .65$, $p > .05$) or the AUC during the waking period ($F_{(2,40)} = .51$, $p > .05$).

Conclusion: The stage of sleep prior to waking does not modulate the CAR, as no differences in various parameters of the CAR were observed despite a high level of control. Future research will examine the effects of other aspects of sleep architecture upon the CAR.

0154

EFFECTS OF ICV ADMINISTARTION OF A MAST CELL HISTAMINE RELEASE ENHANCER ON SLEEP/WAKE IN WILD-TYPE AND MAST CELL DEFICIENT MICE

Chikahisa S[1,2], Kodama T[3], Sagawa Y[1], Ishimaru Y[1], Sei H[2], Nishino S[1]
[1]Sleep & Circadian Neurobiology Laboratory, Stanford University School of Medicine, Palo Alto, CA, USA, [2]Department of Integrative Physiology, Institute of Health Biosciences, The University of Tokushima Graduate School, Tokushima, Japan, [3]Department of Psychophysiology, Tokyo Metropolitan Institute of Medical Science, Tokyo, Japan

Introduction: Mast cell activation and degranulation can result in the release of various chemical mediators that significantly affect sleep, such as histamine and cytokines. We have recently found that brain mast cells contribute to the regulation of enhanced wakefulness during food deprivation using mast cell deficient (DEF) mice. However, the functional role of brain mast cell-derived histamine in sleep/wake regulations is still elusive. Since up to 40% of histamine contents in the brain are from brain mast cells, enhancement of brain mast cell activity may influence brain histamine release and thus sleep. In this study, we examined potential involvement of brain mast cell-derived histamine in sleep/wake regulations, using DEF mice and a mast cell histamine release enhancer.

Methods: Sleep were recorded in male DEF (KitW/W-v) mice and their wild-type littermates (WT). In order to evaluate the involvement of histamine released from mast cells in sleep/wake regulation, compound 48/80 (1, 5, 10 ug/ul, intracerebroventricularly; icv), a histamine releaser from mast cells, and cromolyn (1, 5, 10 ug/ul, icv), a blocker of mast cell degranulation, were administered into WT and DEF mice, and their drug effects on sleep parameters were evaluated. To confirm the histamine release in response to compound 48/80 injection, perfusate were collected from the left lateral ventricle or thalamus every 30 min using intracerebral microdialysis.

Results: Compound 48/80 significantly increased the amount of wake in WT mice, while it had no effect in DEF mice. This data was completely consistent with the microdialysis results that histamine release in the lateral ventricle was increased immediately after the injection of compound 48/80 in WT mice but not in DEF mice. When the microdialysis probe was inserted into the thalamus, the histamine increase was not observed in both genotypes. Unfortunately, we could not evaluate the effect of icv administration of cromolyn on sleep because of its life threatening side effects. Interestingly, H1 antagonists (mepyramine and triprolidine, ip) also had no significant effect on sleep in DEF mice, although these drugs significantly increased the amounts of SWS in WT mice.

Conclusion: Histamine released from brain mast cells (from the circumventricular organs) is wake-promoting, and the inhibition of this mechanism may mediate the sleep inducing effects of H1 antagonists. Our

results provide pharmacological evidence of the contribution of brain mast cells in the sleep/wake regulation.

0155

DIETARY FOLATE AND SLEEP - A PILOT STUDY IN HEALTHY VOLUNTEERS

Peuhkuri K, Sihvola N, Korpela R
Medical Nutrition Physiology, Instituite of Biomedicine, University of Helsinki, Finland

Introduction: Water-soluble folate is needed for the synthesis of serotonin and melatonin, which are neurotransmitters influencing sleep. However, a link between folate and sleep is not clear and knowledge about the association between intake of folate and sleep is limited.
Methods: Ten healthy volunteers (7 females, 22-40 years, BMI mean 22.6 range 20.0-27.3 kg/m2) were recruited in a pilot study consisting of three separate sessions. The sleep variables (actual sleep time (h:min) and efficiency (% of sleep of total time spent in bed) were measured by actigraphy armband (Actiwatch AW7) during two nights of which the latter was analyzed. Folate intake was assessed by 24 h food dairy and calculated using the Diet32 software. Validated Karolinska sleepiness scale (KSS) was used to evaluate subjective tiredness. Generalized estimating equations method was used to study the association between intake of folate (higher vs. lower) and sleep variables.
Results: Sleep time varied between 4.5 - 8.1 h and efficiency 79.8-96.2%. Mean intake of folate was 359 µg (95% Cl 249-469). If intake exceeded median (293 µg), subjects slept longer (mean 7.8 95% Cl7.2-8.3 vs. 7.4 95% Cl 6.9-7.9, p=0.017) and more efficiently (mean 90.6 95% Cl 87.7-93.4 vs. 88.5 95% Cl 85.5-91.4, p<0.001). Sleep time lengthened also if intake of folate was energy standardized (mean 6.5 95% Cl 5.9-7.0 vs. 6.2 95% Cl 5.6-6.8, p=0.033), but sleep efficiency was not significantly affected. Those receiving more folate slept about 22 min (95% Cl 4-41) longer. Neither absolute nor energy standardized intake of folate was significantly associated with subjective tiredness measured by KSS.
Conclusion: Absolute and energy standardized intake of folate associated positively with total sleep time and absolute intake also with sleep efficiency. Those receiving more folate slept about 20 min longer without impact on subjective feeling of vigor in the next morning.

0156

METABOLIC EQUIVALENT PLAY AN IMPORTANT ROLE BETWEEN EXERCISE AND SLEEP

Wang C[1,2], Chung S[1,2], Jin H[1,2], Zhang Y[1,2]
[1]Applied Psychology, Harbin Engineering University, Harbin, China, [2]Sleep Laboratory, Harbin Engineering University, Harbin, China

Introduction: It is generally expected that acute daytime exercise will enhance sleep. But researches still remain controversy. The metabolic equivalent (MET) is a physiological concept expressing the energy cost of physical activities and can be used to quantify the total amount of physical activity in a way comparable across different persons and types of activities. In the present study, we evaluated the effect on sleep under certain physical exercise to different MET subjects.
Methods: 600 participants were recruited from community comprise 238 females (40%) with mean age of 44.32 (±13.98), and 362 males (60%) with mean age of 44.83(±13.09). Participants spent 1 day in sleep lab. They underwent a rest MET test in day time. 30minutes acute exercise of 5.5MET stationary bicycle riding were arrange on 4 hours before sleep. A standard polysomnography (PSG) montage was used at night. One-way ANOVA was applied to examine exercise effects on different MET group. Parameters included arousal index (AI), sleep efficacy (SE%), total sleep time(TST), and sleep latency(SOL).
Results: As expect, after acute exercise compared to poor MET group, good MET group had higher SE% (mean=79.89±11.38 and 82.91±9.45, F=10.99, P=.001) and TST (mean=338.57±62.22 and 354.83±46.94, F=11.94, P=.001). Also poor MET group had more arousal during sleep (mean=38.32±18.62 and 34.55±16.56, F=5.90, P=.015). But there was no different in SOL (mean=16.05±15.31 and 17.86±18.67, F=1.49, P=.223).
Conclusion: Metabolic equivalent may play an important role between exercise and sleep. Acute exercise can improve sleep efficacy, increased total sleep time, and decreased arousal during sleep in higher MET group but no effect on lower MET group. Our finding also indicate that no significant difference in sleep latency.

0157

EFFECT OF A SINGLE BOUT OF MODERATE-INTENSITY AEROBIC EXERCISE AT NIGHT ON FOLLOWING NIGHT SLEEP

Ganeko M[1], Shioda K[1], Kojima T[1], Uchida S[2,3]
[1]Graduate School of Sport Sciences, WASEDA University, Tokorozawa, Japan, [2]Faculty of Sport Sciences, WASEDA University, Tokorozwa, Japan, [3]Future Institute for Sport Sciences, WASEDA University, Takadanobaba, Japan

Introduction: Although there have been studies to investigate the effect of a single bout of exercise on sleep, many studies estimated sleep quality measured by sleep EEG and had only a little effect on sleep stages or EEG. However, other studies reported changes in the peripheral physiological parameters such as heart rate or rectal temperature during sleep after exercise. Thus effects of exercise on sleep should be more focused on these parameters. The purpose of the study was to examine not only EEG, but also peripheral physiological parameters.
Methods: 6 healthy young males, who are sedentary nonsmokers, underwent 2 experiments consisting of 2 nights in a counter-balanced order separated by 1 week. The first night was adaptation night in the both sets. The second night was exercise condition or control condition. Sleep time was 8 hours (11pm-7am). On the exercise condition, subjects began 60-minutes cycle ergometer exercise at 60%VO2max 3.5 hours before bedtime. On the control condition, subjects relaxed by watching TV and reading books at the same time period. We recorded PSG including EEG, heart rate, respiratory rate, and rectal temperature. In addition, blood-glucose level, blood-lactate level, sleepiness, and subjective fatigue were measured before and after exercise and sleep.
Results: There were no significant differences in any PSG sleep parameters. Heart rate was higher during the first 2 sleeping hours and during NREM sleep in the former half of the sleep in exercise condition than in control condition. Blood-glucose level in the morning was higher in exercise condition than in control condition.
Conclusion: A single bout of moderate-intensity aerobic exercise didn't have significant effect on PSG sleep, but may have an improving carbohydrate metabolism during following night sleep. Whether this impact is related to sleep state or not should be examined in the future study.

0158

THE ACUTE EFFECTS OF PRE BEDTIME ALCOHOL CONSUMPTION ON HEART RATE AND PARASYMPATHETIC NERVOUS SYSTEM ACTIVITY DURING WAKEFULNESS AND SLEEP

Nicholas CL[1], Andrewes HE[1], Chan JK[1], Mayer BZ[2], Colrain IM[2,1], Trinder JA[1]
[1]Psychological Sciences, The University of Melbourne, Melbourne, VIC, Australia, [2]Human Sleep Research Program, SRI International, Menlo Park, CA, USA

Introduction: At sleep onset there is a marked reduction in heart rate (HR), blood pressure and a shift to parasympathetic (PNS) dominance of the autonomic nervous system (ANS). These changes are beneficial for long term cardiovascular health and the absence of these changes is thought to contribute to the increased risk of adverse cardiovascular events in patients with sleep apnea. Alcohol consumption is known

to acutely decrease PNS activity and increase HR during wakefulness. We investigated whether acute pre-sleep alcohol consumption prevents these ANS changes during sleep.
Methods: We evaluated the effect of pre bedtime alcohol consumption on HR and PNS activity (measured using the high frequency component of heart rate variability: HF-HRV) during pre sleep wakefulness and sleep in 18 healthy light drinking 18-21 year olds (19.2±0.2yrs, 12 female) under two 'in laboratory' conditions. The first with pre-sleep alcohol administration (Dosed to 0.1% peak BAC), and the second with a placebo beverage. All abstained from alcohol for 48hrs prior to testing. Artefact and arousal (sleep data) free epochs were identified, and HR and HF-HRV values pre/post beverage consumption were calculated for wakefulness and during stable N2, N3 and REM sleep. These data compared between conditions. Due to technical reasons data were analysed for 14 and 16 participants for wake and sleep analysis respectively.
Results: Mean BAC at lights out was 0.084% in the alcohol Vs. 0.00% in the placebo condition during wakefulness. HR was increased after alcohol consumption by 8.4 beats per minute with no change after placebo consumption (interaction, $p=0.015$). This increase was maintained in all sleep stages across the night ($p<0.001$). Similarly PNS activity was reduced by alcohol consumption during wakefulness with no effect of placebo (interaction, $p=0.005$) and continued in all sleep stages across the night ($p<0.001$).
Conclusion: The findings suggest that pre-sleep consumption of alcohol ameliorates the beneficial sleep related changes in ANS activity and that these changes persist throughout the night, even after it is likely that alcohol has been eliminated. The possible long-term implications of regular pre sleep alcohol consumption include an increased risk of cardiovascular disease, which may exacerbate these problems in already at risk patients such as those with sleep apnea.
Support (If Any): Australasian Sleep Association (Rob Pierce Grant) & NH&MRC (Fellowship #1012195) - CLN. National Institute on Alcohol Abuse and Alcoholism (AA017320; AA005965) - IMC.

0159

RE-EXPOSURE TO A FEAR CONDITIONED STIMULUS DURING SLEEP IN A MOUSE MODEL OF PTSD

McDowell A, Filippone AB, Romano LC, Germain A, O'Donnell C
Medicine, Univsersity of Pittsburgh, Pittsburgh, PA, USA

Introduction: Post-traumatic stress disorder (PTSD) afflicts approximately 5% of the population and includes symptoms of sleep disturbances. Animal models of fear conditioning have been used to examine aspects of PTSD during wakefulness, but little is known on how representation of fear conditioned stimuli (CS) during sleep might impact sleep and fear responses. We developed a new model using a novel CS, 3 % hypercapnia, to study re-exposure during sleep.
Methods: Adult male Balbc/J mice were instrumented with EEG, EMG and EKG electrodes. Baseline sleep architecture and quantitative EEG (qEEG) measures were first obtained. The subsequent day, animals received a 1 min exposure to CO2 paired with footshock (0.25 mA) pulses three times over a five-hour period that preceded the light-on period. Heart rate and EMG activity were analyzed during exposure to the CS or air relative to baseline. Following conditioning, animals began either a 48-hour regiment of 1 min re-exposure to the CS or to air after 3 min of sleep.
Results: The CS induced a marked a bradycardia HR (-90 ± 12 bpm) response during CS exposure that habituated across sessions (-80 ± 9 bpm and -34 ± 2 bpm). During the 48 hrs of re-exposure, sleep architecture, qEEG, and the number of re-exposures during sleep did not differ between CS or air control groups; however, on average CS-exposed animals aroused (34.1 + 4.8) and awoke (5.5 + 1.6) more often than control animals aroused (24.0 + 2.1, $p<0.05$) or awoke (1.6 + 0.8, $p<0.05$).
Conclusion: The conditioned HR response was robust, but diminished across sessions. Conditioned fear responses were evident during sleep with CO2 re-exposure, although marked sleep disruption was not observed. These preliminary findings suggest that the newly developed model can be used to probe fear-related processes during sleep.
Support (If Any): DOD Grant DM102174.

0160

EFFECT OF 10-MIN LIGHT EXPOSURE ON SUBSEQUENT SLEEP DURING BRIEF AWAKENING IN THE MIDDLE OF NIGHT

Chen A[1], Chen Y[1], Yang C[1,2], Lu C[3], Tu H[3], Chiang Y[3]
[1]Psychology, National Chengchi University, Taipei, Taiwan, [2]The Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan, [3]Opto-Electronics Device Application, Industrial Technology Research Institute, Hsinchu, Taiwan

Introduction: Light exposure, especially short-wavelength light, prior to sleep were showed to increase alertness and increase sleep onset latency (SOL) and decrease deep sleep, suggesting that light exposure may have negative impacts on subsequent sleep. The goals of this study are: 1) to examine the effects of brief light exposure on subsequent sleep after awakening in the middle of night, and 2) to compare the effects among composite light sources containing different level of short-wavelength light.
Methods: 10 normal sleepers (5 women), aged 22±1.76 years, participated in the study. They came to sleep laboratory for five nights: one screening/adaptation night and four experimental nights. For the four experimental nights, subjects were waken up during Stage 2 sleep after 2 hours of sleep and were required to read an article under either dim light (<30 lux) or three different light sources with similar color temperature and light intensity, which were: composite light-emitting diode (LED) with less short-wavelength and more long-wavelength light (LED1: 2972K, 242lux), LED with less short-wavelength light (LED2: 3081K, 246lux), and commercial fluorescent lamps (3101K, 242lux). Polysomnographic recording and alertness ratings were conducted before and after light exposure.
Results: No significant differences of light on subjective alertness were found. Sleep efficiency was significantly lower following dim light than other light conditions ($F=2.48$, $p=0.083$). SOL to Stage 2 was significantly shorter after LED1 exposure ($F=3.82$, $p=0.02$). EEG alpha power showed a tendency to decrease faster during the period of sleep onset following LED1 ($F=2.68$, $p=0.06$). No differences were found for the other EEG power bands.
Conclusion: Brief light exposure during awakening in the middle of night does not have a detrimental effect on subsequent sleep in comparison to dim light. Light source containing less short-wavelength light may have less negative influence on sleep.
Support (If Any): Supported by Industrial Technology Research Institute (Taiwan).

0161

SLEEP FACILITATION BY JAPANESE HOT SPRING; EEG DELTA POWER, CORE, PROXIMAL, AND DISTAL TEMPERATURE EVALUATIONS

Ito SU[1], Kanbayashi T[2], Wakasa M[1], Saito A[1], Ito W[2], Yoshida M[3], Echizenya M[2], Shimizu K[2], Nishino S[4], Shimizu T[2]
[1]Department of Physical Therapy, Akita University Graduate School of Health Sciences, Akita, Japan, [2]Department of Neuropsychiatry, Akita University Graduate School of Medicine, Akita, Japan, [3]SleepWell CO., Ltd, Osaka, Japan, [4]Psychiatry and Behavioral Sciences - Sleep Disorder/Sleep Center, Stanford University, Palo Alto, CA, USA

Introduction: Bathing, especially with hot spring with various mineral compositions, is known to facilitate/improve sleep by warming the body. In this study, we evaluated the effects of usual (plain hot water; PH) and hot spring bathing (HS) on sleep using clinical thermometers and EEG.
Methods: Eight healthy men (average age 20.1 years) were divided into 3 groups and each group received the HS (Akita-Onsen Satomi),

PH bath and no bathing (NB) a week interval. The temperature of the bathwater was set to be 40 C degrees. Subjects soaked in the bath deep enough their chests touched the water at 22:00 for 15 min. From the time they finished bathing to the next morning, we measured their core body temperature (CT: rectum), distal skin temperature (DT: top side of the foot), proximal skin temperature (PT: lower part of the clavicle) and EEG using a single channel portable device (Moomin-kei, SleepWell). Subjects were told to sleep from 24:00-7:00.

Results: The amount of delta power per min in the first sleep cycle significantly increased in the bath groups ($p<0.04$, ANOVA), and the highest power was observed in HS group. Sleep latency also decreased in the same order but the difference did not reach to the significant level. Total sleep time increased in the order of PH, HS, and NB groups ($p<0.05$). Bathing significantly increased CT and the subsequent declines during initial 40 minutes ($p<0.05$). Changes in the DPG (Distal-proximal temperature gradient) were associated with significant decrease in PT, and the larger decline in PT was seen in the HS group.

Conclusion: These sleep changes are associated with large decline in the elevated CT, increased heat dissipation and positive DPG values. Hot spring bathing had the larger effects on these parameters. It is proposed that some mineral compositions of hot spring likely produced larger temperature changes and subsequent sleep facilitations.

Support (If Any): The study was partially supported by the fund by Japan Health & Research Institute and Akita University.

0162

SLEEP WITH AN EXPOSURE OF RADIOFREQUENCY ELECTROMAGNETIC RADIATION IN GROWING ORGANISMS

Pelletier A[1], Décima P[1], Delanaud S[1], Libert J[1], Bach V[1], de Seze R[2,1], Loos N[1]

[1]PériTox-INERIS (EA 4285 - UMI 01), University of Picardy Jules Verne, Amiens, France, [2]TOXI, INERIS, Verneuil en Halatte, France

Introduction: Disturbances of sleep by radiofrequency electromagnetic radiation (RF-EMR) emitted by mobile phone base stations type GSM are not well-established. This may be explained by the fact that this environmental factor is not strong enough to be significant. Additional stress (e.g. thermal stress) could increase adverse RF-effects on sleep. However, studies are usually carried out in adults exposed to thermoneutrality (even though not strictly controlled). Moreover, there is a lack of information concerning growing organisms for which sleep is particularly important since it promotes cerebral and body restitutions. In this study, it is held that RF-EMR exposition could potentiate sleep disturbances through interaction with thermal stress in juvenile rats.

Methods: 13 Wistar rats (3 weeks-old) exposed to RF-EMR during 5 weeks were compared to a non exposed control group (n=11). One week after surgery, sleep was measured on different days (00-06 pm) at thermoneutrality (environmental temperature: 24±1°C) and in a warm environment (31±1°C), combined or not with RF exposure. Sleep was visually scored in 30 second-periods in Wakefulness (W), Slow Wave (SWS) and Paradoxical Sleep (PS). The total durations of sleep stages, the mean durations and the frequencies of the episodes were analyzed with ANOVA.

Results: RF exposure did not modify total sleep stage and wakefulness durations. However, when compared to non exposed group, significant RF-effects were found at 31°C but not at 24°C: W and SWS episodes were longer but less frequent (W: 7.0 vs 5.0 min, 0.9 vs 1.8 episodes.h-1; SWS: 3.2 vs 2.8 min, 12.1 vs 14.2 episodes.h-1; always $p<0.01$). The reverse was observed for PS (1.7 vs 2.1min; 5.2 vs 3.8 episodes.h-1).

Conclusion: RF-EMR-effect on sleep is found when this exposure is associated with a thermal stress. This observation strongly suggests that RF-EMR exposure modifies the sleep structure by disturbing thermoregulatory processes.

Support (If Any): Grenelle de l'environnement.

0163

HOMEOTHERMIC FUNCTIONS CHANGES WITH CHRONIC RADIOFREQUENCY ELECTROMAGNETIC RADIATION OF MOBILE PHONE RELAY-ANTENNAE

Loos N[1], Pelletier A[1], Décima P[1], Delanaud S[1], Bach V[1], de Seze R[1,2], Libert J[1]

[1]Péritox-INERIS (EA-UMI01), Jules Verne University of Picardy, Amiens, France, [2]INERIS, Verneuil en Halatte, France

Introduction: we have previously shown temperature-dependant sleep changes induced by radiofrequency electromagnetic radiations (RF-EMR) within the thermoneutral zone in growing rats. We hypothesize that other main homeothermic functions could be also modified in the exposed animals.

Methods: 13 Wistar rats (3 weeks-old) continuously exposed to RF-EMR during 6 weeks were compared to 11 non-exposed control rats. After surgery, sleep-wakefulness cycle, cortical and peripheral (caudal, Ttail) skin temperatures and food intake were simultaneously measured within 00-06 pm at room temperature (24±1°C) and at the upper limit of thermoneutral zone (31±1°C), combined or not with RF exposure. Prazocine was used as adrenergic blocant of cutaneous microvascularization. Patterns of vigilance states were scored by considering their total duration, mean durations and frequencies of episodes. All parameters were tested with ANOVA and post-hoc statistic tests.

Results: Ttail was lowered by RF-EMR at 31°C (-1.21°C, $p<0.001$) for all vigilance stages (Wakefulness: -1.17°C; Slow waves sleep: -1.20°C; Paradoxical sleep: -1.25°C). Cortical temperature did not differ between the 2 groups ($p=0.63$). Ttail decreases depend on higher local vasoconstrictor tone, since the thermal effects disappeared with abolition of tone by prazocine. Peripheral vasoconstriction found in the exposed animals (ascribing by decreases of Ttail) reduces body heat. At 31°C, ingested food quantity was higher in exposed animals (+1.3 g, $p<0.001$) that suggests higher energetic needs in the exposed animals.

Conclusion: results show that RF-EMR exposure induces a process of saving body's energy to preserve homeothermia.

Support (If Any): Post-Grenelle de l'Environnement.

0164

INDIVIDUAL DIFFERENCES IN POLYSOMNOGRAPHIC SLEEP VARIABLES ACROSS MULTIPLE RECORDINGS BEFORE AND AFTER REPEATED EXPOSURES TO TOTAL SLEEP DEPRIVATION

Bender AM, Belenky G, Short RA, Van Dongen H

Sleep and Performance Research Center, Washington State University Spokane, Spokane, WA, USA

Introduction: Tucker et al. (2007) first quantified trait individual differences in polysomnographic (PSG) sleep variables at baseline and following sleep deprivation, in a sample of 21 healthy adults (age range 22-40, mean age 29.4; 11 females; 11 African Americans, 9 Caucasians, 1 Asian) from the metropolitan area of Philadelphia, PA, USA. To examine the replicability of their findings, we repeated the study protocol in a laboratory in Spokane, WA, USA.

Methods: 10 healthy adults (age range 22-40, mean age 29.1; 7 females; 9 Caucasians, 1 American Indian) spent 11 consecutive days and nights in the laboratory. The experiment began with an adaptation night. Subjects then had a baseline night, 36h of total sleep deprivation, and a recovery night; and this pattern was repeated two additional times. Subjects then had a final recovery night. All eight sleep periods were 12h TIB (22:00-10:00), and were PSG-recorded and manually scored according to the criteria of Rechtschaffen and Kales. Mixed-effects ANOVA, controlling for age, gender, and the position of each night on the study timeline, was used to determine the intraclass correlation coefficient (ICC; between-subject variance divided by between- plus within-subjects variance) to quantify the stability of individual differences across the experiment.

Results: ICCs were of fair size (0.2-0.4) for total sleep time, sleep efficiency, REM duration, and sleep latency to stages 1 and 2. ICCs were of moderate size (0.4-0.6) for stages 1 and 2, REM latency, non-REM/REM cycles, and sleep stage transitions. These results resemble those reported by Tucker et al. (2007), with the exception of wake after sleep onset (WASO) and slow-wave sleep (SWS) latency. WASO exhibited a much lower ICC (0.19 versus 0.59 in Tucker et al.) due to three subjects experiencing disrupted sleep on the last night of the study. SWS latency exhibited a much higher ICC (0.74 versus non-significant in Tucker et al.) due to one (non-symptomatic) subject consistently displaying sleep onset REM. In both our sample and that of Tucker et al. (2007), ICCs were substantial (>0.6) for SWS.
Conclusion: For a range of PSG variables, individual differences that are stable, and robust to prior sleep deprivation, were observed in our sample from in and around Spokane, WA, USA - confirming the presence of trait (phenotypic) variance in sleep architecture in healthy young adults.
Support (If Any): NIH grant HL70154.

0165

SLEEP DISORDERS ARE ASSOCIATED WITH ADVERSE HEALTH AND SAFETY IN FIREFIGHTERS

Barger L[1,2], Rajaratnam SM[1,2], Lockley SW[1,2], Sullivan J[1], O'Brien C[1], Qadri S[1], Czeisler CA[1,2]
[1]Medicine/Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Sleep disorders affect 50-70 million Americans. Most remain undiagnosed and untreated and have been associated with adverse health and safety outcomes. The present study sought to examine the prevalence of sleep disorders in a national sample of firefighters.
Methods: Firefighters (n=6,933) from 66 departments completed a questionnaire to determine their risk of common sleep disorders. Validated screening questionnaires were used for all sleep disorders except for Shift Work Disorder (SWD). For SWD, the screening questions were based on the International Classification of Sleep Disorders-2 criteria. The questionnaire also included questions about health and safety.
Results: The percentage of firefighters that screened positive for any sleep disorder was 37.2 %. The percentage for each disorder was as follows: Obstructive Sleep Apnea 28.9 %; Insomnia 6.1%; Restless Leg Syndrome 3.4 %; and SWD 7.7 %. Compared to those who did not screen positive, firefighters who screened positive for a sleep disorder were significantly more likely to report making an important mistake on official paperwork, losing their temper at work, committing a procedural error and taking a sick day (P<0.001). Firefighters who screened positive for a sleep disorder had an increased risk of a motor vehicle crash (RR 1.76; p=0.005), a near-miss motor vehicle crash (RR 2.10; p<0.001) and an injury (RR 1.97; p<0.001). Those who screened positive for a sleep disorder were also significantly more likely to fall asleep during meetings at work, on the telephone, while driving and while stopped in traffic and were significantly more likely to report diabetes (RR 2.93), depression (RR 3.05), anxiety (RR 3.49), and cardiovascular disease (RR 2.74) than those who did not screen positive (p<0.001).
Conclusion: Positive screening for a sleep disorder in firefighters is significantly associated with adverse physical and mental health conditions, attentional failures and safety events in the work place.
Support (If Any): This work was supported by a FEMA Assistance for Firefighters Grant EMW-2007-FP-02197.

0166

CELL DEATH AND RENEWAL IN VITAL ORGANS RESULTING FROM SLEEP LOSS AND SLEEP RECOVERY IN RATS

Everson CA[1], Henchen C[1], Hogg N[2]
[1]Neurology, The Medical College of Wisconsin, Milwaukee, WI, USA, [2]Biophysics, The Medical College of Wisconsin, Milwaukee, WI, USA

Introduction: Sleep loss in rats results in dramatically increased food intake, hypercatabolism, and oxidative stress in the lung, liver, intestine, and heart. Oxidative stress that is uncompensated by antioxidant processes results in injury of the cell, which then is either repaired or replaced. The purpose of the present experiment was to locate changes in cell damage and cell renewal resulting from sleep loss and recovery.
Methods: Total and partial sleep deprivation (SD) in rats were produced by the Rechtschaffen-Bergmann method for 10 days, which was tolerated and produced hypercatabolism and hyperphagia. Recovery rats were allowed 2 days of sleep after 10 days of total or partial SD. Control rats were permitted sleep ad libitum. Cell proliferation by BrdU antibody staining was measured in the spleen and small intestine in rats injected 90 min before tissue harvests with 25-50 mg/kg of BrdU for incorporation into newly synthesized DNA in replicating cells. DNA damage was measured by TUNEL in the heart, liver, lung, small intestine, and spleen. N=5-11 per treatment. Data from histomorphometric analyses were analyzed by t-tests.
Results: Compared with control values, cell damage in the intestine was increased 125 ± 89 (± SE) and 285 ± 105% during total and partial SD, respectively (combined SD: P=0.03 1-tailed), and decreased by 72 ±18 and 70 ± 16% during recovery (both P<0.03 2-tailed). Cell damage was located mainly in the intestinal lamina propria, a mucosal layer known to be rich in lymphocytes. Recovery also was associated with a near absence of cell damage in the lung, compared with otherwise low levels. Data for the heart and the liver were unremarkable. Cell proliferation was increased 65 ± 13 and 44 ± 7% in the intestinal crypts during total and partial SD, respectively, and increased 84 ± 38% in the spleen (mainly in the red pulp) during total SD, compared with controls (P< 0.004); these changes appeared reversed by recovery.
Conclusion: Increased cell damage and turnover resulting from deficient sleep links cellular changes with previously reported systemic proinflammatory and metabolic burdens. The most affected tissues share the function of filtration of antigens, microorganisms, and defective cells. These findings point to specific physiological properties of sleep loss that may contribute to a toll on health and to recuperation during sleep recovery. Abnormalities in cell death and renewal are associated with a wide variety of illnesses, from cancer to autoimmune disease.
Support (If Any): HL-080744.

0167

ASSESSMENT OF THE ABILITY TO RECOVER SLEEP AFTER SLEEP DEPRIVATION IN A SLEEP SATIATION PROTOCOL

Klerman EB[1], Dijk D[2]
[1]Medicine/Div. Sleep Medicine, BWH/Harvard Medical School, Boston, MA, USA, [2]Surrey Sleep Research Centre, University of Surrey, Guildford, United Kingdom

Introduction: Assessment of sleep homeostasis requires conditions under which it can be fully expressed. This includes both allotment of sufficient time for sleep during both day and night and beginning the sleep-homeostatic intervention without a sleep "debt". We used a sleep satiation-deprivation-recovery inpatient protocol to quantify the homeostatic regulation of polysomnographically assessed sleep.
Methods: Thirty-five healthy participants (18-32 years; 18 F) with no current use of medications were studied. The protocol was approved by the Partners Healthcare Institutional Review Board. The inpatient portion of the study occurred in an environment free of time cues with

all events scheduled relative to the subject's habitual sleep times. After their first inpatient night, for three or four consecutive 24-hr days, subjects stayed in bed in darkness for 16 hrs per 24 hrs: 12 hrs centered mid-habitual nocturnal sleep episode and 4 hrs centered opposite this (during the afternoon). After this sleep satiation segment, subjects were randomly assigned to a Wake intervention of 4, 16, 28 or 52 hrs duration, followed by 3 more 24-hr days of 12+4 hrs of sleep opportunity, a 24-hr day with 12-hr sleep opportunity and a 24-hr day with 8 hr sleep opportunity. (Klerman and Dijk Sleep 2005 and Current Biology 2008). Sleep homeostasis was assessed by constructing a dose-response curve of Total Sleep Time, NREM sleep, SWS (NREM Stages 3 and 4), and REM sleep in the 84 hrs before the end of the Wake intervention compared with the 84-hr recovery period after the end of the Wake intervention.
Results: The amount of NREM Sleep and TST accumulated in the 84 hrs before the recovery period differed across the W16, W28 and W52 condition, as expected. Surprisingly, the amount accumulated during 60 hrs of sleep opportunity in the 84 hrs after the Wake intervention was approximately the same across the W16, W28 and W52 conditions: ~26 hrs of NREM sleep and ~35 hrs of TST. The amount of NREM Sleep and TST after W4 was less than in the other three Wake interventions. For REM sleep and SWS, the recovery sleep durations were greater for W52 and W28 than for W16 and W4, but with no clear differences between the W52 and W28 conditions.
Conclusion: Following sleep satiation and when given extended sleep opportunity, recovery of "lost sleep" using NREM Sleep and TST obtained across conditions of 4, 16, 28 or 52 of wakefulness is incomplete. These results provide new insights into sleep homeostasis.
Support (If Any): The National Institutes of Health P01-AG-09975 (DJD EBK), R01-AG06072K01-AG00661 (EBK), K02-HD045459 (EBK), K24-HL105663) (EBK), RC2-HL101340 (EBK) and the NASA Cooperative Agreement NCC9-58 with the NSBRI HFP01603 (EBK). The studies were conducted in the Brigham and Women's Hospital General Clinical Research Center, which was supported by the National Institutes of Health (NIH M01-RR02635). D.J.D. is supported by the Biotechnology and Biological Sciences Research Council and the Air Force Office of Scientific Research.

0168

EFFECT OF MODAFINIL COMPARED WITH CAFFEINE ON PREATTENTIVE AUDITORY PROCESSING AS REFLECTED BY MISMATCH NEGATIVITY (MMN)

Youn T[1], Chung I[1], Jang K[2]
[1]neuropsychiatry, Dongguk University Medical Center, Goyang, Republic of Korea, [2]Psychology, Sungshin Women's University, Seoul, Republic of Korea

Introduction: The mismatch negativity (MMN) as an auditory evoked potential is thought to reflect an early, preattentive, preconscious attention process. We investigated the impact of modafinil as a CNS stimulator on MMN with high density electroencephalography (EEG).
Methods: group of 21 healthy subjects was studied in randomized double blind trials under the following 4 conditions: after 200mg Provigil, 100mg caffeine, 200mg caffeine or placebo. The MMNs resulting from auditory stimuli with passive oddball paradigm in 21 normal subjects, were recored by 64 channel EEG. The latency and power of MMN were analysed by SCAN (neuroscan) program.
Results: A latency of MMN after Provigil and caffeine 100mg and 200mg were shortened than placebo significantly. An amplitude of MMN of Provigil, caffeine 100mg, and 200mg were also increased significantly.
Conclusion: Modafinil is a psychostimulant appreared to have multiple effects on catecholamine systems in the brain, including dopamine and norepinephrine. Our study showed modafinil improved informational processing in normal subjects.

0169

OPIOID RECEPTORS IN THE CAUDAL NUCLEUS TRACTUS SOLITARIUS MEDIATES ELECTROACUPUNCTURE-INDUCED SLEEP ENHANCEMENT

Yi P[1,2], Cheng C[1], Chang F[1]
[1]Department of Veterinary Medicine, National Taiwan University, Taipei, Taiwan, [2]Department of Sports, Health & Leisure, College of Sports Knowledge, Aletheia University, Tainan, Taiwan

Introduction: We previously demonstrated that caudal nucleus tractus solitarius (NTS) mediates the enhancement of non-rapid eye movement (NREM) sleep induced by electroacupunture (EA) stimulation of Anmian acupoints. Discovery of endogenous opioid peptides, including β-endorphin, dynorphin, enkephalin and endomorphin, in the central nervous system (CNS) reveals the mysterious actions of EA, especially in its analgesic effect. Mu- and delta-opioid receptors in the spinal cord are dominant in the low-frequency EA-induced analgesia, while kappa-opioid receptors contribute to the high-frequency EA effects. Current study was designed to elucidate the involvement of NTS opioid receptors in the sleep alteration induced by different frequencies of EA.
Methods: Male Sprague-Dawley rats were surgically implanted with three electroencephalogram (EEG) electrodes and a microinjection guide cannulae directed into the NTS. A 24-hour undisturbed baseline EEG was recorded beginning at the dark onset. Twenty-min EA stimulation (10 or 100 Hz) was administered 25 minutes prior to the dark onset and performed when rats were lightly anesthetized by ketamine. EA was given on two consecutive days and sleep was recorded after rats received the second EA stimuli. Naloxonazine, naltrindole and nor-binaltorphimine were respectively used to block the μ-, δ- and κ-opioid receptors in the NTS.
Results: Our results demonstrated that both 10 and 100 Hz EA of Anmian acupoints enhanced NREM sleep during the dark period, but exhibited no effect on REM sleep. The 10 Hz EA-induced enhancement of NREM sleep was blocked by non-selective opioid receptor antagonist (naloxone) and the μ-opioid receptor antagonist (naloxonazine); administrations of δ-receptor antagonist (natrindole) and the κ-receptor antagonist (nor-binaltrophimine), however, did not affect the 10 Hz EA-induced alteration in sleep. High frequency (100 Hz) EA-induced enhancement of NREM sleep was blocked by naloxone and κ-receptor antagonist (nor-binaltrophimine), but was affected neither by μ- (naloxonazine) nor δ-receptor antagonists (natrindole).
Conclusion: We concluded that μ-opioid receptors in the caudal NTS mediate the low-frequency (10 Hz) EA-induced alteration of NREM sleep, while κ-opioid receptors mediate the high-frequency (100 Hz) EA-induced enhancement of NREM sleep.
Support (If Any): This work was supported by National Science Council grant NSC95-2320-B-002-098-MY2. We thank Mr. Yi-Fong Tsai's technical assistance in this project.

0170

LITERATURE-BASED DISCOVERY SUGGESTS NEUROMELANIN AND IRON METABOLISM IN RESTLESS LEGS SYNDROME

Miller CM[1], Rindflesch TC[1], Strohl KP[3], Koo BB[2]
[1]National Library of Medicine, Lister Hill National Center for Biomedical Communications, National Institutes of Health, Bethesda, MD, USA, [2]Department of Neurology, University Hostipals Case Medical Center, Cleveland, OH, USA, [3]Department of Pulmonlology, Critical Care and Sleep Medicine, Louis Strokes Cleveland VA Medical Center, Cleveland, OH, USA

Introduction: The etiology of restless legs syndrome (RLS) is poorly understood. Koo et al. (2007) propose the involvement of alpha-melanocyte stimulating hormone, but without suggesting a mechanism. Further, Koo (unpublished) found a statistically significant relationship between RLS prevalence and increasing geographical latitude. We explored the

etiology of RLS within the framework of these claims, by using the Semantic MEDLINE natural language processing application (Kilicoglu et al 2008) to exploit "undiscovered public knowledge" (Swanson 1986) inherent in the published literature.

Methods: Based on the prominent relationship between dopamine and iron in the pathophysiology of RLS and considering tyrosine's prominent role in dopamine synthesis, a query consisting of these substances was issued to the application. Core content in citations retrieved was then visualized as a graph of interconnected semantic relationships. Through a process of cooperative reciprocity between the application and the researchers, this graph was systematically examined for known facts that might underpin novel hypotheses about the etiology of RLS.

Results: Twenty-five predications asserted substance interactions, and we examined the publications from which these had been extracted. The following points were particularly salient, revealing an interaction between neuromelanin and iron in Parkinson disease (PD). ●Neuromelanin binds iron in PD (Double 2006). ●Neuromelanin is neuroprotective in PD (Double 2006). ●Neuromelanin, iron, and dopamine interact in PD (Zecca et al 2008).

Conclusion: Results show that melanin is involved in the etiology of PD, through both dopamine and iron. Since there are similarities between RLS and PD involving these substances, we hypothesize that melanin is also significant in the etiology of RLS, being neuroprotective as in PD. This provides mechanistic elucidation of (Koo 2007) and (Koo, unpublished). This insight is novel. The PubMed query "(melanin OR neuromelanin) AND restless legs syndrome" (05/20/2011) returns eight citations, none of which discusses the mechanism of neuromelanin in RLS.

Support (If Any): This study was supported in part by the Intramural Research Program of the National Institutes of Health, National Library of Medicine.

0171

LIGHT FLASHES PHASE SHIFT HUMAN CIRCADIAN RHYTHMS DURING AND WITHOUT DISTURBING SLEEP

Zeitzer J[1,2], Ruby NF[3], Heller H[3]
[1]Psychiatry and Behavioral Sciences, Stanford University, Palo Alto, CA, USA, [2]Psychiatry Service, VA Palo Alto Health Care System, Palo Alto, CA, USA, [3]Biology, Stanford University, Stanford, CA, USA

Introduction: Light is the preeminent zeitgeber of the human circadian system. We have shown that this system is exquisitely responsive to trains of brief, millisecond flashes of light, a phenomenon likely attributable to temporal integration of light. As the circadian system is most sensitive to light during the night, we wanted to test whether these light flashes could phase shift the human circadian system while individuals were asleep without impacting sleep itself.
Methods: Seven subjects participated in a two day study. To stabilize the circadian system and its phase angle to sleep, subjects had customized, regular sleep/wake times for two weeks prior to their in-lab stay. Subjects came to the lab at habitual wake time +7 hrs and an hour later started a constant semirecumbent posture (CP) protocol lasting eight hours. Two hours after bed time, subjects were exposed to one hour of a light stimulus - a 2-msec flash of 2,995 lux white light every 30 sec (total light exposure time = 0.24 sec) - during their sleep (i.e., not intentionally awakened), after which they were allowed to sleep undisturbed an additional five hours. Subjects were ambulatory in dim light until eight hours after waking then started a second CP lasting 10 hours. Saliva samples were collected every 30 minutes during CPs. Saliva samples were later assayed for melatonin concentrations and melatonin onset determined.
Results: Due to assay failure in one subject and a mistimed initial phase in a second, we completed analysis on five subjects. Subjects experienced a 28.7±8.89 min phase delay ($p<0.01$, paired t-test), that was significantly different from a previous study showing a 6.00 ± 34.5 min phase advance after exposure to one hour of dark at the same time ($p<0.05$, t-test). Despite the phase shift, the light flashes did not affect sleep. In comparing the hour during which the flashes were administered to the previous hour, there were no differences in the amount of any stage of sleep (N1, N2, N3, REM, wake), the number of transitions between stages, or the total EEG power in delta, theta, alpha, sigma, beta or gamma bands ($p's>0.03$, paired t-tests Bonferroni adjusted for multiple comparisons). There was, however, a robust 0.5 Hz event-related potential generated in the EEG immediately after each flash, confirming that the light flashes were "perceived" by the brain.
Conclusion: These data indicate that light has the ability to change circadian phase during sleep without impacting sleep itself.
Support (If Any): Air Force Office of Scientific Research (F2-4506); VA Sierra Pacific Mental Illness Research, Education and Clinical Center.

0172

AMBIENT EVENING LIGHT EXPOSURE REDUCES PHASES ADVANCES TO MORNING LIGHT INDEPENDENT OF SLEEP DEPRIVATION

Burgess HJ
Biological Rhythms Research Laboratory, Rush University Medical Center, Chicago, IL, USA

Introduction: Late bedtimes and short sleep episodes are common and result in additional ambient evening light exposure and sleep deprivation. Previous work indicates that staying up late can reduce phase advances to morning light, but the relative contribution of ambient evening light versus sleep deprivation remains unclear. Here we examined the effect of additional ambient evening light on phase advances to morning light, while controlling for sleep deprivation.
Methods: Twelve young healthy subjects (6 females) participated in a within-subjects counterbalanced design. In both conditions subjects followed their habitual sleep schedule at home for 6 nights before a laboratory phase assessment to determine their dim light melatonin onset (DLMO). Subjects returned to sleeping at home for a week before a 4-day laboratory session. During the 4-day laboratory session, subjects underwent a 3-day advancing protocol (3.5 hours of bright light each morning, starting 8 hours after the DLMO), followed by another phase assessment. In one condition (no additional evening light) subjects had a 9 hour nocturnal sleep opportunity during each day of the advancing protocol. In the other condition (additional evening light) subjects had a 3 hour afternoon nap and then a 6 hour nocturnal sleep opportunity during each day of the advancing protocol.
Results: Eight of the twelve subjects slept the same amount in both conditions (PSG average TST 7.7 versus 7.5 hours/night, $p=0.38$), resulting in evening light (<40 lux) being the main difference between conditions. The 3 hours of additional evening room light reduced phase advances to morning bright light from an average of 1.7 to 0.7 hours ($p=0.007$).
Conclusion: These results indicate that the relatively dim evening light people receive when they stay up late can (1) significantly reduce their responsiveness to morning light, (2) may predispose people to circadian misalignment and (3) occurs independently of associated sleep deprivation.
Support (If Any): R01 HL083971 to HJB.

0173

GETTING IN SYNCH WITH THE NATURAL LIGHT-DARK CYCLE IN THE MODERN ERA OF ELECTRIC LIGHTING

Wright KP, McHill AW, Birks BR, Griffin B, Rusterholz T, Chinoy ED
Department of Integrative Physiology, Univ of Colorado, Boulder, CO, USA

Introduction: The use of artificial lighting has allowed humans to extend light exposure into the solar night. We compared the influence of typical exposure to artificial plus natural light versus exposure to only natural light on the timing of human circadian clock.
Methods: Eight (two females) participants aged 30.3±8.5 years (mean±SD) completed a within-subject protocol during July 2011 at latitude 40°N. Circadian melatonin phase(DLMO25%) of participants was assessed under controlled laboratory conditions (dim-light ~1.5 lux angle of gaze) before and after exposure to: (a) one week of maintaining daily routines of work, school, social activities, habitual self-selected sleep schedules, and typical exposure to artificial plus natural light, versus (b) one week of camping with exposure to only natural light (i.e., light exposure limited to sunlight and camp fires; no flashlights, no personal electronic devices etc.) and self-selected sleep schedules. Wrist actigraphy with concurrent light exposure (Actiwatch-L, MiniMitter Respironics, Bend OR) was used to estimate sleep timing and duration and document the pattern of light exposure. Sunrise and sunset times were determined from National Oceanic and Atmospheric Association databases. Mixed-effects ANOVAs were used to analyze changes in DLMO25%, sleep timing and duration.
Results: Following one week of exposure to only natural light, we observed an average phase advance of the human circadian clock ($p<0.01$). The DLMO25% was significantly closer to sunset and the phase angle between DLMO25% and sleep ($p<0.01$) was larger such that subjects went to bed at a later biological time ($p<0.01$). Sleep duration did not significantly change ($p>0.10$).
Conclusion: Our findings indicate that the natural timing of the human circadian clock during summer is such that the beginning of the biological night occurs near sunset. Our findings provide strong support that artificial lighting has altered the relationship between the human circadian clock, sleep and the solar light-dark cycle.
Support (If Any): NIH R01 HL081761 and NIH/NCRR Colorado CCTSI Grant Number UL1 RR025780.

0174

SHEDDING LIGHT ON THE ADOLESCENT PHASE RESPONSE CURVE (PRC)

Crowley SJ, Eastman CI
Biological Rhythms Research Laboratory, Department of Behavioral Sciences, Rush University Medical Center, Chicago, IL, USA

Introduction: The circadian system shifts later during adolescence, which often conflicts with early school-day rise times, leading to chronic sleep restriction. Advancing morning light could help attenuate this conflict; however, a PRC to determine the optimal time for phase advancing light is not available for adolescents. We present a partial PRC to bright white light focusing on the phase advance region.
Methods: Eleven adolescents (14.2-17.9 years, 6 boys) completed two 14-day protocols in a counterbalanced order. A 9-day fixed 9-h sleep schedule at home preceded a 5-day laboratory session, which included: a phase assessment to determine the salivary baseline dim light melatonin onset (DLMO), 3 days of an ultradian light-dark cycle (2h sleep in the dark:2h wake in room light, ~35 lux), and another phase assessment to determine final DLMO. In one laboratory session, bright white light (~4500 lux; three 20-min light pulses alternated with 20 min room light) was given during one of the 2h wake episodes for 3 days. Participants sat about 45 cm from a SunRay light box (56x32 cm). In the other (control) laboratory session, participants remained in room light. To construct the PRC, the control session DLMO shift was subtracted from the bright light session DLMO shift, and was plotted against bright light start time relative to baseline DLMO.
Results: Phase advances (N=9; range=0.1 to 1.2 h) occurred when light started 5.2 to 12.9 h after the DLMO. Phase delays (1.3 and 1.5 h) occurred when light started 2.5 to 3.0 h after the DLMO.
Conclusion: Circadian phase advances occurred when the time of light corresponded to the last two-thirds of home sleep through 2 h after home wake. The delay region is not well characterized yet, but corresponds to the beginning of home sleep. We plan to generate a full PRC to bright white light for adolescents.
Support (If Any): SRS Foundation 2010 J. Christian Gillin, M.D. Research Award and Rush University Medical Center, Department of Behavioral Sciences Incubator Grant awarded to S.J. Crowley; NIH grant R01 HL086934 awarded to C.I. Eastman.

0175

INCORPORATING THE DOSE-DEPENDENT DIRECT ALERTING EFFECT OF LIGHT INTO A MATHEMATICAL MODEL OF SLEEP, CIRCADIAN RHYTHMS, PERFORMANCE AND ALERTNESS

St. Hilaire MA[1], Kim H[2,3], Klerman EB[1]
[1]Analytic & Modeling Unit, Division of Sleep Medicine, Brigham and Womens Hospital/Harvard Medical School, Boston, MA, USA, [2]Department of Brain and Cognitive Science, Massachusetts Institute of Technology, Cambridge, MA, USA, [3]Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, USA

Introduction: The phase of the circadian pacemaker affects performance and alertness - promoting high levels at some phases and low levels at others. Light can affect performance and alertness both by shifting circadian phase and through a direct dose-dependent alerting effect of light on performance and alertness. We updated our existing mathematical model of the effects of light on the circadian pacemaker and linked model of the effects of sleep and circadian rhythms on performance and alertness to incorporate this dose-dependent direct alerting effect of light.
Methods: Our circadian light mathematical model includes a light preprocessor, Process L, which transforms a light input from the retina into a drive that acts on the master circadian pacemaker, Process P. The output of Process P provides input to the circadian component (C) of our linked performance and alertness models, which also includes a homeostatic component (H) driven by sleep-wake timing inputs and a sleep inertia component (W) driven by the time since wake. To incorporate a direct alerting effect of light on performance and alertness we added a fourth component, k*B, where B represents the light drive from Process L, to the sum of components C, H, and W. The protocol described in Cajochen et al. (Behav. Brain Res. 2000) for a 6.5-hr light exposure of 3-9100 lux was simulated. The best-fit value of k was chosen based on the reported half-maximal alerting response to a four-parameter logistic function fit to their Karolinska Sleepiness Scale (KSS) data, which was 94.8 lux. Using the best-fit value of k, we simulated a phase response curve (PRC) protocol to a 6.7-hr 10,000 lux light exposure to generate predictions of direct alerting effects across all circadian phases on our subjective alertness measure.
Results: The best-fit value of k was equal to 0.575. This generated a half-maximum response at 95.3 lux for KSS, close to the 94.8 lux half-maximum value reported from experiments. Using this value of k for our PRC simulation, the model predicted that the direct alerting effect of light is high when light exposure is given during the biological night and low when light exposure is administered during the biological day.
Conclusion: The incorporation of a direct alerting effect of light to our performance and alertness model predicts the dose-dependent effect and generates testable hypotheses of the phase-dependent effect.
Support (If Any): NIH T32-HL07901 (MSH), RC2-HL101340 and K24-HL105664 (EBK) and NSBRI HFP01603 through NASA NCC 9-58.

0176

CONTINUOUS NOCTURNAL BLUE LIGHT EXPOSURE IMPROVES THE ABILITY TO DRIVE AT NIGHT AS WELL AS CAFFEINE INTAKE: A RANDOMIZED CONTROLLED STUDY IN REAL DRIVING CONDITION

Taillard J[1], Capelli A[1], Sagaspe P[1], Anund A[2], Akerstedt T[2], Philip P[1]
[1]USR3413 SANPSY Sleep, Attention and Neuropsychiatry, CNRS Univ. Victor Segalen, Bordeaux, France, [2]Departement of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden

Introduction: Sleep deprivation induced by prolonged wakefulness highly decreases nocturnal driving performance. The development of in-car countermeasures (in contrast with interventional countermeasure, ie coffee…) is a major issue for the prevention of sleep related accidents.
Methods: 48 subjects (mean age 33.19 ± 1.57) participated in this randomized and controlled study. Participants drove 400 km (250 miles) on the same 2-lane highway for 4 hours (from 1:00 AM to 5:15 AM with a 15-minute mid-way break). They randomly received either continuous blue light exposure (GOLite, Philips, 460 nm, 20 lux) during driving or 2*200 mg of caffeine or placebo of caffeine before driving and during break with at least 1 week between conditions. Main criteria were the number of inappropriate line crossings (ILC) and the quality / quantity of sleep recovery.
Results: 8 participants complained about dazzle during blue light exposition and were thus removed from analysis. Results from the 40 other participants showed that countermeasures reduced the number of ILC ($F(2,91.11)=6.64$; $p<0.05$). ILC were lower with coffee (12.51 ± 2.08, $p=0.001$) and blue light (14.58 ± 2.18, $p=0.003$) than with placebo (26.42 ± 3.86). A significant effect of the moment of driving was also found ($F(1,103.92)=11.47$; $p<0.01$) indicating higher number of ILCs during the 2nd night-time driving session (21.32 ± 2.64) than during the 1st night-time driving session (14.59 ± 2.07, $p=0.001$). Caffeine, placebo and continuous nocturnal blue light exposure did not modify quality, quantity and timing of subsequent sleep.
Conclusion: Despite a slighter tolerance, a non-inferior efficacy of continuous nocturnal blue light exposure compared with caffeine suggests that this in-car countermeasure could be used to fight nocturnal sleepiness at the wheel.

0177

PRELIMINARY EVIDENCE THAT LIGHT THROUGH THE EYELIDS CAN SUPPRESS MELATONIN AND PHASE SHIFT DIM LIGHT MELATONIN ONSET

Figueiro M, Rea MS
Lighting Research Center, Rensselaer Polytechnic Institute, Troy, NY, USA

Introduction: A previous study reported a method for measuring the spectral transmittance of individual human eyelids. A prototype light mask was developed for the present two studies to deliver narrow-band, green light through a person's closed eyelids.
Methods: The first study investigated whether an individual-specific dose of light could suppress a predicted amount of melatonin (40%) through the closed eyelid without disrupting sleep as measured by polysomnography. Individual-specific light doses were delivered through the closed eyelids of six subjects while they were awake, during their rapid eye movement (REM) sleep, and during their non-REM sleep. In the second study, two individual-specific levels of light were delivered through the subjects' closed eyelids (n=7) before their expected minimum core body temperature to suppress two predicted amounts of melatonin suppression (30% and 60%). Dim light melatonin onset prior to and after light exposures were measured.
Results: Compared to a dark control night, the energized light mask suppressed melatonin in study 1 by 36% after the 60 minute light exposure while subjects were awake, 45% during REM sleep, and 56% during non-REM sleep. Compared to a dark control night, nocturnal melatonin was suppressed in study 1 by 25% and by 45% after the 60 minute light exposure while subjects slept. Circadian phase was delayed by 34 minutes and 104 minutes, on average, with respect to the dark control night in these subjects as determined by the measured difference in times of DLMO.
Conclusion: These two studies offer preliminary support for the conclusion that individual-specific doses of light can be delivered through closed eyelids to treat circadian sleep disorders.
Support (If Any): Philips Respironics.

0178

INTRA-INDIVIDUAL VARIABILITY IN CIRCADIAN PHASE

Emens J, Lewy A
Psychiatry, Oregon Health & Science Univ, Portland, OR, USA

Introduction: The hypothalamic circadian pacemaker (biological clock) is known to be important in the regulation of sleep and wakefulness and the timing of the clock (circadian phase) is primarily determined by the external light/dark cycle. It has also been shown that relatively dim indoor artificial light can have a resetting effect on the clock. There is limited longitudinal data on the stability of phase outside the laboratory in modern humans living under conditions of artificial light. We sought to assess the intra-individual variability in circadian phase over many weeks.
Methods: Subjects (13 female, 9 male; 21-34 years old) were first-year medical students at Oregon Health & Science University (OHSU) who were in generally good health as documented by a Health and Screening Questionnaire. Subjects maintained a sleep/wake schedule of their choosing for seven weeks and kept a sleep/wake diary. Four assessments of circadian phase were made over the course of the study: every 2 weeks subjects were admitted to the OHSU Clinical and Translational Research Center and hourly saliva samples were collected for six hours in dim light (< 10 lux). Melatonin concentrations were measured by radioimmunoassay (ALPCO) and the salivary dim light melatonin onset (DLMO) was calculated using a 3 pg/ml threshold.
Results: Subjects had an average (±SD) DLMO of 21:26 ± 01:25 hours. The average individual standard deviation in the DLMO was 28 minutes with a minimum of 4 minutes and a maximum of an hour and 36 minutes. The standard deviation in the DLMO showed a greater correlation with standard deviation in bedtime (r= 0.71) than with the standard deviation in waketime (r = 0.43). Two individuals who reported dim nocturnal light exposure over the course of the study (reading at night) had the greatest variability in phase (DLMO standard deviations of 1 hour and 36 minutes and 53 minutes).
Conclusion: Circadian phase demonstrated a wide range of intra-individual variability in this small cohort. Variability in bedtimes and evening light exposure may be a more significant contributor to variation in phase compared to waketimes or morning light exposure. Assessment of phase variability over time in normative and pathological populations and determination of any correlations with symptoms is warranted.
Support (If Any): R01 EY018312 (to AJL) and UL1 RR024120 (to OHSU).

0179

A ROLE FOR GLUTAMATERGIC NEURONS IN THE DORSOMEDIAL HYPOTHALAMIC NUCLEUS IN CIRCADIAN ORGANIZATION OF BEHAVIOR

Vujovic N[2,1], Rapp K[1], Fuller PM[1], Saper C[1]
[1]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Program in Neuroscience/Division of Medical Sciences, Harvard University, Cambridge, MA, USA

Introduction: The dorsomedial hypothalamic nucleus (DMH) receives direct and indirect neural input from the clock in the suprachiasmatic nucleus and is necessary for normal amplitude rhythms in activity, wakefulness and several other clock outputs. For this reason, cells in the DMH are thought to relay timing information from the circadian pacemaker to the rest of the brain and body in a manner essential for expression of certain behavioral rhythms. It is not known whether excitatory, inhibitory or peptidergic output from the DMH is most important for this function; in this study we evaluate the role of excitatory glutamatergic output.
Methods: We selectively disrupted glutamatergic neurotransmission from DMH neurons by using a conditional knock out mouse for vesicular glutamate transporter 2 (VGlut2), a gene critical for synaptic glutamate release in this region. In these mice, we performed stereotaxic injections of an adeno-associated viral (AAV) vector expressing cre recombinase, in the presence of which the VGlut2 allele is rendered null. As a vector control, an AAV expressing green fluorescent protein was injected into the same region. Location of injection placement was confirmed using immunohistochemistry for cre-recombinase or green fluorescent protein, respectively and deletion of VGlut2 where appropriate was confirmed using in situ hybridization.
Results: Reduced VGlut2 expression in the DMH causes a significant decrease in the amplitude of circadian and diurnal rhythms of locomotor activity. Baseline body temperature is also decreased by approximately 0.5°C following this deletion, although the amplitude of circadian and diurnal rhythms in body temperature is unaffected.
Conclusion: These data are consistent with the idea that the DMH plays a significant role in relaying circadian clock information to the rest of the brain, and indicate that excitatory glutamatergic neurons in this region may be especially important in the expression of daily activity rhythms.
Support (If Any): NHBLI: HL-60292 and NINDS: NS-33987 to CB; NINDS: NS071890-01 and NSF-GRF to NV.

0180

12 WEEKS OF CHRONIC PHASE ADVANCES ALTER SLEEP AND WAKE DYNAMICS DURING RE-ENTRAINMENT

Brager AJ, Ehlen J, Castanon-Cervantes O, Davidson AJ, Paul K
Neurobiology, Morehouse School of Medicine, Atlanta, GA, USA

Introduction: We have reported that 4 weeks of chronic phase-advances in mice increase REM sleep amounts by 34.1%, but does not alter total sleep amount (Castanon-Cervantes et al. 2010). Here, we extend

upon this study to characterize the effects of 12 weeks of chronic phase-advances on sleep/wake dynamics.
Methods: EEG/EMG electrodes telemetrically interfaced to a data acquisition system were surgically implanted in male mice for polysomnographic recordings of sleep and wakefulness that were scored in 10 second epochs. At the end of each week, the dark phase of the 12:12 light:dark photocycle was phase-advanced by 6 hours.
Results: The total amount of wake across 24 hours of shift 12 was 21.9% higher than baseline. The total amount of NREM sleep across 24 hours of shift 12 was 37.7% lower than baseline and was concurrent with an increase in the total amount of REM sleep which was 175.9% higher than baseline. The mean duration of a NREM sleep bout was decreased by 31.4%, while the mean duration and number of REM sleep bouts were increased by 46.5% and 80.4%, respectively, during shift 12.
Conclusion: These results suggest that there may be cumulative effects of chronic phase-advances on changes to NREM and REM sleep amounts and that sleep loss manifest from chronic phase-advances does not occur until after 4 weeks under such conditions.
Support (If Any): U54NS034194 to AJD and U54NS060659 to KNP.

0181

DESTRUCTION OF MELANOPSIN-EXPRESSING RETINAL GANGLION CELLS REDUCES EFFECTS OF SHORT LIGHT-DARK CYCLES ON SLEEP IN ALBINO MICE

Liao Y, Liu Y, Tsai L, Wang F
Psychology, National Chung Cheng University, Chiayi, Taiwan

Introduction: The dark and light periods of short light-dark cycles (LDc) enhance and inhibit paradoxical sleep (PS) respectively in albino rats and mice. Since the retinally degenerated FVB mice maintain the distribution pattern of PS in short LDc, the rod-cone photoreceptors appear not essential in mediating the photic influence on sleep. The melanopsin-expressing intrinsically photosensitive retinal ganglion cells (ipRGCs) might be the photoreceptor cells responsible for the remaining light-responsive sleep patterns.
Methods: We used a specific immunotoxin to destruct ipRGCs to examine the sleep patterns in response to short LDc in both BALB/c mice with normal visual functions and retinally degenerated FVB mice. Saporin-conjugated melanopsin antibodies or control vehicles were injected into the eyes of the mice each assigned to the destruction or control group. These mice were implanted with electrodes for electrophysiological recordings performed during baseline (12-12h LDc), short LDc treatment, and recovery (12-12h LDc) for two days each. On the day of the short LDc treatment, 5-5 min LDc persisting for 4 hours were applied respectively in the mid-periods of inactive and active phases.
Results: We found that the PS enhancement effects of dark periods and the non-rapid eye movement sleep (NREMS) induction effects of light periods were attenuated or disappeared in ipRGCs destructed mice. The degree of attenuation depended on the amount of destructed ipRGCs.
Conclusion: Among the ipRGCs destructed mice, some still maintained normally entrained circadian sleep and waking rhythms but with reduced sleep responses to short LDc, and some mice showed an opposite pattern, i.e., free-run circadian rhythms but maintained short LDc effects. Destructions of different subtypes of ipRGCs such as M1 and non-M1 cells may be responsible for the variant findings.
Support (If Any): This study was supported by National Science Council, Taiwan ROC, Grant No. NSC98-2410-H-194 -022 -MY2.

0182

EFFECT OF CK1 INHIBITION ON RHESUS MONKEY SLEEP ARCHITECTURE AND CIRCADIAN RHYTHMS

Fuller CA[1], Robinson EL[1], Hoban-HIggins TM[1], Offord J[2], DeMarco G[3], Doran A[4], Chandrasekaran R[5], Wager T[5], Delnomdedieu M[6]
[1]Dept. of Neurobiology, Physiology & Behavior, University of California, Davis, CA, USA, [2]Neuroscience Research Unit, Pfizer R&D, Groton, CT, USA, [3]Comparative Medicine, Pfizer R&D, Groton, CT, USA, [4]PharmacoDynamics & Metabolism, Pfizer R&D, Groton, CT, USA, [5]Chemistry, Pfizer R&D, Groton, CT, USA, [6]Clinical Neuroscience Research Unit, Pfizer R&D, Groton, CT, USA

Introduction: The circadian timing system is responsible for the internal and external temporal coordination of an organism over the course of a 24-h day. Casein kinase (CK)-mediated protein phosphorylation regulates circadian timing in the site of the master clock, the suprachiasmatic nuclei (SCN) of the hypothalamus.
Methods: In this study, three doses of a pharmacological CK1 inhibitor were given to adult male rhesus monkeys to determine the effects on the clock and the sleep-wake cycle. The animals were in a 12:12 light-dark cycle and maintained on a standard diet. Each animal was implanted with a biotelemetry unit (Konigsberg Instruments, Pasadena, CA) to allow for the recording of two channels of electroencephalogram (EEG), as well as electrooculogram (EOG), electromyogram (EMG) and brain temperature (Tbr) data. EEG, EOG and EMG are analyzed to characterize sleep architecture and timing. These data were used to assign sleep state to 30-second epochs and delta EEG power was calculated. Tbr data provide an independent measurement of circadian phase.
Results: Following a baseline period, the drug was administered daily by subcutaneous injection 10 hours after lights on (ZT 10) for five days. Following drug administration, phase delays in sleep were seen, especially at the highest dose. Total sleep time did not appear to be affected, and distribution of total sleep between L and D periods did not change significantly. REM sleep appeared to decrease at the highest dose in animals that responded to the drug, and this was associated with reductions in the amplitude of both the Tbr and REM rhythms. Elevated nocturnal Tbr and reduced REM were the most conspicuous changes in sleep.
Conclusion: The changes in sleep appear to mainly be in timing and distribution. On the basis of the available data this study did not demonstrate a significant effect of CK1 inhibition on sleep homeostasis.
Support (If Any): Collaborative Agreement between University of California, Davis and Pfizer Neuroscience Research Unit, Groton, CT.

0183

TSC/MTOR REGULATES MAMMALIAN CIRCADIAN RHYTHMS

Lipton J, Nathan A, Yuan E, Leech J, Han J, Sahin M
Neurology, Children's Hospital Boston/Harvard Medical School, Boston, MA, USA

Introduction: Circadian rhythm disruption is common in children with neurodevelopmental disorders, contributing adversely to sleep, seizure frequency, metabolic regulation, and quality of life; the mechanisms underlying these associations remain largely unexamined. The neurodevelopmental syndrome, Tuberous Sclerosis Complex (TSC) is characterized by epilepsy, autism, tumor formation, and sleep dysfunction. TSC is caused by loss-of-function mutations in either the Tsc1 or Tsc2 genes, the products of which form a heterodimer with the primary function of inhibiting the GTPase activating protein, Rheb. Rheb in turn, inhibits the mammalian target of rapamycin (mTOR). Diminished function of either TSC1 or TSC2 renders the mTOR pathway overactive. mTOR is a conserved Ser/Thr kinase that integrates cellular responses to nutrient status and stress with anabolic pathways such as protein and lipid synthesis and mitochondrial biogenesis.

Methods: We have employed mouse models of TSC to investigate behavioral, cell biological, and biochemical relationships between Tsc/mTOR signaling and the circadian clock.
Results: In Tsc-deficient cells (in which mTOR is overactive), circadian oscillations are markedly diminished. Pharmacological inhibition of mTOR alters circadian period. Thus, increased or decreased mTOR pathway activity, can adversely affect the circadian clock and suggest that exquisite control of mTOR pathway activity is important to the generation of normal circadian rhythms. Consistently, brain-specific Tsc1 loss results in grossly abnormal circadian temperature oscillations and suggests decoupling of putative oscillators in the suprachiasmatic nucleus. Heterozygous loss of Tsc2 on the other hand, results in a shortening of endogenous circadian period. Ongoing biochemical and cell biological experiments have identified molecular mechanisms that link Tsc/mTOR signaling to the circadian clock.
Conclusion: Our work provides a model for investigating circadian dysfunction in a neurodevelopmental disease and provides potential groundwork for dissecting the connections between cellular responses to nutrients, stress, and growth control with the circadian system.
Support (If Any): American Sleep Medicine Foundation Physician Scientist Training Grant.

0184

RELATIVE MAGNITUDE OF LINGUAL MUSCLE PHASIC ACTIVITY DURING REM SLEEP VARIES WITH CIRCADIAN TIME

Rukhadze I, Mann GL, Kubin L
Dept. of Animal Biology, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Whereas axial muscles become atonic during REM sleep (REMS), distal limb and cranial muscles generate prominent phasic activity. In rats, lingual electromyogram (EMG) exhibits a high level of phasic twitching that gradually increases with the duration of REMS episodes. The mid-day lingual EMG during REMS corresponds to 25-45% of the mean wake activity. Thus, lingual EMG offers insight into the excitatory processes unique to REMS, and in obstructive sleep apnea patients, lingual twitching may prevent upper airway occlusions. Since sleep amount/structure and tongue activity differ between day and night, we quantified lingual EMG during REMS across the circadian cycle.
Methods: Four adult, male Sprague-Dawley rats were instrumented for cortical EEG and nuchal and lingual EMG recordings. After habituation, ca. 17 h-long recordings were obtained starting at 4-5pm and separate recordings were conducted during mid-day (11am-3pm). Wakefulness, slow-wave sleep and REMS were scored in 10 s epochs, root mean squares of lingual EMG were calculated for each state, and the mean level during REMS was expressed relative to the mean during wakefulness for the mid-day recordings and five successive late-day/overnight periods: before 7pm (lights-off), 7-11pm, 11pm-3am, 3-7am (lights-on), and after 7am.
Results: Relative to the mean activity during wakefulness in the same period, lingual EMG during REMS was maximal during mid-day (29.6%±4.6(SE)), and declined overnight to a minimum of 7.3%±2.5 (p=0.009) at 3-7am. This was due to both a nearly threefold lower mean lingual EMG during wakefulness in mid-day sessions (35% ±4) vs. maximal night activity and reduced duration of REMS episodes at night, which limits expression of lingual twitching.
Conclusion: Magnitude of phasic lingual activity during REMS varies across the circadian period in relation to sleep amount and REMS episode duration but not in proportion to the amount of wake activity. This needs to be considered in quantitative EMG studies. If lingual twitching is a marker of brain activity during REMS, then its magnitude and impact will vary with circadian time.
Support (If Any): HL-47600, -71097.

0185

HOW DOES CIRCADIAN PHASE ANGLE AFFECT SELF-REPORTED SLEEP?

Van Reen E[1,2,3], Roane BM[1,2,3], Sharkey KM[1,3,4], Carskadon MA[1,2,3]
[1]Psychiatry and Human Behavior, Warren Alpert Medical School of Brown University, Providence, RI, USA, [2]E.P. Bradley Hospital, Providence, RI, USA, [3]Sleep for Science Research Lab, Providence, RI, USA, [4]Rhode Island Hospital, Providence, RI, USA

Introduction: Circadian and homeostatic processes regulate sleep patterns. We measured circadian phase using dim light melatonin onset (DLMO) in first year college students who completed daily sleep diaries. We hypothesized that students with self-reported bedtimes closer to DLMO phase would report longer sleep onset latencies (SOLs) than students with bedtimes later relative to DLMO and that phase angle might also affect wake time after sleep onset (WASO) or total sleep time (TST).
Methods: Students completed daily online sleep diaries for the first 9 weeks at college. Salivary DLMO was measured in a subset of students 7 weeks after classes started; DLMO phase was estimated from radioimmunoassays (Alpco, Salem, NH) by linear interpolation using a 4-pg/ml threshold in 30-min sampling intervals. Sleep variables are averages across the 7 days before DLMO determination. Phase angle is minutes from DLMO phase to bedtime.
Results: 112 students (mean age=18.6, 52 females) were included. Consistent with our hypothesis, a significant negative correlation was observed between phase angle and SOL (r=-.273, p=.004). In addition, a significant negative correlation was observed between phase angle and TST (r=-.540, p<.001); however, no significant correlation was observed for phase angle and WASO (r= .033 , p=.730).
Conclusion: The association of shorter phase angle with longer SOL is consistent with the notion that going to bed at a circadian phase closer to the "wake maintenance zone" favors longer SOLs, whereas going to bed at a circadian phase closer to the alertness trough favors shorter SOLs. Students who reported going to bed earlier in their circadian phase also had longer TST, perhaps due to a prolonged opportunity to sleep during a circadian phase favoring sleep. The lack of correlation of DLMO phase angle to WASO likely reflects the small range of reported WASO in this sample. Future analyses will explore these associations in a larger sample and include measures of sleep homeostasis.
Support (If Any): MH079179 (MAC).

0186

MORNINGNESS-EVENINGNESS CORRELATES WITH ORBITOFRONTAL GRAY MATTER VOLUME

Kipman M[1], Weber M[1,2], DelDonno S[1], Schwab ZJ[1], Killgore WD[1,2]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Individuals show considerable variability in preferences for diurnal activity and sleep. These preferences comprise a continuum of "morningness-eveningness," with morning chronotypes showing greater preference for activity in the morning hours and an earlier bedtime, while evening chronotypes show the opposite pattern. Despite the robustness of this phenomenon, little is known about the underlying neurobiological mechanisms that may contribute to these individual differences. Here we examined whether structural differences in prefrontal gray matter volume correlate with individual differences in circadian preferences.
Methods: 36 healthy participants (20 males), ranging in age from 18-45, completed the Horne-Ostberg Morningness-Eveningness Questionnaire (MEQ) and underwent structural magnetic resonance imaging (MRI) at 3T. Using SPM8, brain tissue images were first normalized to standard stereotaxic space, segmented into gray matter, white matter, and cerebrospinal fluid, and spatially smoothed. Individual scores on the MEQ

were correlated with gray matter volume of the orbitofrontal cortex after controlling for age and sex. This region was defined by the Wake Forest PickAtlas Toolbox for SPM.
Results: MEQ scores ranged from 30 to 73 (M=50.4, SD=10.6). Greater eveningness (i.e., lower MEQ score) was significantly correlated with increased gray matter volume in the right lateral orbitofrontal cortex ($p<.001$, uncorrected; $k = 32$).
Conclusion: Individuals with stronger evening preferences tended to show increased gray matter volume in the orbitofrontal cortex, a highly complex region of the brain that mediates complex executive functions such as set shifting and reward learning. Prior research has found that eveningness traits correlate with greater intelligence and verbal ability, but also with extraversion, impulsivity, and mood disturbance. The present findings suggest that some of these individual differences may be related to variability in prefrontal cortical structure and organization.

0187

OCULAR MEASUREMENT OF DROWSINESS AND DRIVING IMPAIRMENT IN SHIFT-WORKERS

Lee ML[1,2], Howard ME[3], Horrey WJ[4], Liang Y[4], Anderson C[1,2,5], Shreeve MS[1], O'Brien C[1], Czeisler CA[1,2]
[1]Division of Sleep Medicine, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]Institute for Breathing & Sleep, Department of Respiratory & Sleep Medicine, Austin Health, Melbourne, Australia, [4]Liberty Mutual Research Institute of Safety, Hopkinton, MA, USA, [5]Monash University, Victoria, Australia

Introduction: Shift workers are at increased risk of excessive sleepiness as a result of circadian disruption and sleep restriction. Risk of drowsiness-related accidents is increased, particularly driving home after work. We present results from a novel study assessing objective measures of drowsiness in shift workers driving an instrumented motor vehicle following night shifts and in a rested state.
Methods: Fifteen healthy shift-workers (18-65 years) participated in two 2-hour drives in an instrumented vehicle on a driving track. One baseline session was conducted during a rested state after each participant had slept at night for at least 7 hours. The other session was conducted following a night of shift work. Physiological indicators of drowsiness were collected continuously during the drive. Drowsiness was continuously assessed using: 1) infrared oculography coupled with an algorithm that utilizes the speed, amplitude and duration of eyelid movements to derive a composite measure, the Johns Drowsiness Scale, JDS (Optalert, Melbourne, Australia), 2) an eye tracking system (SensoMotoric Instruments, Teltow, Germany), and 3) continuous polysomnographic recording. The instrumented vehicle collected driving performance data, including lateral lane position, steering wheel movement, and speed variation.
Results: Participants who performed the drive in a rested state rarely experienced JDS scores above 4 (indicative of drowsiness), while driving after a night shift resulted in significantly greater number of JDS scores above 4 ($p=0.024$). Mean JDS scores were significantly higher in night shift drives (1.8) compared to rested drives (1.0), ($p= 0.0088$) and the maximum JDS score was significantly higher in night shift drives (4.4) than rested drives (3.0) ($p=0.028$). Analysis of eye tracking, driving performance and PSG data is ongoing.
Conclusion: Shift workers experienced higher average JDS scores and more frequent high scores when operating a motor vehicle following a night shift, indicative of significant drowsiness.
Support (If Any): IBAS Research Grant, Austin Hospital.

0188

THE HUMAN ENDOGENOUS CIRCADIAN TIMING SYSTEM SIGNIFICANTLY INFLUENCES HUNGER

Morris CJ[1,2], Scheer FA[1,2], Shea SA[1,2]
[1]Division of Sleep Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Humans usually eat throughout the biological daytime and fast during sleep at night. However, it is not known if the endogenous circadian timing system influences self-reported measures of appetite.
Methods: Twelve healthy adults (6 male; age, 20-42 y; BMI, 19.9-29.6 kg/m2) undertook a 13-day in-laboratory protocol. Subjects completed two 24-h baseline days, followed by a forced desynchrony protocol (FD) which balanced all scheduled behaviors, eucaloric meals and sleep periods evenly across the circadian cycle. This was achieved by scheduling recurring 20 h 'days' with 13:20 h of wakefulness and a 6:40 h sleep opportunity. During wake periods, subjects used visual analogue scales to rate their appetite and food preferences before and after meals (1:25 h [breakfast], 6:45 h [lunch], 10:45 h [dinner] and 12:10 h [snack] after scheduled wake time). One subject was excluded from analysis due to not understanding how to use the visual analogue scales.
Results: An endogenous circadian rhythm was present in self-rated hunger, with a peak in the biological evening and a nadir in the biological morning (peak-to-trough amplitude was ~16%; $P<0.05$). Similar endogenous circadian rhythms were present in desire for sweets, salty and starchy foods, fruits, meats/poultry, strength of desire for food and how much food one could eat (peak-to-trough amplitudes were 13-23%; $P<0.05$).
Conclusion: Paradoxically, the circadian rhythm in human appetite causes appetite to be lowest at the end of usual sleep and fasting period. This would counteract the homeostatic changes due to food intake and therefore may help consolidate the overnight fast and thereby also consolidate sleep. This circadian control of appetite could be a novel target for therapies aimed at reducing obesity.
Support (If Any): CJM was supported by the National Space Biomedical Research Institute through NASA NCC 9-58, FAJLS was supported by NIH grant P30-HL101299, SAS was supported by NIH grant K24-HL76446.

0189

ASSOCIATIONS BETWEEN OBJECTIVELY ASSESSED ACTIVITY RHYTHMS AND SLEEP CHARACTERISTICS IN THE ELDERLY

Luik AI[1], Zuurbier LA[1], Van Someren EJ[2], Tiemeier H[1]
[1]Epidemiology, Erasmus University Medical Center, Rotterdam, Netherlands, [2]Sleep and Cognition, Netherlands Institute for Neuroscience, Amsterdam, Netherlands

Introduction: The diurnal rhythm of activity changes profoundly with age in all animals studied so far, including humans. Aging also affects sleep. It is insufficiently known to what extent these two age-related changes are associated. We assessed the cross-sectional association between objectively measured activity rhythms and sleep estimates in a large population-based study.
Methods: 1734 actigraphy recordings of at least 72 hours (138 ± 14 hours, mean ± SD) were collected in participants (age 62 ± 9.4 years) of the Rotterdam Study. Activity rhythms were assessed by calculating the interdaily stability and intradaily variability. A higher interdaily stability reflects a more stable rhythm over days; a higher intradaily variability gives an indication of higher fragmentation of the rhythm. Sleep characteristics were assessed with a diary which was kept during actigraphy.
Results: A higher interdaily stability was associated with less use of sleep medication ($\beta=-0.10$, $p<0.001$), a longer total sleep time ($\beta=0.08$, $p<0.001$), less napping during the day ($\beta=-0.26$, $p<0.001$), a better per-

ceived sleep quality (β=0.11, p<0.001), and less perceived impairment due to sleep loss (β=−0.14, p<0.001), even after adjustment for multiple demographic and lifestyle parameters. Similar effects were observed in the association between sleep parameters and a lower intradaily variability, in line with the moderate negative correlation (r=−0.49, p<0.01) observed between interdaily stability and intradaily variability.
Conclusion: Sleep characteristics are significantly associated with the stability and fragmentation of the activity rhythm. Given the modest effect sizes, it is most probable that both shared and specific mechanisms underlie the variation in sleep characteristics and activity rhythms. Of all sleep characteristics, napping was most strongly associated with a less stable and more fragmented activity rhythm in the elderly.
Support (If Any): A.I. Luik and L.A. Zuurbier were supported by a Netherlands Organization for Scientific Research grant (NWO-VIDI: 017.106.370) awarded to H. Tiemeier.

0190

MORNINGNESS-EVENINGNESS PREFERENCE AND PERCEIVED RESILIENCE TO SLEEP DEPRIVATION ARE ASSOCIATED WITH FELLOWSHIP PREFERENCE AMONG INTERNAL MEDICINE RESIDENTS AT HENRY FORD HOSPITAL

Soca R[1], Drake C[2]
[1]Internal Medicine, Henry Ford Hospital, Detroit, MI, USA, [2]Sleep Disorders and Research Center, Henry Ford Hospital, Detroit, MI, USA

Introduction: Some fellowships and career plans have longer and more irregular working hours than others. While evening chronotypes may adapt better to irregular/long shifts, there are no studies to determine if chronotype is associated with future career plans among medical residents.
Methods: Second and third year Internal medicine residents completed the Horne & Östbergs morningness-eveningness questionnaire (MEQ) and 2 questions to assess perceived resilience to sleep deprivation (pRSD). MEQ and pRSD scores were calculated for all study participants. Residents were divided in 2 groups based on average shift-length of their fellowship of interest. Group 1 for those interested in Cardiology, Nephrology and pulmonary-critical care (long shift length); and group 2 those interested in all the other subspecialties and career plans (average shift length). A T-Test analysis of the MEQ and pRSD scores was used to compare both groups.
Results: A total of 25 second and third year residents completed the study. 14 residents were interested in group 1 fellowships and 11 residents were interested in group 2. Residents in group 1 had a more evening chronotype than those in Group 2 (MEQ score 41.6±7.2 vs. 50.1±9.1 p= 0.02). Residents in group 1 perceived better resilience to sleep deprivation than those in group 2 (pRSD score of 4.0±1.3 Vs. 5.5±1.2; p<0.01).
Conclusion: Medical Residents with a preference for fields associated with long and irregular shifts have a more evening chronotype and report greater resilience to sleep deprivation. Such chronotype information could be used to provide feedback to residents on career path fit and design of educational programs to facilitate optimal fellowship adaptation and coping.

0191

THE RELATIONSHIP BETWEEN SLEEP QUALITY AND DAYTIME SLEEPINESS WITH CHRONOTYPE LATENT CONSTRUCTS: AN EXPLORATORY AND CONFIRMATORY FACTOR ANALYSIS IN CHINESE COLLEGE STUDENTS

Wong ML[1], Lau E[1], Wan J[1], Hui H[1], Cheung S[2], Mok D[2]
[1]Psychology, University of Hong Kong, Hong Kong, China, [2]Psychology, University of Macau, Macau, China

Introduction: The Composite Scale of Morningness (CSM) has been suggested to consist of two to three latent constructs. Yet, the role of each latent construct in relating to other sleep behaviors was unclear. This study examined the factor structure of CSM by exploratory and confirmatory factor analyses from structural equation modeling. We aim to elucidate the relationship between each CSM latent construct with daytime sleepiness and sleep quality with a Chinese sample.
Methods: Participants (n=661, 18-25, Chinese undergraduates, 32.1% male) completed an online survey including the validated Chinese version of Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index(PSQI), and CSM, translated (with back translation) by our research team.
Results: The CSM fits into a 3-factor model (CFI=.982, RMSEA=.047, SRMR=.039) with much better model fit indexes than a 2- or 1-factor model. The derived latent constructs captured individuals' voluntary sleep-wake schedule, self-reported morningness/eveningness chronotype and alertness after waking-up. The 10th and 90th percentile scores are 23 and 40 indicating eveningness and morningness chronotypes, respectively. Correlational analyses revealed that a late voluntary sleep-wake schedule, self-reported eveningness-chronotype and low alertness after waking-up were significantly correlated (p<.05) with a higher level of daytime sleepiness, worse subjective sleep quality, shorter sleep, lower sleep efficiency and greater daytime dysfunction. However, a longer sleep latency was not related to self-reported chronotype but the other two CSM latent constructs. Sleep disturbances and use of sleep medication were only correlated with low alertness after waking-up.
Conclusion: A 3-factor model of CSM is validated with good psychometric properties. While the cutoff score for eveningness-chronotype is comparable with the original paper on Caucasians, a lower cut-off for morningness-chronotype is found among Chinese undergraduates. Regarding the factor structure, these 3 factors differ in their relationships with sleep quality dimensions. A 3-factor scoring of CSM is suggested for better delineation of the different aspects of circadian rhythm for future studies.

0192

THE RELATIONSHIP BETWEEN CREATIVITY, OBJECTIVE SLEEP - WAKE PATTERNS AND EVENING PREFERENCE

Tzischinsky O[1], Ram N[2], Green A[3], Shochat T[4]
[1]Psychology, Emek Yezreel College, Emek Yezreel, Israel, [2]Faculty of Social Welfare and Health Sciencesand Faculty of Education, Haifa University, Haifa, Israel, [3]Sleep and Fatigue Institute, Assuta Medical Center, Tel Aviv, Israel, [4]Department of Nursing, University of Haifa, Haifa, Israel

Introduction: Few studies have investigated the relationships between creativity and subjective and objective sleep patterns. Creative individuals work long hours with deep concentration however, they often need more rest, more sleep time and have an evening preference, compared to less creative individuals. The aims of this study were to understand the relationships between verbal creativity and subjective and objective sleep-wake patterns. We hypothesized that among all subjects, increased verbal creativity is related to a delayed sleep phase, and that art students (research group) exhibit an evening preference, later sleep and wake-up times, and longer sleep duration compared to psychology students (control group).
Methods: Thirty students (mean age 23.5 ±2.03), participated in the study. The research group included 14 art students and the control group included 16 psychology students. Sleep/wake patterns were objectively assessed by actigraphy for one week. All subjects completed the Torrence Tests of Creative Thinking (TTCT) and the Munich Chronotype Questionnaire (MCTQ).
Results: For the entire sample, significant correlations was found between verbal creativity and self-reported sleep duration (r=0.42, p<0.02), and mid-sleep before working days (r=0.38, p<0.04). Borderline correlations were found between verbal creativity and objective sleep duration (r=0.33, p=0.07). Compared to control group, art students were more verbally creative (56±22.69 vs. 38.69±21.03 respectively, p<0.04). Based on actigraphy, significant differences were found between research and control groups in sleep duration (480.7±50.37 vs

432.54±47.53 respectively; p<0.01) and borderline differences were found in wake-up time (9:45±1:52 vs. 8:26±1:44 respectively, p<0.06). Based on subjective measures (MCTQ), the research group reported more evening preference than the control group (4.2±0.97 vs. 3.0±1.79, respectively, p<0.03), and later mid-sleep on work days (04:23±00:50 vs. 3:25±00:48 respectively, p<0.03).
Conclusion: Results indicate that verbal creativity is associated with objective and subjective aspects of sleep duration and timing. As suggested, verbal creativity subjects had an evening preference and longer sleep duration.

0193

A MONOZYGOTIC TWIN DIFFERENCES APPROACH TO IDENTIFYING SPECIFIC NON-SHARED ENVIRONMENTAL INFLUENCES ON DIURNAL PREFERENCE

Barclay NL[1], Eley TC[2], Parsons MJ[3,2], Gregory AM[4,2]
[1]Northmbria Centre for Sleep Research, University of Northumbria, Newcastle upon Tyne, United Kingdom, [2]Social, Genetic and Developmental Psychiatry Research Centre, Institute of Psychiatry, King's College London, London, United Kingdom, [3]Mammalian Genetics Unit, Medical Research Council, Harwell, Oxford, United Kingdom, [4]Department of Psychology, Goldsmiths, University of London, London, United Kingdom

Introduction: Non-shared environmental influences account for a large proportion of variation in diurnal preference in young adults. However, little is known about specific non-shared environmental influences on diurnal preference. Although epidemiological studies have shed light on possible environmental influences, a substantial amount of research has highlighted the importance of genetic influences on measures of the environment, a process termed gene-environment correlation (rGE). It is therefore possible that associations between the environment and diurnal preference are in part determined by genetics, rather than being purely environmental in origin. One way of exploring the contribution of purely non-shared environmental components on the association between diurnal preference and the environment is to use the monozygotic twin differences design. This design allows us to tease apart the influences of genetics and the environment to identify purely environmental components.
Methods: One hundred and ninety monozygotic twin pairs (mean age 19.8 years, SD=1.26, range=18-22 years, 65.8% female) completed the Horne and Östberg 'Morningness-eveningness questionnaire' and questionnaires assessing the following candidate non-shared environmental influences: dependent and independent negative life events; relationship status; deviant peers; affiliation with deviant peers; educational attainment; employment status; general health; smoking; number of cigarettes smoked per day; drug-use; alcohol-use; number of alcoholic drinks typically consumed when drinking; number of driving accidents in past 3 years.
Results: When controlling for genetic and shared environmental effects, within monozygotic twin-pair differences in diurnal preference were associated with within monozygotic twin-pair differences in dependent negative life events ($\beta = -.27$, $p < .001$), educational attainment ($\beta = -.14$, $p < .05$), smoking ($\beta = .22$, $p < .01$), and drug use ($\beta = -.16$, $p < .01$).
Conclusion: These results suggest that these variables have a purely environmental influence on diurnal preference that is independent of genetics. The effects of the remaining 'environmental' variables on diurnal preference, however, may be intertwined with underlying genetic factors.

0194

ADDING CIRCADIAN PHASE SHIFTING EFFECTS OF EXOGENOUS MELATONIN TO A MATHEMATICAL MODEL OF PLASMA MELATONIN

Phillips AJ, Breslow ER, Huang JM, St. Hilaire MA, Klerman EB
Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Melatonin is produced endogenously during biological nighttime and is an accurate marker of the human circadian rhythm. Melatonin secretion from the pineal gland is timed by the suprachiasmatic nucleus (SCN) of the hypothalamus, and its production is inhibited by light. The presence of melatonin receptors on SCN neurons suggests a feedback mechanism of melatonin to the circadian clock that can be exploited by exogenous doses of melatonin. Exogenous melatonin induces circadian phase shifts, and can therefore be used for treatment of jet lag, adaptation to shift work, and entrainment of blind individuals (e.g., Altun et al., 2007). Our research group previously developed a mathematical model of the circadian pacemaker and endogenous melatonin (St. Hilaire et al., 2007). Here, we extend that model to include absorption of exogenous doses and circadian phase shifting effects of circulating melatonin.
Methods: The previous model included compartments for pineal and plasma melatonin concentrations. The model was extended to include oral absorption and a direct effect of melatonin on the circadian pacemaker. To model oral absorption, (i) we fit our model to blood concentration data in the 11 hours following 0.3 mg and 5.0 mg oral gelatin tablet doses (Wyatt et al., 2006) and (ii) calculated parameters for the time and dose-related differences from oral oil and gelatin melatonin preparations. We then simulated a phase response curve (PRC) protocol for 0.5 mg and 3.0 mg oral gelatin doses (Burgess et al., 2010).
Results: The model accurately reproduced blood concentration profiles following 0.3 mg and 5.0 mg doses and changes in the absorption and clearance rates for different oral preparations. The model was fitted to 3.0 mg PRC data. Without any change in parameters, the model correctly predicted that 0.5 mg doses result in a PRC that is lower in amplitude and phase delayed relative to the 3.0 mg PRC.
Conclusion: Our model provides accurate predictions of the blood concentration and phase shifting effects of exogenous doses of melatonin from two different oral preparations. This model could be used to guide optimal use of melatonin for phase-shifting in a variety of real world environments.
Support (If Any): Research supported by NIH T32-HL07901 (MSH), RC2-HL101340 and K24-HL105664 (EBK) and NSBRI HFP01603 (EBK) and PF02101 (AJKP) through NASA NCC 9-58.

0195

THE DEVELOPMENT OF A QUESTIONNAIRE TO ASSESS SLEEP-WAKE FLEXIBILITY: PRELIMINARY DATA

Ma H[1], Jan Y[1,2], Yang C[1,3]
[1]Psychology, National Chengchi University, Taipei, Taiwan, [2]Sleep Center, Taipei Medical University Hospital, Taipei, Taiwan, [3]The Research Center for Mind Brain and Learning, National Cheng-Chi University, Taipei, Taiwan

Introduction: Nowadays, people often sleep and wake out of phase with the natural day-night rhythm due to nightlife activities or working night shift or extended hours. This life style may cause sleep disruption and difficulty in maintaining alert at work. However, some people can adjust well but others cannot. Previous studies focused on the impact of circadian rhythms and showed that chronotype of a person is associated with one's adjustment for shift work; other factors were relatively neglected. The purpose of current study is to develop a questionnaire, which is based on three-process model and neurophysiological systems of sleep regulation, to assess an individual's flexibility in adjustment for shifting of sleep-wake schedule.

Methods: Items regarding sleep flexibility were developed and divided into four categories, which were homeostasis (H), circadian rhythm (C), sleep inertia (W), and arousal process (A). There are 23 items included in the sleep flexibility questionnaire (SFQ). A total of 175 valid questionnaires were obtained from106 college students and 69 workers. They were required to fill out a package of questionnaires, including the SFQ, the Pittsburgh Sleep Quality Index (PSQI), the Situational Fatigue Scale (SFS), and the Epworth Sleepiness Scale (ESS).

Results: Chronbach's alpha of the SFQ was .65 (H=.451 , C=.720, A=.428, W=.875). Exploratory Factor analysis revealed 7 factors (variance= 68.09%). These factors can be classified into the four components as hypothesized. The total score of the questionnaire do not correlate significantly with PSQI, ESS, SFS (rs= -.086, .004, .014, respectively), however, some sub-scale scores correlate significantly with PSQI (C:r=-.154*; W:r=-.276**), ESS (W:r=-.276**; A:r=.162*) ,and SFS (H:r=-.192*; W:r=-.330**). (*=$p<0.05$, **=$p<0.01$).

Conclusion: The SFQ is a new questionnaire designed to assess people's flexibility in shifting sleep-wake schedule. The SFQ showed good construct validity and acceptable internal consistency. It can be applied as a screening tool to identify people who may adjust better of the change of sleep-wake schedule and may potentially be used for the selection of workers who are more suitable for shift works.

0196

AN ANIMAL MODEL OF OBSTRUCTIVE SLEEP APNEA IN RABBIT

Lee W, Lee M, Kim J, Lee J
Otorhinolaryngology, Seoul National University Bundang Hospital, Seongnam, Republic of Korea

Introduction: Obstructive sleep apnea (OSA) is a highly prevalent disease and is known to be related with complications including hypertension, cardiac disease, cerebrovasculr disease and diabetes mellitus. A development of animal model of OSA is necessary for evaluating the pathophysiology of OSA. This study was aimed to establish new OSA animal model simulating real upper airway condition during sleep by using the botulinum toxin.
Methods: A total of 24 New Zealand while male rabbits were used for this experiment. Botulinum toxin (2.5 or 5 units) or normal saline (0.5cc) was injected into the geninoglossus muscle in experimental group (n=8, each group) and in control group (n=8), respectively. All animals completed the Apnea link test (ResMed corp. Poway, CA) before and 1,2,3,4,6 and 8 weeks after the injection. The Apnea hypopnea index (AHI) was provided by the Apnea Link test.
Results: In preliminary study, a total volume of 2.5 to 5 units of botulinum toxin was ideal to induce OSA, more than 7.5units inducing severe apnea had led rabbits to death. Before injections, all of the rabbits showed normal breathing during sleep without hypopnea. The experimental rabbits showed a moderate to severe hypopneas/ apneas with the median AHI value of 88/hr and 86/hr in 2.5 versus 5 units botulinum injected groups, respectively. In control group, there were not any sleep-disordered breathing events induced during sleep. The changes in AHI between the 2.5 units and the 5.0 units injected group did not show any statistical significance (P=0.36).
Conclusion: An OSA rabbit model with neuromuscular denervation could be made by injection of botulinium toxin.

0197

HOW DO CATS SLEEP?

Grand L, Chauvette S, Timofeev I
Le Centre de recherche Université Laval Robert-Giffard, Quebec, QC, Canada

Introduction: Previous studies conducted on cats in isolated small size chambers demonstrated a very fragmented pattern of sleep. It was unclear to what extent these experimental conditions influenced the exact pattern of sleep-wake alternations in these species.
Methods: We examined activity patterns of 11 cats kept either in animal facilities or in the domestic environment. Laboratory cats were housed in two colonies under: (1) a standardized and (2) a non-standardized environment in which employees had random access to the room. Domestic cats lived together with their owners. Activities of all animals were recorded with an accelerometer. In two laboratory cats, continuous accelerometer, video and electrophysiological (wireless) recordings were carried out for 1 month.
Results: Laboratory cats in the standardized environment showed a similar activity distribution. An increase in activity was observed: (1) about 2 hours before light on, (2) at the time of entries of personnel in the experimental room and (3) at the onset of dark period. The increased activity lasted 2-3 hours. Occasional periods of activity were found at other times. Laboratory cats in the non-standardized environment usually showed irregular patterns of activity. Domestic cats were usually active between 5 and 9 am and 5 and 9 pm although occasional periods of activity could extend to midnight. Overall, inactivity periods occupied 70% of the 24-hour period of time in all investigated groups. Parallel recordings of accelerometer and electrographic activities show that sleep states were always detected when inactivity periods lasted for more than 2 min. Manual scoring of electrographic activities showed that SWS occupied 43.2% and REM sleep 16.2% of time.
Conclusion: We conclude that cats sleep 55-65% of the time. Within the 24-hour period, cats have 2-3 periods of increased activity occasionally interrupted with brief periods of sleep. During the sleep period, the cats often have brief periods of waking.
Support (If Any): Supported by CHIR, NIH, NSERC and FRSQ.

0198

THE STUDY OF SLEEP-WAKE CYCLE IN CAPTIVE NUTRIA (MYOCASTOR COYPUS)

Verbitskiy E, Voynov V, Kibalnikov A, Sysoeva Y
Institute of Arid Zones of the Southern Scientific Center of the Russian Academy of Science, Rostov-on-Don, Russian Federation

Introduction: The organization of activity-rest cycle of the mammals close related to their environment. The sleep-wake cycle of semiaquatic mammals are largely unknown. In this case the nutria is convenient object for laboratory researches. The objective of this study was to reveal changes of circadian behavioral and sleep-wake cycle in captive nutrias.
Methods: The male nutrias (Myocastor coypus) (3,5-4,0 kg, 1-1,5 ages) were chronically implanted with EEG/EMG/EOG/ECG recording electrodes. After surgery recovery period the nutrias were kept individually in cage (600×600×600 mm) on land with natural lighting and two single feeding at 8 a.m. and 7 p.m. The activity-rest cycle of adult nutrias also was videotaped under light time 07-18.50 h and dark time 18.50-07 h. The observation lasted during six 24-h periods in each nutria.
Results: According objective date recording over 24h the nutrias were 14,5 ± 3,2 episodes of sleep in dark time and 5,4 ± 2,6 episodes of sleep in light time. The dark time sleep episodes were longer (from 59 to 72 minutes) than light time sleep episodes (from 5 to 15 minutes). In all nutrias the most part of sleep was made by the NREM sleep, the number of REM sleep was significantly reduced. At the adaptation of animals to laboratory environment the amount of slow wave sleep was getting shorter and shorter, while the amount of REM sleep was increasing.
Conclusion: Our data shown that the adaptation of nutrias to laboratory environment was related with variation in their circadian active-rest cycle. The changes of amount of the slow wave sleep and REM sleep in 24h period was found.

0199

IMPACT OF READING OR PLAYING A VIDEO-GAME BEFORE GOING TO BED ON ADOLESCENT SLEEP

Blau A[1,2], Zimmermann S[1,2], Holterdorf M[1,2], Garcia C[1,2], Penzel T[1,2], Fietze I[1,2]

[1]Center of Sleep Medicine, Charité, Berlin, Germany, [2]Advanced Sleep Research GmbH, Berlin, Germany

Introduction: Playing video-games is a common behavior in many adolescents. This could impair a variety of behavioral characteristics. Excessive video-game playing is associated with somatic complaints, attention problems, and family interaction problems. Nevertheless, there is limited evidence about the effects on sleep and playing video-games before going to bed. The aim of this study was to investigate the direct effects of playing a video-game on adolescent sleep.
Methods: We included 23 adolescents (age 14.7±0.4 years, 17 females) in this study. All participants were selected from one school and grade. Two hours before bedtime, participants were randomly chosen to engage in a non-aggressive jump and run video-game or the reading of a youth magazine (control group) in a sleep research facility. We exposed them two hours before bedtime randomly, to a not aggressive jump and run video-game or to read a youth magazine (control group) in a sleep research facility. Watching TV, drinking caffeinated drinks or sleeping was prohibited in the evening. A polysomnography according to the AASM standards was conducted to measure sleep. On the second day the groups switched the tasks. All other procedures were unchanged.
Results: Relative to control conditions video-game playing resulted in significant reduced amount of slow-wave sleep (N3: 44.6±9.6 vs. 49.1±6.6 min., p=.01) and increased lighter sleep (N1 and N2: 201.0±40.2 vs. 182.9±42.9 min., p = .04). There was not a significant trend of increased arousals (17.4±5.6 vs. 19.7±6.6/h, n.s.) and decreased REM sleep (66.0±24.2 vs. 62.6±20.6 min., n.s.). Sleep-onset latency, total sleep time and wake time after sleep onset were unaffected.
Conclusion: Playing video-games before sleep can reduce slow-wave sleep and increase lighter sleep in adolescents. The results support hypothesis of a direct influence of presleep behavior on adolescent sleep-architecture.

0200

INVESTIGATING THE EFFECTS OF SPECIFIC TECHNOLOGIES UPON SLEEP DURATION IN UK ADOLESCENTS

Arora T[1], Thomas G[2], Taheri S[1]

[1]College of Medical and Dental Sciences, University of Birmingham, Birmingham, United Kingdom, [2]Public Health, Epidemiology and Biostatistics, University of Birmingham, Birmingham, United Kingdom

Introduction: The availability and use of technology has dramatically increased in the last 2 decades and ownership is rife amongst adolescents who also commonly experience sleep delays. The effects of specific technologies upon sleep duration have not been extensively investigated and it is currently unclear which types of technology have the most harmful effects on sleep. We sought to examine the effects of television viewing, video gaming, music, reading, mobile telephones and computer use for social networking after bedtime on school nights upon sleep duration in UK adolescents.
Methods: Data were collected in 2011 using the Schools Sleep Habits Survey (SSHS), Cleveland Adolescent Sleepiness Questionnaire (CASQ) and a Technology Use Questionnaire from 959 volunteers (55.7% boys), aged 11-13 years. We examined the cross-sectional data collected from the Midlands Adolescent Schools Sleep Education Study (MASSES) using ANOVA.
Results: Increased frequency (never, sometimes, usually/always) of TV viewing, video gaming, mobile telephones, music and computer use for social networking after bedtime on school nights was significantly associated with reduced sleep duration F=6.18 (2) p=0.002, F=10.16 (2) p<0.001, F=17.61 (2) p<0.001, F=5.49 (2) p=0.004 and F=27.75 (2) p<0.001.
Conclusion: Using computers for social networking and mobile telephones had the most extensive impact on sleep duration. These technologies are less passive and require more interaction with other individuals than TV viewing, music, reading or video gaming. Engaging in interactive technologies may promote brain activity and future studies should examine the effects of these technologies in more detail on other sleep parameters such as sleep onset latency, sleep disturbances and sleep architecture.
Support (If Any): Financial support provided by Action Medical Research.

0201

ELECTRONIC MEDIA USE WITHIN 2 HOURS OF BEDTIME PREDICTS SLEEP VARIABLES IN COLLEGE STUDENTS

Orzech K[1,2], Grandner MA[3], Roane BM[1,2], Carskadon MA[1,2]

[1]Department of Psychiatry and Human Behavior, Brown University, Providence, RI, USA, [2]E.P. Bradley Hospital Sleep Research Laboratory, Providence, RI, USA, [3]Center for Sleep and Circadian Neurobiology, Division of Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Electronic media use has been linked to sleep-related variables in adolescents. Few studies have documented this association in college students, and none has evaluated electronic media use concurrently with sleep diaries. This study examined reported electronic media use and sleep in first-year college students.
Methods: 253 first-year students (Mean age 18.6 years, 48% male) completed daily on-line sleep diaries and intermittent media surveys for 9 weeks. Diaries queried bedtime, wake time, sleep onset latency (SOL), and wake after sleep onset (WASO). Media surveys presented weekly (mean completed =7.6) queried media use in 15-minute blocks for 2 hours before reported bedtime the previous night. Students chose a primary and secondary activity from 14 options each block. Derived variables were quantity of media use for primary blocks and diversity of media use (unique media types for all blocks). We computed mixed effects regression models with media quantity and diversity as predictors of total sleep time (TST), bedtime, SOL, and WASO.
Results: Mean reported TST was 7 h 6 m (sd = 82 m). Mean bedtime was 1:13 am (sd=85 m). Average media quantity was 3.9 blocks (sd = 3.1) and average media diversity was 2.2 types (sd =1.7). Quantity of media use was negatively associated with TST (B=-0.026, p=0.033) and positively associated with later bedtime (B=0.034,p=0.004). Increased diversity of media use was associated with increased TST (B=0.055,p=0.021) and earlier bedtime (B=-0.098,p<0.001). No significant effects were found for SOL or WASO.
Conclusion: Reported electronic media use before bedtime in first-year college students is associated with reported TST and bedtime: more media use predicted decreased TST and later bedtime, whereas more types of media predicted increased TST and earlier bedtime. The paradoxical association of media diversity to sleep merits further study.
Support (If Any): Support received from the National Institute of Mental Health (MH19927-16, MH079179) and the National Heart Lung and Blood Institute (T32HL007713).

0202

LOOKING BEYOND SHORT SLEEP: WHAT ROLE DOES SLEEP VARIABILITY PLAY IN WEIGHT GAIN?

Roane BM[1,2,3], Carskadon MA[1,2,3], Seifer R[1,3], Loxley M[2]
[1]Department of Psychiatry and Human Behavior, Warren Alpert Medical School of Brown University, Providence, RI, USA, [2]Sleep for Science Research Laboratory of Brown University, Providence, RI, USA, [3]E.P. Bradley Hospital, Providence, RI, USA

Introduction: Circadian dysregulation and short sleep have been independently implicated as factors in the obesity epidemic. Little research, however, has examined the role of variable sleep schedules. We examined the hypothesis that greater variability in sleep amount and timing is associated with increased weight gain in first-semester college students.
Methods: Students completed online daily sleep diaries for approximately 9 weeks from the start of university classes. Self-report of weight and height was provided during weeks 1 and 9. Analyses included 154 students (ages 18-20, mean=18.6 years, 84 females). Exclusion criteria were reported height change > 2 inches (n=27) and less than 50% completed sleep diaries weekly. We calculated mean total sleep time (TST) across all entries (mean=54.1 nights). Variability scores were calculated for TST (TSTv), bedtime (BTv), and waketime (WTv) by averaging the ranges of 4-day moving windows. Weight change was computed across the two measures. Two regression analyses examined the association of 1) mean diary-reported TST and sex with weight change, and 2) mean diary-reported TST, TSTv, BTv, WTv, and sex with weight change.
Results: Students' average reported TST = 7.2 h/night (SD=.63) and weight gain = 1.9 lbs (SD=4.5). The first regression analysis was not significant (adjusted R-squared=.02, p=.114). The second analysis was significant (adjusted R-squared=.08, p=.004). Of the individual factors, only TSTv was significantly related to weight gain, with a bivariate correlation of .31 (p=.041) and a correlation of .17 (p=.041) after covarying the effects of the other sleep variables and sex.
Conclusion: Students who reported more variable TST reported greater weight gain across the first 9 weeks of college. The overall model associating TST and TSTv with weight gain supports the notion that amount of sleep affects weight gain and indicates that day-to-day consistency plays a role in weight gain as well. Behavioral dysregulation may underlie both phenomena.
Support (If Any): Support received from the National Institute of Mental Health (MH079179) and the Sleep Research Society Foundation Elliot D. Weitzman, M.D. Research Grant.

0203

THERMOPREFERENDUM DURING SLEEP IS MODIFIED BY RADIOFREQUENCY ELECTROMAGNETIC RADIATION EXPOSURE DURING DEVELOPMENT

Pelletier A[1], Décima P[1], Delanaud S[1], Libert J[1], Bach V[1], Thuroczy G[2,1], de Seze R[2,1], Loos N[1]
[1]PériTox-INERIS (EA 4285 - UMI 01), University of Picardy Jules Verne, Amiens, France, [2]TOXI, INERIS, Verneuil en Halatte, France

Introduction: Sleep disturbances by radiofrequency electromagnetic radiation (RF-EMR) emitted by mobile phone base stations type GSM are not well-established. In another study, we pointed out that most effects of RF-EMR were dependent on the thermal environment, suggesting that RF-EMR exposure may modify sleep through interactions with thermoregulatory processes. In the present study, juvenile rats exposed to RF-EMR were allowed to choose their thermal environment corresponding to the "thermopreferendum".
Methods: 6 Wistar rats (3 weeks-old) exposed to RF-EMR during 5 weeks were compared to a non-exposed control group (n=4). One week after surgery, sleep was measured (wireless) when animals were allowed to move freely between 3 similar communicated rooms which differ according to ambient temperature (24, 28 and 31±1°C). Wakefulness (W), Slow Wave (SWS) and Paradoxical Sleep (PS) were scored at 10 second-periods. The total durations of sleep stages, the mean durations and the frequencies of the episodes were tested with ANOVA.
Results: Exposed rats preferred to sleep at 31°C whereas the controls preferred 28°C. The choice of 31°C induced longer total time sleep (+139 and +103 min compared to 24 and 28°C respectively) as a result of longer total durations of SWS (compared to 24°C: +107.4 min) and of PS (compared to 24 and 28°C: +9 and +7 min respectively).
Conclusion: Thermopreferedum during sleep is increased when exposed to RF-EMR suggesting modifications of the peripheral thermosensitivity. This observation and the longer sleep duration suggest that the RF-exposed group may develop behavioral responses to prevent energy expenditure.
Support (If Any): Grenelle de l'environnement.

0204

WITHIN-SESSION RAT-PSYCHOMOTOR VIGILANCE TASK PERFORMANCE AFTER 24H SLEEP DEPRIVATION

Oonk M[1], Davis CJ[1,2], Krueger JM[1,2], Wisor J[1,2], Van Dongen H[1,2]
[1]Sleep and Performance Research Center, Washington State University Spokane, Spokane, WA, USA, [2]WWAMI Medical Education Program, Washington State University, Spokane, WA, USA

Introduction: The rat-psychomotor vigilance task (rPVT) is a rodent equivalent of the human PVT, developed by Christie et al. (2008) using Fisher-Norway rats. We adapted the rPVT for Long-Evans rats and examined the effects of sleep deprivation (SD) on within-session task performance.
Methods: 21 male Long-Evans rats (4 weeks old at start) were trained to respond to light stimuli (0.5s), presented at 3s-7s inter-trial intervals (ITIs), by nose-poking into a water delivery port. Pokes within 3s of stimulus onset were rewarded with water. Pokes during the ITI resulted in 10s delays for the next stimulus. Rats were water-deprived during the 22h prior to each daily testing session to motivate rPVT performance, and were trained to criterion (>90 rewards and <25 omissions over 3 consecutive 30min sessions). After training, the rats were randomly divided into two groups. One group (n=9) performed a 30min rPVT after 24h SD by gentle handling; the other group (n=12) performed the task after ad libitum sleep. One week later, the experiment was repeated with conditions reversed. Response times (RT), lapses (RTs ≥ twice the rested average and failures to respond within 3s), reward totals, and false starts were analyzed across time on task in 5min bins using mixed-effects ANOVA, controlling for order of conditions.
Results: After SD, rats exhibited increased RTs (P=0.013), lapses (P<0.001) and false starts (P<0.001), and decreased reward totals (P<0.001). In both conditions, lapses increased over time on task (P<0.001), whereas rewards initially increased, then gradually decreased over time on task (P<0.001). RTs showed a trend for an increase over time on task (P=0.057). False starts showed a main effect of time (P=0.005) and a time by condition interaction (P=0.027) - rats in the SD condition displayed increased false starts at task onset but these declined over time on task to the level of the rested condition (which was relatively stable over time on task).
Conclusion: SD significantly degraded rPVT performance. The time-on-task effect, characteristic of human PVT performance after SD, was not significant in rPVT performance in this rat study. The elevated false starts at the beginning of the rPVT after SD may stem from SD-induced hyperarousal or increased thirst levels.
Support (If Any): Sleep Research Society Foundation (Elliott D. Weitzman M.D. Research Grant).

0205

SLEEP DEPRIVATION INCREASES CONDITIONED PLACE PREFERENCE TO COCAINE

Bjorness TE[1], Greene R[1,2]
[1]Psychiatry, University of Texas Southwestern, Dallas, TX, USA, [2]Division of Mental Health, Veterans Affairs North Texas Health Care System, Dallas, TX, USA

Introduction: While sleep loss and drug abuse affect millions of Americans independently, there is also evidence of an interaction in that several drugs of abuse decrease sleep and decreased sleep (in the form of insomnia in humans) is a risk factor for developing drug abuse and is one of the best predictors of relapse. In the current experiment we investigated the effect of acute sleep deprivation on reward behavior to cocaine using the conditioned place preference (CPP) paradigm.
Methods: With CPP, mice are conditioned to associate one side of a CPP box with cocaine (8 mg/kg, i.p. exposed for 20 min on days 1 and 3) and another with saline (i.p. exposed for 20 min on days 2 and 4). Immediately prior to the conditioning test (day 5) mice were either sleep deprived for 4 hrs using a slowly moving treadmill (SD group) or were not disrupted (control group). In order to test for preference, mice were placed into the middle chamber of the CPP box and allowed to move freely. Time spent on either side was measured and preference was calculated by subtracting the preconditioning preference (time in side which will be paired with cocaine - time in side which will be paired with saline) from the conditioning test preference (time in cocaine paired side - time in saline paired side).
Results: Both groups showed preference for the cocaine-paired side compared to the saline paired side. Additionally, sleep deprivation increased preference to the cocaine-paired side compared with control animals (Mann-Whitney t-test $p=0.05$).
Conclusion: This result indicates that sleep loss, in the form of sleep deprivation, increases the reward value of cocaine and adds further support to the idea that sleep behavior can influence drug use.
Support (If Any): T-32-DA-7290.

0206

LEARNED HELPLESSNESS PARADIGM AND ITS EFFECT ON SLEEP-WAKE ARCHITECTURE IN RATS: A STUDY OF DEPRESSION

O'Malley MW[1], Fishman R[1], Patterson EH[1], Datta S[1,2]
[1]Psychiatry, Boston University School of Medicine, Boston, MA, USA, [2]Neurology, Boston University School of Medicine, Boston, MA, USA

Introduction: The learned helplessness paradigm is one of the most common rodent models used to study the mechanisms and effects of depression. However, its effect on sleep was not yet systematically examined. Therefore, the goal of this study was to investigate the changes in sleep-wake architecture that occur in rats exposed to this condition.
Methods: Ten male Sprague-Dawley rats were implanted with sleep recording electrodes. Once baseline sleep-wake activity had been established and recorded (10:00AM-4:00PM), rats were exposed to the learned helplessness condition for 5 consecutive days: Day-1 (5 unavoidable foot-shocks: 1 mA, 3.0 sec duration, 3 min intervals); Day-2 (5 min re-exposure to the same context but without foot-shock); Days 3-5 (15 unavoidable foot-shocks: 1.0 mA, 5.0 sec duration, 45 sec intervals). Sleep-wake activity after Day-5 testing was then recorded (10:00AM-4:00PM) and compared to the baseline.
Results: The percentage of time spent in REM sleep was significantly increased ($p<0.01$) during the first hour of recording after Day-5 (14.23 ± 2.492) compared to baseline (3.110 ± 2.813). Correspondingly, there were reductions in both wakefulness (W) and slow-wave sleep (SWS) but these were not statistically significant. Also, there was a significant decrease ($p<0.001$) in REM sleep latency after Day-5 (4.2 ± 0.9 min) compared to baseline (86.2 ± 11.9 min). Overall, the total percentages of time spent in W, SWS, and REM sleep were not significantly different between baseline and Day-5.
Conclusion: This type of learned helplessness paradigm induces significant changes in sleep-wake architecture, specifically a reduction in REM sleep latency and an increase in time spent in REM sleep during the first hour of sleep. These findings are consistent with the sleep phenotype of depression in humans. However, in order to use this model to understand the mechanisms of depression, further research is planned to examine the day-to-day changes in sleep-wake architecture and the power spectra of hippocampal theta and cortical EEG.
Support (If Any): This work was supported by the National Institutes of Health Research Grant MH59839.

0207

EFFECTS OF STRESSOR PREDICTABILITY ON ESCAPE LEARNING AND SLEEP IN MICE

Machida M, Yang L, Wellman LL, Sanford LD
Pathology & Anatomy, Eastern Virginia Medical School, Norfolk, VA, USA

Introduction: Predictable shock is often considered as less anxiogenic than unpredictable shock. Yet studies show contradictory results including more ulcer development, greater weight loss, and increased susceptibility to disease when animals experience predictable shock. We trained mice with signaled, escapable shock (SES) and with un-signaled escapable shock (UES) to study the effects of predictability on escape learning and sleep.
Methods: BALB/cJ mice were implanted with transmitters for recording EEG and activity. After obtaining baseline sleep, the mice were randomly assigned to SES and UES conditions. Shock training (20 footshocks; 0.5 mA, 5.0 sec maximum duration) sessions were conducted on two days (EST1 & EST2). The mice could terminate the shock by moving into an adjacent compartment. SES mice were presented cues (90 dB, 2 kHz tones) that started 5.0 sec prior to and co-terminated with footshocks, while UES mice were randomly presented identical cues. On each training day, sleep was scored for 20 hours. The duration of shock each mouse experienced was used as an estimate of escape latency.
Results: Based on improved escape latencies on EST2, nine out of 14 mice successfully learned escape (SESl) and five of 14 mice failed to learn escape (SESf). Compared to baseline, SESl, but not SESf, mice showed significantly increased post-shock REM. All UES mice learned escape and showed increased post-shock REM though to a lesser degree than SESl mice.
Conclusion: These data are consistent with our previous reports that stressor controllability in BALB/c mice is associated with increased post-stress REM. The results also suggest that predictability alone (e.g., SESf mice) is not sufficient for increased post-stress sleep. Our studies indicate that specific psychological parameters (i.e., control, predictability) can modify post-stress sleep after physically identical stressors.
Support (If Any): MH061716.

0208

INTERACTIONS OF MATERNAL CARE AND A COMPROMISED UNFOLDED PROTEIN RESPONSE ON THE SLEEP QUALITY OF OFFSPRING

Mavromatis EM, Edson K, Singletary K, Naidoo N
School of Medicine- Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Studies have shown that poor maternal care can have negative outcomes on offspring health. In rodents this includes increased anxiety, aggression, social abnormalities, and cognitive deficits. Postnatally, protein load and energy requirements remain high. However, if protein synthesis becomes overloaded, protein misfolding occurs and results in endoplasmic reticulum stress. A key chaperone protein, BiP, is

induced and the adaptive unfolded protein response (UPR) is activated. This research is predicated upon our preliminary observations that BiP heterozygous, an UPR compromised mouse, dams give poor maternal care. We hypothesize that BiP heterozygous females will have poor maternal care compared to wild type controls. Consequently this will have a negative effect on the sleep patterns of the adult offspring.

Methods: 24-hour infrared beam break and video recordings of BiP (+/-) and BiP (+/+) dams were analyzed for three days starting on postnatal day 0. Time samples of behavior were determined based on two activity peaks and troughs from each light and dark phase. Male and Female BiP (+/-) and (+/+) offspring were grouped by the genotype of their dam. To quantify sleep activity, the adult offspring were monitored via infrared beam break system.

Results: Both genotypes had similar amounts of total maternal care, however, there was a phase difference in the exhibition of behaviors. Offspring of BiP (+/-) dams had a difference in consolidated sleep and there was a trend reduction in sleep latency for BiP (+/-) mice.

Conclusion: This study shows that there is a difference in maternal care between dam genotypes and subsequently, the sleep behavior of their offspring is affected. Timing of maternal care behaviors may be involved in this difference.

0209

NONINVASIVE DETECTION OF SLEEP/WAKE CHANGES IN OREXIN/ ATAXIN-3 TRANSGENIC NARCOLEPTIC MICE ACROSS THE DISEASE ONSET

Sagawa Y[2,1], Hirai N[1], Sato S[3], Sato M[1,2], Okuro M[4,1], Kanbayashi T[2], Shimizu T[2], Nishino S[1]

[1]Sleep and Circadian Neurobiology Laboratory, Stanford University, PaloAlto, CA, USA, [2]Department of Neuropsychiatry, Akita University Graduate School of Medicine, Akita, Japan, [3]Department of Cell Physiology, Akita University Graduate School of Medicine, Akita, Japan, [4]Department of Geriatric Medicine, Kanazawa Medical University, Kanazawa, Japan

Introduction: Orexin/ataxin-3 transgenic (TG) mice exhibit a phenotype similar to human narcolepsy. Hypocretin-containing neurons in TG mice are selectively ablated postnatally and over 99% are lost by 84 days old. However, no sleep recordings can be conducted around the disease onset since implantation of an EEG headstage in growing young mice is challenging. In this study, we evaluated the sleep/wake changes of narcoleptic mice from 2 weeks to 98 days old using a noninvasive piezoelectric sensor.

Methods: 6 TG mice and 6 respective wild type (WT) littermates were included. The PZT sensor can detect movements, the heart rate, and respiratory variations. Mice were simply placed on the PZT-sensor for 3 hours during the light period, and the recordings were repeated on 14, 28, 56, 84, and 98 days old. The frequency power of the PZT signal was computed on every one-second epoch, and the epoch was marked as wake when the power exceeded the threshold, statistically optimized from the whole recorded signal. In the separated session, we also collected the EEG sleep and PTZ signals simultaneously in selected WT mice (total 8999 epochs),.

Results: The concordance rate of the sleep/wake epochs by auto scored PZT signal by manually scored EEG was 73%. We saw that sleep bout length in TG mice, but not in WT mice, significantly decreased with age, with significant differences between the genotypes over 56 days old. We found a unique PZT signaling pattern during sleep, characterized by an absence of movement accompanied with distinct heart beat signals, which we termed "Immobile with Heart Beats (IMHB)". IMHB is divided into gradual onset type (IMHBg) and sudden onset type (IMHBs, wake preceding 40 sec). IMHBs were observed specifically in TG mice, while IMHBg were observed in both WT and narcoleptic mice with similar frequency. An age dependent increase in IMHBs was seen in TG mice.

Conclusion: The PZT is useful as a noninvasive sleep and behavior monitoring system, as we successfully detected the progresses in sleep fragmentation in narcoleptic mice. Since IMHB appeared during resting and when the body muscle was flaccid, IMHBs may reflect occurrences of cataplexy, while IMHBg may reflect the occurrences of REM sleep.

0210

NON RAPID EYE MOVEMENT SLEEP INCREASE AND MEMORY DECLINE AFTER MILD TRAUMATIC BRAIN INJURY IN RATS

Noain D, Schreglmann S, Baumann CR

Neurology, University Hospital of Zurich, Zurich, Switzerland

Introduction: Traumatic brain injury (TBI) is a major cause of disability world-wide, often leaving surviving patients with persistent neurological deficits including sleep-wake disturbances (SWD) and cognitive impairment which impair daytime functioning and quality of life. Clinical studies of posttraumatic SWD, however, are hampered by the fact that TBI is a most heterogeneous entity in respect to localization and severity. Therefore, the neurobiological processes underlying SWD after TBI remain unclear. We aimed at developing the first animal model of posttraumatic SWD to provide better insights into the mechanisms, consequences and possible treatments for sleep-wake sequelae after TBI.

Methods: We developed a new closed acceleration-deceleration rat TBI model in which infliction of brain injury and recording of vigilance states are compatible. Ten days after implantation of electroencephalography-myography (EEG/EMG) electrodes, 9 adult male Sprague-Dawley rats underwent TBI. 24h EEG/EMG recordings were performed before (baseline) and 1 day after TBI. In addition, acquired habituation after exposure to a repetitive task was evaluated, using a 5-points scoring method. In 9 sham controls, the same procedures were performed, except for trauma induction.

Results: Our preliminary findings show non significant habituation scores 7 days after injury in TBI rats, while sham controls acquire significant habituation scores compared to training (TBI (n=8): Tr-5: 0±0; Test 7 days: 0.75±0.25 vs. Sham (n=9): Tr-5: 0.07±0.05; Test 7 days: 1.88±0.45. Repeated measures ANOVA (RMA), Tukey□s post hoc comparisons,*P<0.05). One day after TBI, the EEG/EMG recording revealed that NREM sleep is increased during the dark phase in TBI rats compared to sham controls (TBI (n=8): Baseline: 35.5±1.2%; Post 1 day: 43.0±1.7% vs. Sham (n=9): Baseline: 37.0±2.3; Post 1 day: 38.7±2.6. RMA, Fisher□s post hoc comparisons,*P<0.05).

Conclusion: Our preliminary study revealed a decline in memory and increased need of sleep per 24h in TBI rats, i.e. posttraumatic hypersomnia. The latter result is in line with our previous findings in humans, suggesting that hypersomnia is a cardinal finding after TBI and might be important for neuroplasticity and recovery. Whether cognitive impairment is linked to reduced vigilance or to neuronal damage remains unclear at this point. We conclude that our TBI model will constitute a valuable biological tool in the study of SWD and other sequelae after TBI.

0211

SLEEPINESS AS A PREDICTOR OF DRAFT VALUE IN THE NATIONAL FOOTBALL LEAGUE

Rogers SL[3], Pfeifer PE[2], Winter WC[3,1]

[1]Sleep Medicine Center, Martha Jefferson Hospital, Charlottesville, VA, USA, [2]Business Administration, Darden School of Business, Charlottesville, VA, USA, [3]Sleep Medicine, Charlottesville Neurology and Sleep Medicine, Charlottesville, VA, USA

Introduction: Evaluating collegiate football talent and determining which players will transition best to the professional level is a multifactorial process. It can involve physical evaluations, cognitive testing, and personality assessments. Sleepiness, as measured by the Epworth Sleepiness Scale (ESS), was studied in professional football players to

determine if degree of sleepiness influenced a player's tendency to stay with the team that drafted him.
Methods: In 2006, 560 surveys were collected from ACC football players looking at several aspects of their sleep and health including ESS data. Evaluation of this data revealed that 55 players with ESS data had moved on to play in the NFL. A positive 'value pick' was defined as a player that is still with the team that drafted him as of December 15th. A negative 'value pick' indicated that a player had been traded, demoted to a practice squad/semiprofessional league, or retired.
Results: Of the 55 players evaluated and drafted, those with an ESS score of 8 or more (range 8-17, SD=2.48, X=11.36), had only a 38.5% (15 out of 39) chance of being a value pick and staying with the team that originally drafted them. In comparison, players with an ESS of 7 or less (range 0-7, SD=2.29, X=4.81) had a 56.3% (9 out of 16) chance of being a value pick and still being with their original team.
Conclusion: This data indicates a tendency for less sleepy professional football prospects to remain with their drafting team longer than more sleepy professional football prospects. With so much at stake when a professional football team makes a selection in the NFL draft, taking into consideration degree of sleepiness may help to maximize draft value.

0212

EFFECTS ON DEADLY FORCE DECISION MAKING OF POLICE OFFICERS WORKING CONSECUTIVE NIGHT SHIFTS

Waggoner L[1,2], Grant D[1], Van Dongen H[1], Belenky G[1], Vila BJ[1,2]
[1]Sleep and Performance Research Center, Washington State University Spokane, Spokane, WA, USA, [2]Department of Criminal Justice and Criminology, Washington State University Spokane, Spokane, WA, USA

Introduction: Police officers make critical decisions regarding the use of deadly force, often under fast-paced and ambiguous circumstances. Police work schedules involve long and irregular shifts that have been shown to induce fatigue. In a high-fidelity simulator study with active-duty police officers, we investigated whether schedule-induced fatigue affects deadly force decision making.
Methods: As part of a larger study, N=28 officers came to the laboratory for testing in the morning immediately after the last of five consecutive 10.7h night shifts. On a separate occasion, they also came to the laboratory for testing at the same time in the morning, but after a normal night of sleep following three consecutive days off duty. These post-shift and post-rest conditions were administered in randomized order in a within-subjects design. In each condition, officers participated in five realistic shoot/don't-shoot deadly force decision making simulations. Using a replica handgun, they responded to 3 threat scenarios (suspects wielding weapons) and 2 non-threat scenarios (suspects not wielding weapons). For signal detection analysis, hits (shots fired during threat scenarios) and false alarms (shots fired during non-threat scenarios) in each condition were converted to measures of discriminability and response bias.
Results: ANOVA revealed that discriminability was reduced post-shift relative to post-rest ($F[1,27]=4.67$, $P=0.040$). False alarm rate tended toward a significant increase in the post-shift condition ($F[1,27]=3.91$, $P=0.058$). No significant condition effects were found for hit rate ($F[1,27]=1.00$, $P=0.33$) and response bias ($F[1,27]=1.15$, $P=0.29$).
Conclusion: Officers displayed decreased ability to discriminate simulated threats from non-threats, and tended toward increased shooting rates during non-threatening scenarios, following five consecutive night shifts compared to three days off duty. To the extent that these results generalize to real-world situations, safety risks for police officers and the public in deadly force situations may be mitigated by managing fatigue.
Support (If Any): CDMRP grant W81XWH-01-0099 and ONR DURIP grant N00014-08-1-0802.

0213

EFFECTS OF EXTENDED WAKEFULNESS OBSERVED DURING SPECIALIZED MILITARY TRAINING

Carr W[1], Eonta S[1], Tate C[2], Kamimori G[3]
[1]NeuroTrauma, Naval Medical Research Center, Silver Spring, MD, USA, [2]New Zealand Defense Force, Auckland, New Zealand, [3]Behavioral Biology, Walter Reed Army Institute of Research, Silver Spring, MD, USA

Introduction: "Breaching" (dynamic entry) is a military and law enforcement discipline in which operators make controlled use of explosives to gain entry to secured structures. The extensive training typical for breachers requires both repeated exposure to controlled blast and some extended wakefulness in a two-week course. Data from pilot studies in such training programs were used to examine effects of extended wakefulness that may occur along with hypothesized effects from blast exposure.
Methods: We examined performance and blast data from 50 active duty military male volunteers in three explosive breaching training courses. ANAM4 was administered daily. Self-report on sleepiness and mood scales and performance on other subtests were compared across timepoints, including baseline, blast exposure without extended wakefulness, and with extended wakefulness.
Results: Self-report showed greater sleepiness and fatigue with blast plus extended wakefulness than with blast alone, [$F(3,288)=26.42$, $p<.001$; Bonferroni/Dunn $p<.001$]. In Throughput following blast and extended wakefulness timepoints [$F(3,135)=5.11$, $p=.001$], the extended wakefulness timepoint did not show corresponding deficits in subject performance; however, the next timepoint, the day *following* extended wakefulness, did show a deficit in subject performance (Bonferroni/Dunn $p<.001$). This deficit appeared only for more difficult tasks and did not appear for less difficult tasks.
Conclusion: Extended wakefulness may account for performance decrements in challenging tasks on the day following extended wakefulness as much or more than during extended wakefulness, the time of greatest self-reported sleepiness and fatigue. This result exhibits the importance of taking actual extended wakefulness into account in field studies and not relying on self-report of sleepiness and fatigue. A specific mechanism underlying this result is not revealed in this pilot study. This result may suggest a negative effect on sleep following blast exposure. It clearly suggests the importance of selecting appropriate measures and challenges in studies of effects from blast and other military operations.
Support (If Any): This work was made possible through participation from the Breacher Injury Consortium, the U.S. Marine Corps, and the New Zealand Defense Force. This work was supported by several federal and institutional sources, including CDMRP (00522813), DARPA, ONR, RAD III (MOMRP) of USAMRMC, TSWG, and USAARL.

0214

SLEEPINESS, FATIGUE AND PERFORMANCE AMONG SUBMARINE SOLDIERS: A FIELD STUDY

Hardouin J[3], Chaumet G[1], Schmid B[3], Coste O[1], Padlo F[2], Rabat AA[1]
[1]Alertness Unit, IRBA, Brétigny sur Orge, France, [2]Naval technical, General delegation for armament, Toulon, France, [3]Operational undersea research unit, IRBA, Brétigny sur Orge, France

Introduction: Submarine must ensure operational success while maintaining continuously nautic safety and human reliability. To fulfill these objectives, navy soldiers are submitted to shift work conditions. The purpose of this study was to address if and how such working conditions interfere with vigilance state and performance in a military environment.
Methods: Sleepiness, fatigue complaints and cognitive processes were respectively measured for 2 crews of submariners using questionnaires (Epworth, Chalder, PSQI) and tests (PVT, Go-nogo, Risk-taking task). Three time periods were used: after military permission (Baseline = P1),

at the beginning of the mission (P2) and few weeks before ending the mission (P3).
Results: P1: Few subjects were sleepy (12% with Epworth ≥ 13), 36% complaint of poor sleep quality (PSQI > 7) and 35% of fatigue associated with good performance. P2 and P3 were associated with more sleepy people (45% with Epworth ≥ 13), a broader complaint of poor sleep quality (PSQI > 7: P2 = 66% and P3 = 80%) and fatigue (P2 = 81% and P3 = 75%) associated with PVT omission rate > 2 nights of TSD for 28% of subjects at P2 and 30% at P3 (4% at P1) and a commission rate ≥ 8% for 28% of soldiers at P2 and P3 (5% at P1). In risky situation, soldiers commit more errors at P2 and P3 (ratio error/correct of 0.66 and 0.75 compared to 0.42 at P1) but with a preference more secure situation at P2 and less secure at P3.
Conclusion: These preliminary results highlights 1) residual sleepiness and fatigue in navy soldiers after permission and 2) establishment of chronic states of sleepiness and fatigue associated with attention and cognitive control deficits for a majority of these soldiers before starting and ending the mission. The link between sleepiness and such cognitive disturbances remain unanswered in such military situation.
Support (If Any): Official support of the French Submarine Headquarters and indirectly financial supports from the General Delegation of Armament #10ca707.

0215

SLEEP-WAKE BEHAVIOR AND PVT PERFORMANCE DURING A 520-DAY SIMULATED MISSION TO MARS

Basner M[1], Di Antonio A[1], Jones CW[1], Ecker A[1], Kan K[2], Mollicone DJ[2], Dinges DF[1]
[1]Department of Psychiatry, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, USA, [2]Pulsar Informatics Inc., Philadelphia, PA, USA

Introduction: The Mars 520-day project of the Russian Institute for Biomedical Problems (IBMP) focused on the effects of 520 days of isolation and confinement on a crew of 6 professionals (astronaut surrogates) living in a facility that simulated a spaceflight to/from Mars. It is the longest simulated high-fidelity mission conducted to date.
Methods: For our experiment, each crewmember (all male, mean age 32, range 27-38 years at start of mission) continuously wore a wrist actigraph (Philips Actiwatch Spectrum) to measure changes in sleep-wake behavior and activity levels throughout the mission. Once per week, crewmembers reported sleep times for the previous night and overall sleep quality ratings, and also performed two test bouts of a 3-min version of the Psychomotor Vigilance Test (PVT-B; Basner et al., Acta Astronaut 69: 949-59, 2011).
Results: Data acquisition rates were >98.0% complete (73,203 hours of data) for actigraphy throughout the 520-day study and >99% complete (ca. 900 test bouts) for subjective sleep reports and PVT-B performance tests. Sleep time increased throughout the mission both during the night (defined as 10pm-9am, $p<0.0001$) and during the day ($p<0.0001$) with a concomitant decrease in activity levels ($p<0.0001$). Without external light cues, five subjects were entrained to the 24h rest-activity cycle, although one of them also exhibited a markedly biphasic sleep pattern. A sixth subject was free running with a period of approximately 25h during the 1.42-year mission. PVT response speed increased ($p<0.0001$) while the number of lapses decreased ($p<0.0001$) across time in mission. Crewmembers exhibited considerable inter-individual differences in the variability of both sleep-wake behavior and PVT-B performance across the mission.
Conclusion: Crewmembers on a simulated mission to Mars exhibited substantial differences in sleep-wake behavior and PVT-B performance variability that may pose a challenge to effective crew coordination and performance during long-duration missions.
Support (If Any): We express tremendous appreciation to Dr. Igor Savelev, NSBRI/NASA International Liaison and MARS 500 Facilitator for help in data acquisition. Supported by the National Space Biomedical Research Institute (NSBRI) through NASA NCC 9-58, and in part by the Institute of Experimental Psychiatry Research Foundation.

0216

PSYCHOMOTOR VIGILANCE PERFORMANCE OF MOTORCOACH DRIVERS ACROSS DUTY DAY

Hodges JC, Wu LJ, Belenky G
Sleep and Performance Research Center, Washington State University-Spokane, Spokane, WA, USA

Introduction: In commercial motorcoach driving the duration and timing of duty periods differs by type of operation. Motorcoach operations can be divided into four groups: charter (travel to and from a destination during the same day), tour (multi-day trips), regular route (scheduled trips in and between cities) and commuter express (e.g., scheduled trips to and from work, airport express). We examined the association between operation type and a psychomotor vigilance task (PVT) performance at multiple intervals during the work period.
Methods: N = 75 motorcoach drivers were studied for a mean of 30 continuous days during which they followed their normal routine of on and off duty. Each driver recorded duty and break start and end times. Participants completed a 5 minute PVT at each of four intervals: duty start, break start, break end, and duty end. Mean PVT speeds (the inverse of reaction time [1/RT]) were compared using a mixed effects model.
Results: There was a significant main effect of test interval on PVT speed ($F [3, 3564]=4.46$, $P=0.004$). PVT speed also differed by operation type ($F[3,3563]=5.33$, $P=0.001$). The interaction of PVT test interval and operation type was significant ($F [9, 3563]=2.40$, $P=0.010$.).
Conclusion: Motorcoach drivers' PVT performance was affected differentially across multiple intervals during work depending on type of operation. Given the differences in duty length and timing across operations, this finding may reflect the effect of circadian timing on PVT speed.
Support (If Any): Federal Motor Carrier Safety Administration.

0217

SLEEP DURATION DURING ON AND OFF DUTY DAYS AMONG MOTORCOACH OPERATORS

Wu LJ, Hodges JC, Belenky G
Sleep and Performance Research Center, Washington State University-Spokane, Spokane, WA, USA

Introduction: Under current hours of service regulations, motorcoach operators may work a maximum of 15 hours with 10 hours of driving time. Driving shifts vary widely within this window, often based on customer demand. Long or irregular shifts may affect the duration and timing of drivers' sleep.
Methods: Commercial motorcoach drivers (N=84) wore an actigraph and recorded their work periods for a mean of 30 continuous days. A linear mixed effects model was used to compare each participant's total sleep duration per 24 hours across on and off duty days.
Results: Drivers were on duty for a mean of 20 days during the study period. Drivers obtained more sleep during off duty days relative to on duty days ($F[1,2331]=597.60$, $P<0.001$). Drivers slept a mean(se) of 7.4(0.12) hours per 24 hours while on duty. During off duty periods the sleep duration increased 1.8(0.08) hours.
Conclusion: Motorcoach drivers in this sample obtained a reasonable amount of sleep both while on and off duty. Regardless, drivers obtained relatively more sleep per 24 hours while off duty. The duration and timing of work periods may explain some of the observed variance in sleep duration.
Support (If Any): Federal Motor Carrier Administration.

0218

EFFECT OF SLEEPINESS ON PERFORMANCE AND WORKLOAD DURING SPACE ROBOTICS TASKS

Lowenthal C, Liu AM, Natapoff A, Oman CM
Aeronautics and Astronautics, MIT, Cambridge, MA, USA

Introduction: Astronauts are expected to maintain a high level of performance during space robotics operations, despite sleep schedules that hinder their cognitive function, response time, and attention. This study aimed to determine the usefulness of secondary tasks to assess sleepiness and workload during simulated space robotics performance.
Methods: 13 naive subjects were trained to perform two types of simulated robotics tasks and two types of secondary tasks designed to measure response time. Subjects completed two 2-hour robotics sessions, one at midday after approximately 4 hours awake, and one at night after 18 hours awake.
Results: Comparing 18 hours awake versus 4, Karolinska Sleepiness Scale scores increased by at least 2 points. Subjects were able to maintain primary robotics task performance at the night session, but secondary task measures such as inverse response time showed significant changes, with moderate Hedges' g (0.35 to 0.74) effect sizes. For a passive monitoring of arm movement primary task, a simple response secondary task metric proved more sensitive to time awake than a two choice response secondary task, but the converse was found when the primary task involved track and capture manual control.
Conclusion: Our visual secondary task was sensitive to changes in primary task workload and sleepiness. A secondary task does not require separate testing like the Psychomotor Vigilance Task because it can be imbedded in a real world primary task. Increased response time can be interpreted as sleepiness provided primary task workload is constant and training effects have disappeared. Secondary task workload measures are a potentially useful adjunct to primary task drowsiness metrics like PVT and deserve further investigation. Supported by the National Space Biomedical Research Institute through NASA Cooperative Research Agreement NCC9-58, Project NBPF02001.
Support (If Any): Supported by the National Space Biomedical Research Institute through NASA Cooperative Research Agreement NCC9-58, Project NBPF02001.

0219

OCCUPATIONAL STRESS AND SLEEP QUALITY OF SENIOR HIGH SCHOOL TEACHERS: AFFECT AND EMOTION REGULATION AS INTERMEDIATE VARIABLES

Su K[1,2], Zhang Y[1,2], Wang C[1,2], Wu Y[1,2]
[1]Applied Psychology, Harbin Engineering University, Harbin, China, [2]Sleep Laboratory, Harbin Engineering University, Harbin, China

Introduction: Research has showed that there was a significant relation between stress and sleep quality, and the relation was affected by some mediators. The purpose of this study was to investigate the relation between occupational stress and sleep quality, and the mediating effect of affect and emotion regulation in this relation among senior high school teachers.
Methods: 413 teachers age from 23 to 56 years were recruited from senior high schools in Harbin by random cluster sampling. All participants were administrated with self-reported questionnaires, included Primary and Secondary School Teachers' Sources of Occupational Stress Questionnaire, Pittsburgh Sleep Quality Index (PSQI), Positive and Negative Affect Scale (PANAS) and Emotion Regulation Scale (ERS). All data were analyzed by Pearson correlation and structure equation model (SEM).
Results: Occupational stress score and PSQI score showed significant correlation ($r=0.296$, $p<0.001$). Five subscales of the occupational stress questionnaire, included workload, students' academic pressure, comment from society and school, professional development, students' problem behavior, were all significantly correlated with PSQI score. The finding of SEM revealed that affect and emotion regulation were the significant mediate variables between occupational stress and sleep quality with good overall model fit (CMIN =214.242, GFI=0.931, RMSEA=0.068), as well as affect and emotion regulation played the partial mediating role between occupational stress and sleep quality.
Conclusion: The occupational stress of senior high school teachers negatively influenced sleep quality directly, and negative affect experience and suppression as emotion regulation strategy played the significant role of mediate variable between occupational stress and sleep quality. However, positive affect experience and reappraisal as emotion regulation strategy did not show the similar results.

0220

MOTHERS' SLEEP AND DRIVING IN THE POSTPARTUM PERIOD

Trenorden J, Armstrong K, Smith S
Centre for Accident Research and Road Safety - Queensland, Queensland University of Technology, Kelvin Grove, QLD, Australia

Introduction: Previous studies investigating mothers' sleep in the postpartum period commonly demonstrate elevated levels of sleepiness in this population. A Karolinska Sleepiness Scale (KSS) rating of 5 or above is associated with an exponential increase in vehicle crash risk. To date, no studies have investigated the relationship between mothers' sleep in the postpartum period and their driving behaviour.
Methods: Sleep-wake diary data was collected from 14 mother-infant dyads during two 7-day assessment periods when the infants were 6 and 12 weeks old. The mothers' indicated all driving episodes during these weeks and their respective sleepiness level using the KSS. Semi-structured interviews were conducted with the mothers when their infant was 12 weeks old.
Results: The infants slept significantly more than their mothers at 6 weeks and 12 weeks of age. During both time points, mothers and infants had a similar number of night awakenings (waking between 22:00 and 06:00), with some mothers experiencing greater than 19 awakenings over 7 nights. Notably, 36% of the mothers did not experience a continuous sleep period longer than 4.5 hours when their infant was 6 weeks old. A total of 141 driving episodes were reported during the 7-day assessment period when the infants were 6 weeks old. Over 50% of the driving episodes were denoted with a KSS score of 5 or above. Strategies mothers cited they employed during this period included only driving when feeling alert, postponing driving until another person is present, and driving in the morning when less sleepy.
Conclusion: Mothers are experiencing disrupted sleep at night and some mothers do not obtain more than 4.5 hours of continuous sleep during the early postpartum weeks. In this sample, some mothers reported self-regulating driving behaviour, however over half of the driving episodes were undertaken with a sleepiness rating linked with elevated crash risk.

0221

ACUTE EFFECTS OF AN ALCOHOL BINGE ON SLEEP ARCHITECTURE OF 18-21 YEAR OLD COLLEGE STUDENTS

Chan JK[1], Trinder JA[1], Andrewes HE[1], Mayer BZ[2], Colrain IM[2,1], Nicholas CL[1]
[1]Psychological Sciences, The University of Melbourne, Melbourne, VIC, Australia, [2]Human Sleep Research Program, SRI International, Menlo Park, CA, USA

Introduction: Binge drinking is prevalent in college student populations, however little is known about its effect on sleep in this age-group. In older adults the most consistent findings are that in the first half of the night alcohol increases slow wave sleep (SWS) and decreases REM sleep, with the opposite occurring in the second half. Alcohol also decreases sleep onset latency (SOL) and sleep efficiency, and increases wake after sleep onset (WASO). The effect of alcohol on sleep in late

adolescence is of particular interest given the increase in alcohol consumption, the dramatic changes in normal sleep architecture that occur in this group, and because the acute effects of alcohol during waking are known to vary with age.
Methods: We evaluated the effect of acute alcohol consumption on sleep in 19 light drinking late adolescents (19.1±0.7yrs, 10 female) under two conditions; one with pre-sleep alcohol administration (Dosed to 0.1% peak BAC) and the other with a placebo beverage consumed over a 30 minute period, one hour prior to bed after a standardised meal. All abstained from alcohol for 48hrs prior to testing.
Results: Mean BAC at lights out was 0.086% in the alcohol Vs. 0.00% in the placebo condition. There were no gender differences and no differences in time in bed or total sleep time between conditions. After alcohol there was an overall increase in WASO of 16.7 minutes (p=.03), and SWS sleep of 2.9% (p=.053), and a decrease in REM of 4.4% (p<.001) with no difference in sleep efficiency or SOL. These changes were limited to the 1st half of the night with a 5.9% increase in SWS (P=.042) and a 7.1% decrease in REM (p<.001). No differences were observed in any sleep variables in the 2nd half of the sleep period.
Conclusion: While consistent with previous findings in adults, we did not observe the decrease in SOL or increased second half of the night REM sleep. This indicates that while alcohol is still changing sleep architecture it may be doing so differently in this age group, a group known engage in risky drinking behaviour.
Support (If Any): Australasian Sleep Association (Rob Pierce Grant) & NH&MRC (Fellowship #1012195) - CLN. National Institute on Alcohol Abuse and Alcoholism (AA017320; AA005965) - IMC.

0222

CAFFEINE USE AND ACTIGRAPHICALLY-ESTIMATED SLEEP IN YOUNG ADOLESCENTS

Corbo A[1], Marco CA[1], Wolfson A[2]
[1]Psychology, Rhode Island College, Providence, RI, USA, [2]Psychology, College of the Holy Cross, Worcester, MA, USA

Introduction: Prior research (Pollack & Bright, 2003) using daily questionnaires found that greater caffeine consumption by young adolescents was associated with shorter sleep duration at night, later wake times, and increased sleep during the day. These findings were based on self-reports of sleep which may be subject to errors in recall. This study attempts to replicate these findings using actigraph estimates of sleep, which are more objective than self-report data.
Methods: The Young Adolescent Sleep Smart Pacesetter Program is a longitudinal study of sleep in 145 adolescents in 7th and 8th grades. Data presented here are from the baseline time only. The adolescents were recruited from two urban middle schools. 46.7% were from a minority background and 43.4% were from families with incomes below $40,000. For seven days, participants completed a diary that assessed caffeine use and wore an actigraph to estimate sleep onset, offset, and duration. Data were aggregated to provide daily averages for caffeine consumption and sleep outcomes.
Results: More girls (75.0%) consumed caffeine after noontime than did boys (58.3%; p<.05). Average daily caffeine consumption ranged from 0 to 264.5 mg/day (M=15.3 mg/day for girls; M=10.3 mg/day for boys). The most commonly consumed caffeine product was soda. Regarding sleep, 72.1% of adolescents obtained less than 9.2 hours of sleep on school nights and 49.7% on weekend nights. Caffeine was not related (p's>.05) to sleep onset, offset, or duration, however.
Conclusion: More than half of the young adolescents in this sample reported consuming caffeine; however, the consumption of caffeine was not associated with sleep. These results differ from those by Pollack and Bright; however, the two studies differed in how they estimated sleep and the socioeconomic background of the samples. Additional research is needed to examine the impact that socioeconomic background may have on caffeine and sleep and how caffeine consumption may change as young adolescents move onto high school.
Support (If Any): NICHD R01 HD047928-05.

0223

THE IMPACT OF SOCIAL TECHNOLOGY AND CELL PHONE USE ON SLEEPINESS

Holloway Z[1], Goyal P[1], Campbell C[1], Peszka JJ[2], Mastin DF[1]
[1]Psychology, University of Arkansas at Little Rock, Conway, AR, USA, [2]Psychology, Hendrix College, Conway, AR, USA

Introduction: Sleep hygiene may be described as behaviors and environmental variables which impact sleep quality and quantity. Although watching television, browsing the internet, and even electronic gaming have been suggested as problems for sleep hygiene, the use of social technology (e.g. cell phone use, texting, and posting around bedtime) have not. We suggest social technology related sleep disruption is an important new aspect of understanding sleep hygiene and sleepiness. Social technology may impact stimulus control in the bedroom, disrupt sleep through notifications/prompts, and/or disrupt sleep due to cognitions interfering with sleep onset or maintenance.
Methods: 131 university students (M=21.9 years old, SD=6.08, women=72) were recruited from introductory psychology courses. Each participant completed the Sleep Hygiene Index (SHI), Epworth Sleepiness Scale, and a social technology/cell phone/demographic questionnaire.
Results: Social Technology: There was a significant positive correlation between sleepiness and frequency per week of social network updating (r(128) =.191, p<.05) and of being woken by notifications from social networks (r(128) =.237, p<.05). There was a significant moderate positive correlation between sleepiness and frequency per week of logging into social networking sites in the hour before bed (r(128) =.287, p<.05) and the hour after waking (r(128) =.327, p<.05). Cell phone use: There was a significant moderate positive correlation between sleepiness and checking one's cell phone after lights out (r(126) =.289, p<.05) and immediately upon waking (r(126) =.263, p<.05). Multiple items on the SHI were significantly correlated with sleepiness (r(128)=ranging from .190 to .344, p<.05).
Conclusion: Social technology and cell phone use were both significantly related to daytime sleepiness. These relatively new social behaviors may be seen as potentially delaying sleep, poor stimulus control, and interrupting sleep. We suggest this as a new component of sleep hygiene which may be important for intervention and education.

0224

ALTERNATE TIME ZONES: UNDERSTANDING EVENINGNESS IN ADOLESCENTS

Asarnow L, McGlinchey EL, Harvey AG
Psychology, UC Berkeley, Berkeley, CA, USA

Introduction: Pubertal onset triggers a tendency toward eveningness for a significant proportion of teens, coupled with constrained time available for sleep due to early school start times. Thus, many youth are struggling with the burdens of eveningness and sleep deprivation. However two important characterizations remain unclear: (1) the relationship between eveningness and short total sleep time (TST) (2) the extent to which eveningness is stable across the adolescent years and into young adulthood. We investigated the relationship cross-sectionally between eveningness and TST to determine whether owls (eveningness tendency) and larks (early circadian tendency) differ in TST. We hypothesize that eveningness will be associated with short total sleep time longitudinally. We examined the longitudinal relationship and hypothesized that eveningness in adolescence would predict eveningness in adulthood.
Methods: Utilizing public access data from The National Longitudinal Study of Adolescent health we analyzed the sleep habits of 3342 adolescents across four time points (waves) of data collection (across 14 years). Eveningness was defined as the top tertile of responses to the question, "During the summer, what time do you usually go to bed?".

Results: All analyses were conducted using methods for cluster design survey data. Cross-sectional relationships of sleep time with circadian preference were examined among waves I, II, and III respondents using t-tests between larks and owls on TST. Across all time points owls sleep significantly less than larks; in wave I owls (M=7.34, SE=.06) and larks (M=8.34, SE=.03), differ F(1,2247)=260.82, p=0, wave II owls (M=7.21, SE=.08) and larks (M=8.00,SE=.04), differ F(1,1901)=78.52, p=0, wave III owls (M=7.95, SE) and larks (M=8.89, SE=.09) differ F(1,2564)=34.95, p=0. Logistic regression analysis revealed that eveningness at wave I significantly increased odds of being an owl at wave IV (OR=1.83,[95%CI= 1.41-2.38]).
Conclusion: Eveningness was associated with a shorter TST than larks across waves. Moreover, eveningness in adolescence predicted eveningness in adulthood.

0225

LONGITUDINAL SEASONAL DIFFERENCES IN OBJECTIVE SLEEP MEASURES IN THE HOME

Fabregas SE[1], Shambroom J[2]
[1]Sleep Research Center, Zeo, Inc, Newton, MA, USA, [2]Shambroom Associates, LLC, Framingham, MA, USA

Introduction: It is known that changes in daylight intensity and exposure which accompany changes in season can have an effect on self-reported sleep quality. Little longitudinal data exist to evaluate the effects of changing seasons on objectively measured sleep in the home. The aim of the current analysis was to determine whether objective sleep measures change between seasons.
Methods: DOZER is an IRB-approved sleep registry containing de-identified data voluntarily uploaded by consumers of a sleep product (Zeo, Inc, Newton, MA). Subjects who submitted at least 3 weeknights of data during the final three weeks of each of January 2010, July 2010, and January 2011 were included in the analysis (N=154, 34 female, aged(±SD) 49.2(±14.2) years). Summary sleep measures including total sleep time, wakefulness time during sleep (WTDS), time in each of REM, light sleep, and deep sleep, latency to persistent sleep of at least 10 continuous minutes (LPS), number of awakenings lasting at least 2 minutes (NA), bed-time (BT), and rise-time were averaged for each subject at each timepoint. Repeated-measures ANOVAs were used to determine the effects on each sleep measure.
Results: Significant effects ($F(153,2) \geq 3.84$, $p<.05$) of timepoint were found for WTDS, LPS, NA, and BT. Tukey's HSD revealed ($p<0.05$, mean(SEM)) later BT, along with less WTDS, shorter LPS, and fewer NA in July compared to the earlier January (BT - 23:27(:06) vs 23:15(:07)), latter January (LPS 17.1-min(1.1) vs 19.4(1.3)), or both (WTDS - 25.7-min(2.0) vs 31.6(2.2) & 29.8(2.0) & NA - 3.9(0.2) vs 4.5(0.2) & 4.4(0.2)). In each case, there was a u-shaped change across timepoints. For all other measures, no significant effect of timepoint was found ($p>0.05$).
Conclusion: A reduction in wakefulness was observed in July versus January. No circadian delay in July versus January was observed. These data may be influenced by changes in behavior associated with summer's extended daylight hours.
Support (If Any): Support for this study was provided by Zeo, Inc.

0226

EPIDEMIOLOGY ANALYSIS ON THE EFFECT OF SELF-MONITORING ON SLEEP DIARIES

Zamora RB[1], Lichstein KL[1], Taylor DJ[2], Riedel BW[3], Bush AJ[4]
[1]Psychology, University of Alabama, Tuscaloosa, AL, USA,
[2]Psychology, University of North Texas, Denton, TX, USA,
[3]Psychology, University of Memphis, Memphis, TN, USA,
[4]Psychology, University of Tennessee, Memphis, Memphis, TN, USA

Introduction: Sleep diaries are commonly used as an assessment procedure for insomnia research; however, sleep diaries may be used as a form of self-monitoring. The present study attempts to examine week differences in 2 weeks of sleep diaries, collected in a normative epidemiological study, to determine if the task of completing sleep diaries alters sleep efficiency.
Methods: 769 participants from a metropolitan community were enrolled using random-digit dialing. The population was nearly equally comprised of males and females. Participant ages ranged from 20 to 98. The majority of the population was Caucasian or African-American. Participant's sleep efficiency was collected for 14 days via 2 weeks of sleep diaries. A repeat-measure analysis was performed to analyze week differences in sleep efficiency.
Results: The differences in mean sleep efficiency between week1 ($M = 85.87$) and week 2 ($M = 86.36$) was statistically significant, $F(1, 768) = 5.69$, $p = .017$, $\eta = .007$.
Conclusion: The presence of sleep difference between the 2 weeks suggests that the task of completing sleep diaries can alter sleep efficiency; however the effect was small. Future directions will examine the issue in a multi-level approach to optimally capture day to day variability.

0227

SLEEP HABITS AMONG HIGH SCHOOL STUDENTS SHOW A SIGNIFICANT LACK OF PARENTAL LIMIT SETTING

Bird G[1], Casturi LR[1], Alapat P[1], Sharafkhaneh A[2], Sharafkhaneh S[4], Rao A[3]
[1]Pulmonary, Critical Care and Sleep medicine, Baylor College of Medicine, Houston, TX, USA, [2]Pulmonary, Critical Care and Sleep Medicine, DeBakey VA Hospital, Houston, TX, USA, [3]Glenda Dawson High School, Pearland School District, Pearland, TX, USA, [4]Lamar High School, Houston School District, Houston, TX, USA

Introduction: Teen student sleep habits are an area of important research. Previous studies on sleep duration and quality in adolescents have shown improved daytime performance, athletic skill and behavior with increased sleep duration. This study was performed to provide a general overview of sleep habits among high school aged students in the Pearland, Texas School District.
Methods: This study was approved by the Institutional Review Board of the Pearland, Texas School District. A previously validated questionnaire on academic performance, sleep duration, and sleep habits was given to high school students from August 2010 to December 2010.
Results: Of the 269 respondents (aged 14-19, BMI 15.6-38.4, Female 58%) there were many students with a lack of parental limit setting with regards to bedtime. The respondents reported that only six percent of the students had a set bedtime (6%). The other reasons given for going to bed were feeling sleepy (30%), homework finished (38%), finished socializing (15%), TV shows finished (3.5%) or "other" (7.5%). When correlated with their grade category (A, A-B, B, B-C, C-D, D-F), 15/16 (94%) of students with parental controlled bedtimes had either A's or A-B's while none of the students with grades from C-D or D-F had a parental controlled bedtime.
Conclusion: Among adolescent high school students there was a significant lack of parental limit setting for bedtimes which correlated with poor academic performance. This may represent one of the most important areas for intervention to improve sleep quality and duration among adolescents. Further research into effective methods to improve parental limit setting is needed.
Support (If Any): No authors had any financial support from any entity.

0228

WHAT CAN WE DO TO KEEP OUR SLEEPY STUDENTS AWAKE DURING LECTURES?

Han H, Echols H, Shaw R, Esmaeili A, Baldo T, Harsh J
Psychology, The University of Southern Mississippi, Hattitesburg, MS, USA

Introduction: College students often have poor sleep health. They have irregular sleep-wake patterns, insufficient sleep and sleep at the wrong times. As a consequence, risk for excessive sleepiness is high. High sleepiness leads to impaired cognitive functioning. Our findings show that sleepiness progressively increases during lectures to a high level, especially for students with high chronic sleepiness (Epworth Sleepiness Scale, ESS > 10). The present report is concerned with factors, such as level of student involvement in class, that may moderate the sleepiness-by-time function. We anticipated that low levels of involvement would associate with a greater slope of the sleepiness-by-time function.
Methods: Data were collected from 204 college students during lectures presented in different classes taught by different instructors. Classes were categorized into high and low student involvement by 75% agreement of 4 independent raters. Starting at the beginning of a 75-min lecture, students were signaled at 10-min intervals to rate their level of sleepiness (using clickers) with the Stanford Sleepiness Scale (SSS). The Epworth Sleepiness Scale (ESS) was used to create low (<10) and high (≥10) sleepiness groups.
Results: An ANOVA yielded main effects for ESS ($p = .038$) and a significant involvement by time point interaction ($p < .001$). Level of sleepiness was low at the first time point for all students, and increased for students in low-involvement lectures. A further analysis examined the proportion of very sleepy students (SSS≥5). This proportion was about 10% at the first time point, and increased to almost 20% in high involvement and to greater than 50% in low involvement classes.
Conclusion: Level of involvement is closely associated with the tendency for student sleepiness to greatly increase during lectures. High student involvement may be critically important to maximizing the benefit of lectures to sleepy college students.

0229

USE OF SEDATIVES AND STIMULANTS FOR MANAGEMENT OF SLEEP AND WAKE STATES IN COLLEGE STUDENTS

Thacher PV, Goodhines P
Psychology, St. Lawrence University, Canton, NY, USA

Introduction: Most college students use a variety of substances as they manage their social and academic lives, including caffeine, nicotine, and alcohol, and students also use licit and illicit drugs such as marijuana and stimulants including methylphenidate. One goal of some students may be to manipulate their wakefulness and sleepiness through pharmacological means, which may adversely affect health, cognition, and academic achievement. Our study sought to discover more about the types and patterns of substances used primarily to manipulate states of wake/sleep.
Methods: Participants were recruited through psychology courses for credit. Participants who indicated either FEW (0 or 1) or MANY (5 or more) stimulants or sedatives ingested to manipulate wake/sleep were invited into the study. They completed cognitive tasks (Digit Symbol Substitution and a Letter Cancellation task) and measures of sleep patterns, health, medication and substance use. All participants reported estimated cumulative GPA.
Results: Of 69 screened students, 28 (19 women) completed measures; mean age was 20. Groups did not differ by gender. Groups did not differ on performance on cognitive tasks nor on GPA. Preliminary examination of sleep did not reveal group differences. Stimulant use was correlated with marijuana use (r=.36) and pulling all-nighters (r=.36); sedative use was correlated with caffeine use (r=.48). Groups did not differ with respect to alcohol, nicotine, or marijuana use. "Frequent" users of substances to manipulate sleep/wake state primarily differed in number of reported prescription medications ($t=2.5$, $p<.03$).
Conclusion: In this preliminary pilot study, students who reported that they often used substances to affect wake/sleep state of consciousness were also more likely to be using significantly more prescription medications, but were not more likely to be using nicotine or alcohol.

0230

MAKING IT PERSONAL: USING PERSONAL SALIENCE OF HEALTH BEHAVIORS AS A MEANS TO IMPROVE SLEEP

Clegg-Kraynok M, Hurd LE, Amstutz A
Psychology, Ohio Northern University, Ada, OH, USA

Introduction: College students obtain far less sleep than is recommended and often report that environmental factors such as noisy residence halls impair the sleep they do get. Insufficient and poor quality sleep put college students at risk for suboptimal academic performance, poor neurocognitive functioning, and accidents. The purpose of this study was to examine whether increasing participant accountability and salience of personal health behaviors, including sleep, would improve sleep variables.
Methods: As part of a larger study, college students completed the Pittsburgh Sleep Quality Index (PSQI) in addition to a battery of other health related questionnaires both at the beginning and the end of an academic term lasting 10 weeks. Participants were 34 college students enrolled at a small liberal arts college and were recruited from psychology courses. The sample was 57% female, 88% white, and was 19.74±1.05 years in age.
Results: Participant self-reported sleep quality, with lower scores indicating better sleep quality, improved from Time 1 ($M = 1.20$, $SD = 0.79$) to Time 2 ($M = 0.97$, $SD = 0.58$) [$F(1, 32) = 4.57$; $p < 0.05$]. Ratings of sleep disturbance, with lower scores indicating less sleep disturbance, also improved from Time 1 ($M = 1.14$, $SD = 0.43$) to Time 2 ($M = 0.94$, $SD = 0.49$) [$F(1, 32) = 7.78$; $p < 0.05$].
Conclusion: This study suggests that simply asking college students to report on their health behaviors over time might be sufficient to improve sleep quality and reduce sleep disturbance. Follow-up studies should include objective measures; however, utilizing personal accountability and increasing personal salience of health promoting behaviors would be a low-cost, high impact method to improve both sleep and overall health for people of all ages.

0231

EMERGING ADULT LOCUS OF CONTROL AND REGULAR BED TIME RELATED TO SLEEP QUALITY

Hurd LE, Clegg-Kraynok M
Psychology, Ohio Northern University, Ada, OH, USA

Introduction: Research has found that emerging adults often report poor sleep quality, which has been connected to problems with mood regulation, academic performance, and accidents. One way to regulate these problems is to practice healthy sleep habits, such as keeping a regular bed time to ensure optimal sleep quality. Additionally, some people with external locus of control, believing events are outside one's personal control, may disregard their ability to engage in good sleep practices, affecting their overall sleep quality.
Methods: As part of a larger study, Rotter's Locus of Control (LOC) and the Pittsburgh Sleep Quality Index (PSQI) were utilized to assess college students over the course of an academic term. Participants (N=34) ranged in age from 18-22 (M=19.73) with 19 females and 15 males.
Results: An ANOVA assessing the relationship between LOC and Global PSQI scores indicated a main effect of LOC ($p=.045$), such that those with an external LOC had higher overall PSQI scores (M=8.59) than those with an internal LOC (M=6.28). An additional ANOVA examining regular bed times and Global PSQI scores showed a main effect of

bed time (p=.016), such that those without a regular bed time had higher overall PSQI scores (M=8.47). Furthermore, participants' scores were above the accepted clinical cutoff of 5 for Global PSQI indicating overall poor sleep quality.
Conclusion: The results suggest that among emerging adults, an external LOC and not having a regular bed time are associated with worse overall sleep quality than those who have a set bed time and have an internal LOC. These findings suggest that manipulations of one's locus of control as well as education about sleep hygiene might be a point of intervention for college students to improve sleep quality and, subsequently, academics and mood.

0232

WEEKEND SLEEP IS RELATED TO GREATER COPING AND RESILIENCE CAPACITIES

DelDonno S[1], Schwab ZJ[1], Kipman M[1], Weber M[1,2], Killgore WD[1,2]
[1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Sleep deprivation has significant degrading effects on mood and emotional processes and has been linked to decreased behavioral coping abilities, increased risk-taking behavior, and increased scores on indices of some aspects of psychopathology. Notably, poor sleep is one of the most common symptoms reported among a diverse set of psychopathologies including PTSD, depression, and anxiety. Adequate sleep may play a protective role in preserving coping and resilience capacities. The present study investigated relationships between self-reported sleep quality during the workweek and on weekends and several facets of resilience.
Methods: Forty-four healthy individuals (ages 18-45, M = 30.0, SD = 8.7; 21 female) completed the Connor-Davidson Resilience Scale (CD-RISC), Invincibility Belief Index (IBI), NEO Personality Index Revised (NEO-PI-R), and a questionnaire asking about average sleep duration and sleep onset latency. Data were analyzed with Pearson's correlations.
Results: Although average weekday sleep duration was unrelated to measures of resilience, weekend sleep duration was significantly correlated with higher scores on the CD-RISC and lower NEO Neuroticism ($p<.05$). Regarding the latency to fall asleep, individuals with shorter sleep onset latency on weekdays showed higher scores on the CD-RISC, global Invincibility, Audacity/Boldness/Courage, and lower Neuroticism ($p<.05$). Likewise, shorter sleep onset latency on weekends was related to higher CD-RISC, general invincibility, Audacity/Boldness/Courage, Adroitness/Cunning/Skill, and lower Neuroticism ($p<.05$).
Conclusion: Participants who reported obtaining more sleep and falling asleep more quickly, particularly on weekends reported greater resilience, boldness/courage, and lower neuroticism. Results suggest that emotional resilience may be mediated by the amount of sleep obtained on weekends and the latency to fall asleep. These findings suggest that "catching up" on sleep on weekends may actually have more beneficial effects on coping and resilience capacities than previously realized. Further research will be necessary to establish the causal direction of these relationships, however.

0233

EXAMINING THE RELATIONSHIPS BETWEEN SLEEP DURATION, OBESITY PREDICTIVE BEHAVIOURS AND BODY MASS INDEX IN UK ADOLESCENTS

Arora T[1], Thomas G[2], Taheri S[1]
[1]College of Medical and Dental Sciences, University of Birmingham, Birmingham, United Kingdom, [2]Public Health, Epidemiology and Biostatistics, University of Birmingham, Birmingham, United Kingdom

Introduction: Daytime sleepiness is common amongst adolescents. Sleep loss has been linked to risky-decision making and obesity. Health-related decisions during adolescence may track into adulthood and so it is essential to develop a better understanding of how sleep may be associated with healthy lifestyle choices during adolescence. We sought to examine the associations between sleep duration and a number of lifestyle behaviours and body mass index (BMI).
Methods: Data were collected in 2011 using the Schools Sleep Habits Survey (SSHS) and objectively measured BMI in 959 volunteers (55.7% boys), aged 11-13 years. We examined the cross-sectional data collected from the Midlands Adolescent Schools Sleep Education Study (MASSES) using ANOVA, bivariate correlation and linear regression.
Results: Always eating breakfast daily, always eating 3 daily meals, never snacking after bedtime and never drinking caffeinated drinks after bedtime had significantly enhanced sleep duration compared to those who ate breakfast almost daily ($F=10.36$ (2), $p<0.001$), sometimes or rarely; ate 3 daily meals never, sometimes or usually ($F=12.98$ (3) $p<0.001$); sometimes, usually or always snacked after bedtime ($F=13.45$ (3), $p<0.001$); and those who sometimes, usually or always drank caffeinated drinks after bedtime ($F=6.54$ (3), $p<0.001$). Exercise frequency (very often, often, sometimes, rarely, never) was not significantly associated with sleep duration ($F=1.03$ (4), $p=0.39$). There was a significant negative correlation between sleep duration and BMI, $r=-0.08$, $p=0.02$. The crude linear regression model also showed a significant negative relationship between sleep duration and BMI $\beta=-0.07$, $p=0.05$ but after adjustment for age, gender and ethnicity, the relationship diminished $\beta=-0.04$, $p=0.21$.
Conclusion: Practising good dietary habits are significantly associated with longer sleep duration but exercise frequency is not. Sleep duration was not linearly associated with BMI after adjustment. Longitudinal evidence is needed.
Support (If Any): Financial support provided by Action Medical Research.

0234

THE RELATIONSHIP BETWEEN WEIGHT GAIN AND SLEEP AND SLEEPINESS DURING THE TRANSITION FROM HIGH SCHOOL THROUGH THE COLLEGE YEARS

Peszka JJ[1], Mastin DF[2], Harsh J[3]
[1]Psychology, Hendrix College, Conway, AR, USA, [2]Psychology, University of Arkansas at Little Rock, Little Rock, AR, USA, [3]Psychology, The University of Southern Mississippi, Hattiesburg, MS, USA

Introduction: Short-term sleep deprivation results in acute physiological changes associated with eating (e.g. ghrelin, leptin, glucose tolerance). However, no studies have examined whether long-term changes in sleep lead to lasting changes in body weight. Our objective was to examine the relationship between changes in sleep and changes in weight during the transition from high school through four years of college.
Methods: Participants completed sleep questionnaires (Epworth Sleepiness Scale, Horne-Östberg Morningness-Eveningness Questionnaire, Sleep Timing Questionnaire, The Sleep Hygiene Index, and a napping questionnaire) during their pre-freshman summer (N=89, 17-20 yrs) and at the end of their freshman (N=34) and senior years (N=43) of college. Body mass index (BMI) was recorded at each time.
Results: During high school, BMI was negatively related to sleep duration on school nights ($r(86)=-.292$, $p<.05$), and weekend nights ($r(86)=-.189$, $p<.05$). Sleep duration was not related to BMI in college. However, during the high school/college transition, an increase in BMI was seen with decreased school night sleep, approaching significance ($r(31)=-.269$, $p=.065$); and with increased weekend nighttime sleep ($r(32)=.347$, $p<.05$). Less napping during freshman year was correlated with greater weight gain throughout college ($r(23)=-.340$, $p<.05$). However, increased napping during college was related to greater weight gain ($r(23)=.594$, $p<.05$). Increased sleepiness from high school through college was associated with increased BMI ($r(23)=.418$, $p<.05$). And

shifting more towards evening chronotype during college was related to increased BMI (r(22)=.356, p<.05).
Conclusion: These data suggest long-term changes in sleep are related to long-term weight changes. Lack of napping during freshman year and increases in daytime sleepiness throughout college predicted college weight gain; however, college weight gain was also linked to increased weekend sleep and increased napping. These sleep timing changes could be due to shifts towards a more evening chronotype which was also related to greater weight gain.

0235

INTERPLAY BETWEEN SLEEP DISTURBANCES AND EATING BEHAVIOURS

Michaelsen S[1], Wiebe S[2,1], Dubé L[2], Knauper B[2], Mangal M[3,1], Shuo Jin E[2,1], Gruber R[1,2]
[1]Douglas Mental Health University Institute, Verdun, QC, Canada, [2]McGill University, Montreal, QC, Canada, [3]Concordia University, Montreal, QC, Canada

Introduction: Mounting evidence indicates that an appropriate amount of sleep is necessary in order to lead a healthy life, as sleep is beneficial for cognitive, emotional, and physiological functioning. Several studies have found a relationship between sleep, weight regulation and eating, where lack of sleep is associated with a heightened risk for increased weight and poorer eating habits. However, the mechanisms underlying the interplay between sleep and eating remain unclear. It is still uncertain as to what aspects of sleep (e.g. duration, quality) and what aspects of eating play a role in this relationship. The aim of the study was, therefore, to examine different aspects of sleep habits in relation to women's eating behaviours. We hypothesized that greater sleep disturbances would be associated with greater disordered eating behaviours.
Methods: Twenty women (aged 33-53 years, mean = 40.4 ± 5.2) completed the Adult Dutch Eating Behavior Questionnaire (DEBQ) and the Pittsburgh Sleep Quality Index (PSQI). The DEBQ consists of: emotional eating (eating in response to emotions), restrained eating (attempts to restrain eating due to weight concerns) and external eating (eating based on external cues). Higher scores on the DEBQ suggest greater presence of disordered eating. The PSQI consists of 7 components (sleep quality, latency, duration, efficiency and disturbance, use of sleep medications, and daytime dysfunction) and a global score. Higher scores on the PSQI are related to greater sleep disturbance.
Results: Partial correlations were conducted between PSQI and DEBQ subscales, controlling for age and education level. An alpha of .05 was used to indicate significance. Women scoring higher on emotional eating also had longer sleep latencies, more sleep disturbances, greater daytime dysfunction and higher overall scores on the PSQI. Women scoring higher for restrained eating were found to have more sleep disturbances and greater daytime dysfunction.
Conclusion: Greater sleep disturbances are associated with greater problematic eating habits. While future research is needed to determine the direction of the relationship, it may be beneficial to target sleep in weight loss or disordered eating programs.

0236

THE CROSSOVER EFFECTS OF SUPERVISOR WORK-FAMILY POSITIVE SPILLOVER ON EMPLOYEE SLEEP DEFICIENCY: MODERATING EFFECTS OF FAMILY SUPPORTIVE SUPERVISOR BEHAVIORS (FSSB)

Crain TL[1], Hammer LB[1], Bodner TE[1], Buxton OM[2,3]
[1]Department of Psychology, Portland State University, Portland, OR, USA, [2]Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [3]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Sleep-related constructs have rarely been included in work-family research. However, positive spillover, or the transfer of positive affect between work and family domains, has been shown to have enriching effects on physical health. The current study investigated if positive spillover is transmitted from supervisor to employee, improving employee sleep. We hypothesize that employee perceptions of family-supportive supervisor behaviors (FSSB) will moderate the relationship between supervisor positive spillover and employee sleep adequacy and duration.
Methods: As part of the Work, Family and Health Study, 221 supervisors (76 female, age 46.2±7.7 years) and 823 employees (282 female, age 45.7±9.0 years) working in the information technology sector reported measures of work-to-family affective positive spillover, FSSB, sleep adequacy (getting enough sleep to feel rested upon waking), and sleep duration.
Results: In multilevel moderated regression analyses, FSSB was positively related to employee sleep adequacy (B=.07, p=.019, CI=.01-.13), but did not result in a significant interaction of supervisor positive spillover with FSSB on employee sleep adequacy (B=.05, p=.336, CI=-.05-.15). A disordinal interaction was found between supervisor positive spillover and FSSB on employee sleep duration (B=.20, p<.001, CI=.09-.30), such that the relationship between supervisor positive spillover and employee sleep duration was positive under high levels of FSSB, but negative under low levels of FSSB. No direct effect of FSSB on sleep duration was found (B=.03, p=.319, CI=-.02-.09).
Conclusion: Supervisor positive spillover is associated with the adequacy and amount of sleep that employees are able to attain, supported by the relationship of employee-reports of FSSB on employee sleep adequacy. The effect of supervisor positive spillover on employee sleep duration was strongest when employee reports of FSSB were high. Future occupational health interventions may not only train supervisors to exhibit family-supportive behaviors, but could target the supervisor work-family interface as a means for improving employee sleep health.
Support (If Any): This research was conducted as part of the Work, Family and Health Network (www.WorkFamilyHealthNetwork.org), which is funded by a cooperative agreement through the National Institutes of Health and the Centers for Disease Control and Prevention: Eunice Kennedy Shriver National Institute of Child Health and Human Development (Grant # U01HD051217, U01HD051218, U01HD051256, U01HD051276), National Institute on Aging (Grant # U01AG027669), Office of Behavioral and Science Sciences Research, the National Heart, Lung and Blood Institute (R01HL107240), and National Institute for Occupational Safety and Health (Grant # U01OH008788, U01HD059773). Grants from the William T. Grant Foundation, Alfred P Sloan Foundation, and the Administration for Children and Families have provided additional funding. The contents of this publication are solely the responsibility of the authors and do not necessarily represent the official views of these institutes and offices. Special acknowledgement goes to Extramural Staff Science Collaborator, Rosalind Berkowitz King, Ph.D. and Lynne Casper, Ph.D. for design of the original Workplace, Family, Health and Well-Being Network Initiative.

0237

THE PARADOXICAL EFFECTS OF MINDFULNESS MEDITATION ON SUBJECTIVE AND OBJECTIVE MEASURES OF SLEEP

Peck T[1], Lester A[2], Lasky R[1], Bootzin RR[1]
[1]Psychology, University of Arizona, Tucson, AZ, USA, [2]Neuroscience, University of Arizona, Tucson, AZ, USA

Introduction: While a growing literature exists on the effects of mindfulness meditation (MM) on self-reported sleep quality, little research has investigated how MM affects sleep as measured by polysomnography (PSG).
Methods: This study recruited 38 healthy adult mindfulness meditators (19 male) of varying meditation skill levels and age (18 - 82, median = 42), and participants' sleep and meditation habits were recorded for one week using diaries and Actigraphy. At the end of this week, physi-

ological measures were recorded during a brief meditation following which participants' overnight sleep was measured by in-lab PSG. Sleeping EEG was scored both visually and using a Fast Fourier Transform. Meditation skill was computed by assigning participants scores on two composite measures of MM skill derived through principal component analysis. Data were analyzed using linear regression with mindfulness skill as the quasi-independent variable.

Results: Several positive outcomes in self-reported sleep were found to correlate with meditation skill: a decrease in perceived restlessness of sleep ($p = .01$), a decrease in wake after sleep onset ($p = .02$), and a non-significant trend ($p = .11$) towards increased sleep quality. Data from the PSG, however, showed meditation skill was associated with more wake after sleep onset ($p < .01$) and a greater total number of awakenings ($p < .01$). Meditation skill was also associated with several EEG changes that appeared negative: higher frontal and central alpha power during sleep ($p < .05$), substantially less REM ($p < .01$), and reduced delta power during n3 ($p < .05$). All of these changes persist when controlling for age and other factors.

Conclusion: Mindfulness meditation skill is associated with improved perception of sleep but also with what appear to be signs of worse sleep as measured using PSG.

Support (If Any): The Francisco J. Varela Award from the Mind and Life Institute.

0238

THE GOAL OF THE PRESENT STUDY WAS TO DETERMINE THE RELATIONSHIP BETWEEN MINDFULNESS MEDITATION EEG AND SLEEP EEG

Dawson S, Peck T, Bootzin RR
Psychology, University of Arizona, Tucson, AZ, USA

Introduction: The goal of the present study was to determine the relationship between mindfulness meditation EEG and sleep EEG.

Methods: Physiological measures were recorded in 34 adult meditators (female: 16, age M = 42.88, range = 18-82) during a baseline period and meditation, each 6 minutes long and identical except for meditation. Polysomnograms were then recorded and scored according to standard criteria then analyzed with fast Fourier transform (FFT); baseline and meditation data were analyzed with FFT. All FFT measures were averaged between hemispheres. Hierarchical multiple regression models were used to predict sleep EEG power from meditation EEG power after controlling for age, sex, and psychopathology as measured by the Brief Symptom Inventory (BSI). Within each model, all EEG measures were for the same frequency band and EEG site.

Results: After controlling for age, sex, BSI, and baseline EEG power, meditation EEG power was a significant predictor of several sleep EEG measures. Frontal beta power during meditation significantly predicted frontal beta power during REM ($\beta = .421$, $p < .05$). Frontal alpha1 and beta power during meditation significantly predicted the same measures during N2 ($\beta = .886$, $p < .05$; $\beta = .568$, $p < .05$). Occipital theta2 and alpha1 power during meditation significantly predicted the same measures during N2 ($\beta = .399$, $p = .05$; $\beta = .894$, $p < .001$).

Conclusion: These findings show an association between frontal beta during meditation and REM as well as N2, and between occipital theta2 and alpha1 during meditation and N2.

Support (If Any): Francisco J. Varella Award from the Mind and Life Institute.

0239

HUMAN BRAIN STRUCTURE PREDICTS VULNERABILITY TO SLEEP DEPRIVATION INDUCED HIPPOCAMPAL MEMORY IMPAIRMENTS, AND THEIR RESTORATION BY NREM SLOW WAVES

Saletin JM[1,2], Goldstein AN[1,3], Greer SM[1,3], Stark S[4,5], Stark CE[4,5], Walker M[1,2,3]

[1]Sleep and Neuroimaging Laboratory, University of California, Berkeley, Berkeley, CA, USA, [2]Department of Psychology, University of California, Berkeley, Berkeley, CA, USA, [3]Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, USA, [4]Department of Neurobiology and Behavior, University of California, Irvine, Irvine, CA, USA, [5]Center for the Neurobiology of Learning and Memory, University of California, Irvine, Irvine, CA, USA

Introduction: Sleep deprivation markedly impairs hippocampal-dependent memory function. However, the factors conferring vulnerability (as well as resilience) to such deprivation impairments remain unknown. Here, we demonstrate that the structural morphology of the human hippocampus predicts the susceptibility of memory to sleep loss, and its degree of restoration following recovery sleep.

Methods: 15 healthy adults (19.6±1.45yrs, 7-males) had a high-resolution structural MRI brain scan and completed a within-subject design across three conditions: (1) a sleep-rested condition, (2) a total sleep-deprived condition (~24hr), and (3) a recovery condition following a 90-minute nap measured with high-density EEG. In each condition, participants performed a validated continuous-recognition memory task, allowing for the ability to examine changes in hippocampal-dependent memory function following sleep deprivation and recovery. Analysis of structural hippocampal volume was performed for each participant to assess predictive relationships with deprivation and recovery memory changes. Furthermore, topographic sleep EEG power was calculated to examine associations with recovery.

Results: Sleep deprivation significantly impaired hippocampal memory performance ($P<0.05$), yet this impairment was reversed following a recovery nap. Additionally, those individuals with greater hippocampal volume expressed the greatest susceptibility to the effects sleep deprivation ($P<0.05$), and conversely the greatest degree of restoration following the recovery sleep period ($P<0.05$). Moreover, the relationship between recovery and hippocampal structure was significantly mediated ($P<0.05$) by homeostatic NREM slow wave activity (SWA) expressed over prefrontal cortex during the nap.

Conclusion: Here we demonstrate that the structure of the human hippocampus represents one factor determining vulnerability to, and recovery from, sleep deprivation, the latter mediated by SWA that potentially restores synaptic plasticity. Such findings suggest that morphology of the human brain is an under-appreciated factor governing inter-individual differences in susceptibility to sleep deprivation; a factor with translational significance for disorders where sleep disruption, memory impairments and hippocampal abnormalities co-occur.

Support (If Any): This work was supported by NIH NIA [RO-1AG031164] (MPW) and NSF GRFP (JMS).

0240

EEG CORRELATES OF OVERNIGHT MEMORY CONSOLIDATION IN A VIRTUAL NAVIGATION TASK

Wamsley EJ[1,2], Nguyen ND[2], Tucker MA[1,2], Olsen A[3], Stickgold R[1,2]

[1]Psychiatry, Harvard Medical School, Boston, MA, USA, [2]Psychiatry, Beth Israel Deaconess Medical Center, Boston, MA, USA, [3]Harvard College, Boston, MA, USA

Introduction: We previously demonstrated that performance in a Virtual Maze Task (VMT) is improved by post-learning sleep. Here, we examined high-density EEG correlates of overnight improvement in this task, using the technique of microstate segmentation.

Methods: Participants were trained on the VMT beginning at 10pm. In a series of test trials, participants must navigate to the maze exit as quickly and accurately as possible. High-density EEG (60 channels) was recorded during encoding and throughout the night following learning. Participants were retested on the VMT the following morning. We used the technique of "microstate segmentation" to quantify the spatial characteristics of the EEG during the initial minutes of sleep (e.g. Pascual-Marqui et al., 1995).

Results: During maze navigation, microstate segmentation identified 5 distinct scalp topographies that explained a combined 43% of the spatial variability in the signal. Source localization of these states indicated parietal sources in the precuneus and superior parietal lobule, as well as superior frontal gyrus. During NREM sleep, segmentation identified 4 microstates explaining a combined 51% of signal variance. One of the topographies identified during NREM had a superior frontal gyrus source similar to that seen during encoding, and this topography strongly predicted overnight improvement on the maze task (distance traveled to the goal: $r(9)=.83$, $p=.006$). Overnight improvement in distance traveled to the exit was also positively correlated with % time spent in Stage 2 NREM sleep ($r(19)=.46$, $p=.049$).

Conclusion: We found that an encoding-related topography identified during NREM sleep was associated with the extent of overnight navigation improvement. Although alternative explanations are possible, this preliminary evidence suggests that the extent to which particular encoding-related EEG topographies are expressed post-training could relate to offline memory processing during sleep. Stage 2 sleep was also implicated in consolidation of this spatial memory task.

Support (If Any): This research was supported by grants R01-MH48832 and T32-HL07901 from the NIH.

0241

WHAT DRIVES LOCAL HOMEOSTATIC REGULATION OF SLEEP?

Sheth B[1,2], Li Z[1]

[1]Electrical and Computer Engineering, University of Houston, Houston, TX, USA, [2]Center for Neuroengineering and Cognitive Science, University of Houston, Houston, TX, USA

Introduction: During sleep, slow-wave activity (SWA), defined as electroencephalographic (EEG) activity <4Hz, increases as a function of prior wakefulness, and gradually decreases to baseline levels. It has been claimed that local increase in SWA in specific brain regions during sleep is correlated with overnight improvement on an attention-demanding motor learning task. We wondered if the local, homeostatic regulation of sleep is associated with learning or attention.

Methods: We developed a motor task in which participants (n=10) performed out-and-back movements to a target using a pen-like cursor with their dominant hand on a digitizing tablet while target and cursor positions were shown on the screen. Three conditions were run on three different nights >1 week apart: i) a single rotation (SR) condition, in which a systematic rotation was imposed on the perceived cursor trajectory on all trials; ii) a random rotation (RR) condition, in which a rotation was imposed on the trajectory but unlike SR, the angle of the rotation was randomly varied across trials; iii) a no rotation (NR) control. SR is an implicit learning paradigm: the participant adapts to the required rotation as indicated by reduction in error. In contrast, RR is not likely to be learnt. Both SR and RR require attention, however. Sleep was monitored with classical polysomnography. Furthermore, EEG data were recorded, and the average SWA power density for the first 30 minutes of nREM sleep was computed. Pre- and post-sleep motor performance (error) was compared.

Results: As expected, participants improved overnight on the SR condition (14.4±3.0%, $p=0.001$) but not on the RR condition (-1.0±4.3%, $p=0.84$). Global topological patterns of SWA in sleep following the task in SR/NR and RR/NR conditions were remarkably similar ($r=.46$, $p=.028$). Local increase in SWA in the left- centroparietal area in the SR

and RR conditions relative to the NR control were observed, although the precise location within this region that showed the increase varied across participants. We selected the site that showed maximum SWA increase on an individual basis from SR data, but found no correlation between change in SWA in this selected site with overnight improvement on SR (r=-0.04, p=0.91).
Conclusion: Combined, our results fail to support the claim that SWA changes in sleep following the motor task are related to implicit motor learning. We are currently exploring correlations of other performance measures (learning/attention) with local SWA increase.

0242

THE TIMING OF SLEEP AFTER ACQUISITION DIFFERENTIALLY AFFECTS DECLARATIVE AND PROCEDURAL MEMORY CONSOLIDATION

Nissen C[1], Holz J[1], Piosczyk H[1], Feige B[1], Spiegelhalder K[1], Riemann D[1], Voderholzer U[1,2]
[1]Department of Psychiatry and Psychotherapy, University Medical Center, Freiburg, Germany, [2]Medical-Psychosomatic Clinic, Roseneck Clinic, Prien, Germany

Introduction: Sleep has been shown to promote the consolidation of newly encoded memories. However, fundamental questions on the best timing of sleep after encoding persist. Here, we tested the hypothesis that periods of sleep directly after acquisition provide better conditions for the consolidation of declarative and procedural memories than delayed periods of sleep.
Methods: Fifty-four healthy adolescent subjects (all female, aged 16-17 yrs) were trained on a declarative word-pair and a procedural finger-tapping task at 3 pm in the afternoon (n=27, afternoon group) or at 9 pm in the evening (n=27, evening group) prior to a sleep laboratory night (10 pm to 7 am). Retrieval was assessed 24 hrs after initial training.
Results: Subjects in the afternoon and evening group did not differ on the level of encoding or in parameters of night-time sleep. Off-line gains in finger-tapping performance were significantly higher in subjects trained in the evening compared to those trained in the afternoon (ANOVA Session X Group interaction, finger-tapping speed F=4.2, p=0.025, accuracy F=6.0, p=0.004). In contrast, subjects trained in the afternoon showed a significantly elevated retention rate of word-pairs compared to subjects trained in the evening (ANOVA Session X Group interaction F=3.5, p=0.033).
Conclusion: The results support the notion that the time-interval between acquisition and sleep differentially affects the consolidation of declarative and procedural memories in adolescents.

0243

THE LINK BETWEEN SLOW-WAVE SLEEP AND MEMORY CHANGES FROM YOUNGER ADULTS TO OLDER ADULTS

Scullin M
Psychology, Washington University in St. Louis, St. Louis, MO, USA

Introduction: Nearly all research on memory consolidation during slow-wave sleep (SWS) has examined college-aged adults, thus ignoring how consolidation may change with aging. Separate research literatures have reported SWS declines and memory declines with increasing age. These literatures converge on an intriguing question: do older adults consolidate memories during SWS?.
Methods: Younger adults and healthy older adults (N = 98) encoded word pairs in the morning or evening and then returned 12 hours or 24 hours later for a final test (three groups: 12-hr wake, 12-hr sleep, 24-hr sleep) and a second learning phase. Sleep stage scoring was obtained using an automated wireless home monitoring system.
Results: The older adults, relative to the younger adults, demonstrated declines in memory retention and in SWS. In the younger adult group, memory retention was greater in the sleep condition than in the wake condition and memory retention was strongly correlated with amount of SWS (r = .500). Interestingly, in the older adult group, there was no effect of delay condition and SWS did not correlate with memory retention (r = .016). Furthermore, for one measure of post-sleep learning, the older adults (but not the younger adults) even demonstrated a surprising negative correlation between amount of SWS and learning (r = -.507). These results were maintained even when comparing top performing older adults to low performing younger adults.
Conclusion: Prevalent theories of SWS and memory suggest that consolidation should decline in older adults to the extent that SWS declines. However, the present findings suggested that the SWS—memory link weakens in older adults. Pinpointing when and why the sleep—memory link changes in older age could be one of the next great research questions for our field.
Support (If Any): Supported by NIH Grant 5T32AG00030, APF/COG-DOP, Psi Chi, and a Zeo Equipment Grant.

0244

CLASSROOM NAPS BENEFIT SPATIAL LEARNING IN PRESCHOOL CHILDREN

Kurdziel L[1], Duclos K[2], Spencer R[2,1]
[1]Neuroscience and Behavior, University of Massachusetts Amherst, Amherst, MA, USA, [2]Psychology, University of Massachusetts Amherst, Amherst, MA, USA

Introduction: The preschool-age (2 years 9 months to 5 years 11 months) represents a unique point of development with respect to both cognition and sleep. Specifically, the preschool age is typically when children transition from biphasic to monophasic sleep patterns. At the same time, the brain is highly plastic and, as a result, education at this age has lifelong impacts on health and economic outcomes. Recent evidence suggests that the transition from biphasic to monophasic sleep is correlated with greater cognitive abilities in children. However, whether individual naps enhance cognition, particularly of recently learned material, has not been examined and was the focus of this study.
Methods: Forty-three children (ages 3.9 +/- 0.7 yrs) were taught to locate images on a grid of 9, 12, or 16 locations (depending on the child's age). Recall was probed after a nap and after an equivalent interval of wake. All children were tested in both the wake and sleep conditions to control for differences in brain maturation.
Results: Results indicate that naps protect memory for spatial locations relative to the decay in memory observed over an equivalent waking interval ($t(42) = 2.18$, $p = 0.035$). The observed nap benefit could not be attributed to the child's age ($r = -0.138$, $p = 0.378$) or to nap duration ($r = 0.122$, $p = 0.435$).
Conclusion: The results of this study provide direct evidence for a benefit of napping on spatial memory in preschool-aged children, regardless of age. This supports the continued need for naptime in preschools, and may suggest that nap promotion be continued even after a child has become nap defiant.

0245

SLEEP-PROMOTING DOSES OF GABA-A MODULATORS NEGATIVELY IMPACT COGNITION RELATIVE TO DUAL OREXIN RECEPTOR ANTAGONISTS

Uslaner JM[1], Tye SJ[1], Eddins D[1], Fox SV[1], Gotter AL[1], Tannenbaum PL[1], Hargreaves R[1], Coleman PJ[2], Winrow CJ[1], Renger JJ[1]
[1]Neuroscience, Merck, West Point, PA, USA, [2]Medicinal Chemistry, Merck, West Point, PA, USA

Introduction: Approximately 10% of the general population suffers from chronic insomnia and 30% experience symptoms intermittently. The current standards of care, such as the nonbenzodiazepine GABA-A receptor modulators, carry unwanted side-effects including cognitive disruption. Genetic and pharmacological studies have indicated that Orexin Receptors (OXRs) play a key role in regulating wakefulness.

With the aim of developing better tolerated medications for insomnia, we have identified Dual OX1R/OX2R antagonists (DORAs) and engaged in studies evaluating their effects relative to general GABA-A receptor modulators.
Methods: We compared the effects of GABA-A receptor modulators (Eszopiclone and Zolpidem) to DORAs on memory performance in rats (novel object recognition) and attention and working memory in rhesus macaques (serial choice reaction and delay non-match to sample). Doses of each compound tested were chosen based on their ability to reduce active wake, as defined by electroencephalogram (EEG) and electromyogram (EMG).
Results: In rat, we report that GABA-A modulators disrupted recognition memory at doses near those that significantly decreased active wake. In marked contrast, DORAs only disrupted novel object recognition performance at doses well in excess of those affecting active wake. Similarly, at doses at or below the minimum effective dose on active wake, GABA-A modulators negatively impacted both attention and working memory in rhesus macaque, whereas the DORA was without effect on either cognitive measure at all doses tested.
Conclusion: These findings in two preclinical models suggest that DORAs carry less risk associated with cognitive impairment than the current standards of care, which could have important implications for treating insomnia. Clinical studies are ongoing to understand the efficacy and safety profile of DORAs.
Support (If Any): This project was supported by Merck & Co., Inc.

0246

DRUG ALTERED SLEEP ENHANCES MEMORY

Mednick SC[2,1], McDevitt EA[2], Drummond SP[1], Walsh JK[3]
[1]Psychiatry, 9116a, UC San Diego, San Diego, CA, USA, [2]Psychology, UC Riverside, Riverside, CA, USA, [3]Sleep Medicine, St. Lukes Hospital, Chesterfield, MO, USA

Introduction: A central function of sleep is the consolidation of memories. Specific electroencephalographic (EEG) waveforms have been shown to correlate with improvements in discrete memory domains. However, it is not known whether experimental manipulation of specific sleep EEG features via direct pharmacological intervention will enhance memory consolidation. Sleep spindles are electrophysiological markers of stage two sleep and their frequency has been associated with hippocampal-dependent memory consolidation in both humans and animals. Here, we examine the effects of zolpidem (ZOL) (10mg), sodium oxybate (SO) (2.5g) and placebo (PBO) on spindle density (number of spindles/ minutes in stage two sleep) during a 9AM nap.
Methods: 30 subjects were tested in a repeated-measures crossover design. Cognitive testing on the word pair associates task, the texture discrimination task, and motor sequence task occurred at 6AM and 3PM.
Results: We show that during a daytime nap ZO produced increased sleep spindle density and decreased REM sleep, compared to SO or PBO. Increases in sleep spindles correlated with better retention of verbal memory and decreases in perceptual learning, that were independent of motor learning.
Conclusion: These results establish a causal relationship between pharmacological increases in sleep spindles and memory consolidation, which yield performance gains exceeding those of sleep alone or sleep with a control drug, and therefore demonstrate the capacity for "exceptional" memory enhancement with pharmacologically-specified sleep. We propose a mechanism for hippocampal-dependent consolidation in which the inhibition of new encoding (i.e. reduced synaptic plasticity) may be a critical component. Specifically, ZO may provide the strongest inhibition of the formation of new memories, which is an ideal condition for the transfer of recent memories from the hippocampus to cortical long-term memory stores, i.e. neural replay.
Support (If Any): K01 MH080992, Jazz Pharmaceuticals.

0247

THE IMPACT OF SLEEP AND WAKEFULNESS ON MOTOR SKILL IN MUSICIANS AND NON-MUSICIANS

Tucker MA[1], Nguyen N[1], Stickgold R[1,2]
[1]Harvard Medical School, Boston, MA, USA, [2]Harvard University, Cambridge, MA, USA

Introduction: Numerous studies show that sleep benefits motor skill in healthy young individuals. The current study examined whether an individual's musical ability interacts with the known motor skill benefits of sleep. To address this question we examined motor sequence task (MST) performance in subjects who had no prior experience playing a musical instrument and those who had experience playing musical instruments that require motor movements similar to those required for the MST (e.g., piano or woodwind instruments).
Methods: Participants were 35 undergraduate students (17 sleep, 15 musicians) who were trained at 9AM or 9PM on the MST, and were retested 12hrs later. Performance was computed as the number of correct trials on the last 3 training trials and first 3 retest trials.
Results: Sleep and wake subjects performed similarly at training (25.2 v. 25.1 correct sequences, p=.9). After a 12hr interval we found that sleep (p=.005) and musicality (p=.009) both benefited MST performance, with musicians who slept improving most (+24%) and non-musicians who stayed awake performing worst (+4%). However, there was no interaction between the two variables (p>.9) indicating that musicians and non-musicians benefit equally from sleep. Notably, subjects who play an instrument but stay awake improve as much as non-musicians that sleep (16.1 v. 16.9%, p=.8).
Conclusion: Sleep benefits motor skill to an equal extent in musicians and non-musicians alike, and it appears that musical talent can override the detrimental effects of wake on MST performance, bringing wake subjects' performance up to the level of that observed after sleep alone.

0248

SLEEP ENVIRONMENT DETERMINES THE IMPACT OF SLEEP-DEPENDENT MEMORY CONSOLIDATION

Wang H, Nguyen ND, Stickgold R
Psychiatry, Beth Israel Deaconess Medical Center / Harvard Medical School, Boston, MA, USA

Introduction: Sleep research tends to be conducted in three traditional environments: the sleep laboratory, a hospital room, or the home. Our experiment examined the impact of sleep environment on memory consolidation.
Methods: 24 healthy, college-aged subjects (16 male) participated in a three-part, repeated measures sleep study. Subjects arrived in the evening at Beth Israel Hospital and were trained on the visual discrimination task (VDT). They then slept in one of three locations in randomized order: a) at Home b) in a spacious sleep Laboratory, furnished to resemble a hotel room c) in a standard Hospital room; after an 8hr sleep opportunity, subjects were retested on the VDT. Polysomnographic (PSG) recordings were obtained in the Lab and Hospital conditions.
Results: VDT: Performance improved significantly (8%) overnight when subjects slept at Home, differing significantly from the Hospital night (-0.2%; Home vs. Hospital: p=.017); VDT performance showed improvement in the Lab (3%), which was not significantly different from the Home or Hospital. PSG: Sleep efficiency was significantly higher for subjects sleeping in the Lab than in the Hospital (94.6 vs. 89.5%; p=.025), and REM sleep was greatly diminished in the Hospital condition (p<.01). Questionnaires: In contrast to PSG data, subjects largely reported better quality sleep in the Hospital than in the Lab (p=.025).
Conclusion: Analyses of these data suggest that overnight sleep-dependent improvement is sensitive to sleep environment, and that this decrement in performance may be related specifically to poorer objective measures of sleep including sleep efficiency and REM sleep.

0249

DOES SLEEP REALLY BENEFIT INSIGHT FORMATION?

Tucker MA[1], Williams J[2], Tartaglia J[3], Kishore D[3], Stickgold R[1,3]
[1]Harvard Medical School, Boston, MA, USA, [2]Morehouse School of Medicine, Atlanta, GA, USA, [3]Harvard University, Cambridge, MA, USA

Introduction: A small number of studies show that sleep enhances insight formation. The current study examined insight formation across a night of sleep or a day of wake using the Compound Remote Associates (CRA) task, in which subjects see a series of word triplets (e.g., fence-card-master), and attempt to generate a forth word that creates a two-word phrase or compound word with the three words. This task is similar to a task used in a previous study that saw a benefit of a daytime nap on insight formation.
Methods: Participants (24 undergraduate students; 13 Sleep) were trained on 50 CRAs at either 9AM or 9PM, and were retested 12hrs later. At retest, subjects were tested only on the incorrect items, and were given help (individual letters of the answer were slowly revealed) if an answer was not given within 10s.
Results: Sleep and Wake subjects performed similarly at training (30.5 v. 33.8% correct answers, p=.37). At 12hr retest we found that sleep and wake subject performance was similar across a number of number of variables, including percentage improvement with and without help (without help: +27.8 v. 22.4%, p=.44; with help: +92.8 v 99.4%, p=.70). The percentage of letters revealed with help was similar in both groups (p=.82), as were confidence ratings for correct responses at training (p=.85) and retest (p=.24).
Conclusion: While a few studies have shown that sleep can enhance insight formation, this may not always be the case, and may depend on a number of factors, including the nature of the insight task.

0250

CAN THE SLEEPING BRAIN DISCRIMINATE BETWEEN REWARDED AND NON-REWARDED INFORMATION?

Tucker MA[1], Tang S[4], Morgan A[3], Stickgold R[1,2,3]
[1]Harvard Medical School, Boston, MA, USA, [2]Harvard University, Cambridge, MA, USA, [3]Beth Israel Deaconess Medical Center, Boston, MA, USA, [4]SUNY Downstate College of Medicine, New York, NY, USA

Introduction: In a recent study we showed that sleep and monetary reward both enhance memory for visual paired associates, but that the two variables do not interact, when examined as between-subjects factors. In this study we examined whether the sleeping brain can simultaneously enhance memory for rewarded information and forgetting of unrewarded (i.e., non-essential) information. Participants were informed that in addition to the $10 they would be paid for participating, they would receive $2 for each correct answer they gave at retest on just one of two learned lists of picture pairs, which meant that they could earn up to $40.
Methods: Participants were 55 Harvard students (29 sleep; 31 rewarded on list 1) were trained at 9AM or 9PM on 2 lists of 15 visual paired associates (Face - Object picture pairs) each followed by an immediate test of memory. Retest occurred 12hrs later with lists presented in the same order.
Results: Overall, we found that a 12hr interval that contained a night of sleep benefited recall across all picture pairs, compared to a day of wakefulness (p=.002). However, the benefit of sleep was about the same for rewarded (p=.015) and unrewarded pairs (p=.005), yielding a non-significant sleep x reward interaction (p=.75).
Conclusion: Sleep benefits visual (i.e., pictorial) declarative memory performance. However, the reward value of the learned information has a similar non-significant effect across sleep and wake, which is in contrast to our previous finding of a robust effect of reward when looked at as a between-subjects variable. It appears that the sleeping brain does not discriminate between rewarded and unrewarded information, processing both types of information equally well.

0251

INTERFERING WITH THEORIES OF SLEEP AND PROBABILISTIC LEARNING

Barsky M[2], Tucker MA[1], Stickgold R[1,2]
[1]Harvard Medical School, Boston, MA, USA, [2]Harvard University, Cambridge, MA, USA

Introduction: Probabilistic learning is known to benefit following a full night of sleep, with the amount of REM sleep correlating with training performance. In the current study we examined the effect of a daytime nap, as well as the effect of interference learning, on probabilistic learning, using the weather prediction task (WPT).
Methods: Participants were 50 undergraduate students (26 Nap, 24 Wake; 26 No-Interference Training) who trained on the WPT at 11AM. At 2PM half the participants underwent interference learning (same probabilistic distribution with a different card set), following the nap/wake interval. All participants were retested using the original card set at 4PM. Performance was computed as the percentage of correct weather predictions at training and retest.
Results: Sleep and Wake subjects performed similarly at initial testing (80 v. 79% correct responses, p=.7). In the No-Interference condition At retest Nap subjects showed a significant 10% improvement relative to initial testing (p=.005), which was not seen in the Wake subjects (-1.4%; Nap-Wake difference, p=.008). Interestingly, interference training caused a near-significant drop in performance in the Nap group, compared to Nap subjects who did not learn the interference task (p=.06). The Wake subjects actually performed a bit better following interference training than No-Interference Wake subjects (p=.21)), with the Nap x Interference interaction reaching significance (p=.03). The amount of REM sleep during the nap correlated with improvement in weather prediction ability (r=.41, p=.04). No other sleep stages correlated with WPT improvement.
Conclusion: A nap benefits probabilistic learning compared to time spent awake, with REM sleep predicting greater task improvement. However, when interference training is introduced, post-nap performance suffers, while post-wake performance slightly improves, indicating that interference training may reactivate a probabilistic rule structure that had been consolidated by sleep, making the memory labile and thus more susceptible to the negative effects of interference.

0252

EXPLICIT SEQUENCE LEARNING AND THE ROLE OF SLEEP/TIME DEPENDENT CONSOLIDATION

Cousins JN, El-Deredy W, Parkes L, Lewis PA
School of Psychological Sciences, University of Manchester, Manchester, United Kingdom

Introduction: Procedural learning is thought to improve after a consolidation period containing sleep. However different tasks have produced conflicting results and it remains unclear whether consolidation produces immediate benefits, or instead facilitates new learning upon re-test. We predicted that the performance improvement on a Serial Reaction time task (SRTT) after a retention period containing sleep would be apparent immediately after retention, and would also extend to later blocks at re-test.
Methods: 40 participants were broken into a 24h group (N=20) with a 24 hour retention period containing sleep and an Immediate group (IM) (N=20) with just one hour of retention. Participants produced a button press in response to visual cues appearing in one of four screen locations. 9 blocks of 72 trials following a repeating 12-item sequence were performed at learning and again at re-test. A measure of reaction time (RT) improvement was obtained by comparing the last two blocks of

learning to the first two blocks of re-test (Early) or the last two blocks of re-test (Late).
Results: A mixed ANOVA with group (24h vs. Immediate) and Retest (Early vs Late) revealed a significant interaction between re-test and group, $F(1, 38) = 4.747$, $P<0.05$, while planned comparisons showed a significant difference in the amount of improvement between 24 hour and IM groups at the late test, $t(38)= 3.086$, $P<0.01$ but not at the early test, $t(38)= 1.091$, $P=.282$.
Conclusion: Procedural skill improvement associated with a longer retention period containing sleep was only apparent in later blocks of re-test, supporting the idea that overnight consolidation facilitates new learning rather than immediate skill improvement.

0253

THE EFFECT OF A SHORT NAP ON TASK SWITCHING PERFORMANCE

Kaida K, Takeda Y, Tsuzuki K
Human Technology Research Institute, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan

Introduction: Performance deterioration in task switching would be a concern for human error related accidents such as air traffic control. The aim of the study was to confirm the effect of a short afternoon nap (20 min) on task switching performance.
Methods: Sixteen participants (range 23-44 years old, 8 males) carried out a switching task after a nap or rest which was taken between 1400h and 1500h. Subjective fatigue was measured before and after the treatment. In the switching task, the participants had to judge whether a digit stimulus was odd or even, or whether it was larger or smaller than five. In a "pure block", the participants repeated the same task (i.e., a task-repetition trial). In a "mixed block", they performed two different tasks in a random order, namely a switch trial (task required a different strategy from the last trial) and a non-switch trial (same task was repeated). A cue that indicated the type of trial to perform on a subsequent stimulus was presented before each trial. "Switch cost" was calculated by subtracting reaction times in the non-switch trials from that in the switch trials. "Mixing cost" was calculated as differences in reaction time between the task-repetition trials and the non-switch trials. Switch and mixing costs are considered to represent executive and working memory functions in the brain, respectively.
Results: A short afternoon nap shortened only the switch cost (i.e., no significant result in the mixing cost) compared to the rest condition. Error rate and subjective fatigue were lower in the nap condition than in the rest condition ($ps < .05$).
Conclusion: The results suggest that a short afternoon nap improved executive brain function rather than working memory function. A short afternoon nap would be one of the useful countermeasures to reduce human errors related to task switching.

0254

LAUGH YOURSELF TO SLEEP: SLEEP AND MEMORY FOR POSITIVE HUMOROUS MATERIAL

Chambers A, Payne JD
Psychology, University of Notre Dame, Notre Dame, IN, USA

Introduction: Numerous studies have examined sleep's influence on emotional memory formation, but most of these studies have either focused solely on memory for negative material or have grouped positive and negative material together to investigate the differential impact of sleep on "emotional" versus neutral memory. Thus, the question of how sleep impacts positive memory formation remains unanswered. The present study investigated the role of humor as a strong positive emotional stimulus in sleep-dependent memory consolidation.
Methods: Participants (N=66) incidentally encoded 27 Farside cartoons that appeared in either their original humorous version or were altered into non-humorous control versions. Subjects freely recalled the cartoons following a 12-hour delay across a period of either wake or sleep.
Results: As expected, results indicate that humorous stimuli were rated significantly more positive ($F(2,63)=18.52$, $p<.001$) and arousing ($F(2,63)=86.35$, $p<.001$) than non-humorous material, supporting its use as a positive stimulus. Further, humorous material was better recalled overall, with subjects recalling more humorous cartoons than non-humorous ones ($F(2,59)=15.15$, $p<.001$). However, there were no differences in recall between the sleep and wake groups ($F(1,60)=.20$, $p=.653$). Interestingly, there was a between-group difference in ratings of how humorous ($F(1,64)=7.20$, $p<.01$) and how arousing ($F(1,64)=5.84$, $p=.019$) cartoons were, with the sleep group rating cartoons higher on both dimensions.
Conclusion: These results suggest that the short-term memory humor effect found in previous studies is robust across a 12-hour delay. The fact that sleep and humor did not interact may indicate that humor is a strong enough memory aid on its own, with little added benefit from sleep-dependent consolidation processes. Finally, differences in ratings of humor and arousal between the groups suggest a circadian effect on these aspects of humor, which could benefit from further research.

0255

THE EFFECT OF STRESS ON RAPID EYE MOVEMENT SLEEP, EMOTIONAL MEMORY TRADEOFF EFFECT, AND CORTISOL AWAKENING RESPONSE

Mattingly S[1], Payne JD[1], Cunningham T[1], Kensinger EA[2]
[1]Psychology, University of Notre Dame, South Bend, IN, USA,
[2]Psychology, Boston College, Chestnut Hill, MA, USA

Introduction: The brain selectively consolidates emotional memory over a night of sleep. This selection process is influenced by the valence and arousal of the information presented and the state of the brain. In previous experiments, we have shown an emotional memory "trade-off effect", a selective preservation for negative objects at a cost to the backgrounds they appear on compared to neutral objects and backgrounds. However, it is not known how stress exposure and cortisol elevation during the consolidation process affect such trade-offs after a night of sleep, or how stress affects the cortisol awakening response (CAR). Because previous studies demonstrated that stress exposure benefits negative information while impairing neutral information, we predict that stress exposure following encoding will produce a larger benefit for negative objects and greater cost to the neutral backgrounds on which they appear after a night of sleep, increase REM sleep, and modulate the CAR.
Methods: After a stressor or matched control, participants viewed negative and neutral objects embedded in backgrounds while saliva samples were collected. After a night of polysomnography (PSG) monitored sleep, a surprise recognition task consisting of objects and backgrounds divorced from each other was administered.
Results: Pending PSG and cortisol analysis, behavioral data yields a trend of condition on scene component, $F(1,21)=3.553$, $p=.073$, over a night of sleep. Surprisingly, stress did not target negative emotional objects or impair neutral backgrounds they appear on. Instead, in the stress condition, both negative $F(1,9) = 93.07$, $p < .001$, and neutral $F(1,9) = 4.334$, $p = .067$ objects were preferentially recognized compared to their backgrounds.
Conclusion: Counter to predictions, these findings suggest that post-encoding stress exposure creates general tradeoffs in memory, irrespective of valence. This may be useful in stressful situations where the next potential danger is unknown but expected, e.g. soldiers on patrol.

0256

CROSS-MODAL TRANSFER OF ABSTRACT STATISTICAL STRUCTURE BENEFITS FROM SLEEP

Durrant SJ[2,1], Cairney SA[1], Lewis PA[1]
[1]School of Psychological Sciences, University of Manchester, Manchester, United Kingdom, [2]Psychology, University of Lincolin, Lincolin, United Kingdom

Introduction: Recent studies have demonstrated that sleep is beneficial for extracting the essential structure or 'gist' from a set of stimuli. To date, this has been demonstrated only within a single modality. Here, we extend this work with overnight sleep monitoring and functional magnetic resonance imaging (fMRI) to demonstrate for the first time that sleep is directly involved in the transfer of abstract statistical structure from one modality to another.
Methods: 36 Participants were exposed to a statistically structured sequence of 1818 auditory tones, then tested immediately for recognition of 18-tone auditory sequences which conformed to the learned statistical pattern. Subsequently, after consolidation over thirty minutes or twenty-four hours, they were tested again with fMRI monitoring. The fMRI session included a set of 84 analogous visual test sequences in which the vertical position of visual stimuli corresponded to the pitch of an equivalent auditory sequence. Random auditory tones were played during the visual tests to prevent auditory imagery.
Results: Behaviourally, successful transfer of the statistical information from the auditory to the visual domains took place only after twenty-four hours of consolidation, and this transfer was predicted by the amount of slow wave sleep (SWS) obtained during the night. Functionally, we observed decreased hippocampal responses and increased striatal responses after sleep.
Conclusion: Taken together, these findings suggest that cross-modal transfer of abstract statistical information is associated with a gradual shift from the hippocampal to the striatal memory system and that this may be mediated by SWS.
Support (If Any): Work was supported by a BBSRC New Investigator Grant to PL.

0257

DOES SLEEP PREVENT INTERFERENCE AND ENHANCE VISUAL STATISTICAL LEARNING?

McDevitt EA[1], MacKenzie KJ[2], Fiser J[3,4], Mednick SC[1]
[1]Department of Psychology, University of California, Riverside, Riverside, CA, USA, [2]Neuroscience Program, Brandeis University, Waltham, MA, USA, [3]Volen Center for Complex Systems, Brandeis University, Waltham, MA, USA, [4]Department of Psychology, Brandeis University, Waltham, MA, USA

Introduction: Rapid learning of statistical regularities in the environment is important for language learning and the formation of schemas. A recent study of auditory statistical learning found sleep-related enhancements that were correlated with slow wave sleep duration. We examined the role of sleep in stabilization and consolidation of visual statistical learning (VSL). We asked 1) is VSL blocked by introducing multiple learning rules within close spatial and temporal proximity using an interference paradigm? And 2) can a nap between interfering conditions stabilize and consolidate the learning rules?.
Methods: 169 healthy subjects (age=20.2±2.24yrs) completed four VSL tasks. In each task, scenes were composed of simple shapes arranged by certain statistical regularities. Subjects passively viewed four learning blocks (A-D), each containing scenes composed of different shapes with distinct regularities. Blocks A and B were presented sequentially, and blocks C and D were separated by a period which subjects either took a nap (without REM(NREM), n=47; with REM, n=39) or remained awake (active wake(AW), n=48; quiet wake(QW), n=35). Familiarity of learning rules was tested following learning of block D. We conducted two repeated-measures ANOVA with group (AW, QW, NREM, REM) as the between-subjects variable and block sequence (A-B or C-D) as the within-subjects variable.
Results: We found no differences in performance between blocks A and B, however there were differences between blocks C and D (p=.013). Post-hoc t-tests showed the REM group performed significantly better on block D than block C (p=.002).
Conclusion: We did not find evidence of VSL interference between two sequential blocks, suggesting subjects can learn multiple statistical rules that overlap in both space and time without confusion. Sleep did not provide any benefit to familiarity of statistical rules learned prior to the nap. However, subjects with REM sleep showed superior post-nap VSL, indicating that REM sleep may enhance acquisition of new learning rules.

0258

TASK REACTIVATION DURING SLEEP ENHANCES PERFORMANCE

Bos MW[1], Ritter SM[2], Strick M[2], Van Baaren RB[2], Dijksterhuis A[2]
[1]Negotiation, Organizations & Markets, Harvard Business School, Boston, MA, USA, [2]Behavioural Science Institute, Radboud University Nijmegen, Nijmegen, Netherlands

Introduction: Sleep facilitates performance on a variety of tasks. We investigate whether the beneficial effect of sleep on performance can be actively enhanced by covertly reactivating the performance task during sleep. For this reactivation we used a scent as cue.
Methods: Individuals' performance was compared after three different conditions: sleep with conditioned odor, sleep with control odor, or sleep with no odor. In the sleep with conditioned odor condition, task reactivation during sleep was induced by means of an odor which was also presented while participants were informed about the performance task in the evening prior to sleep. Participants in the sleep with control odor condition were exposed to a different odor during sleep than the one diffused during task presentation. In the no odor condition, no odor was presented.
Results: After a night of sleep with the conditioned odor, participants were found to perform better than participants who had been exposed to a control odor or no odor while sleeping.
Conclusion: These findings indicate that task reactivation during sleep can actively improve task-related processes during sleep and boost the beneficial effect of sleep on performance.

0259

"REMEMBER LAST NIGHT?": NOCTURNAL AWAKENING DURATION NECESSARY FOR MORNING RECALL IN NEW MOTHERS

Winser MA, Montgomery-Downs H
Psychology, West Virginia University, Morgantown, WV, USA

Introduction: Our previous work with nulliparous females showed that in order to be remembered the next morning, nocturnal awakenings must last an average of 4.5 minutes. However, large variability in individuals' awakening length needed for morning recall suggests that other factors such as sleep disturbance likely influence memory for awakenings. Since postpartum sleep disturbance provides an opportunity for naturalistic assessment of this phenomenon, and also because insight into their own sleep disturbance may be important for postpartum mothers, the goal of this study was to determine memory for nocturnal awakenings among this population.
Methods: Forty-four primiparous women (27 years, 89% white, 16 years of education) each wore an actigraph during postpartum weeks 2 through 12. Each morning, within two hours after awakening, participants self-reported their number of awakenings using an electronic Personal Digital Assistant. For each participant, the precise duration of an awakening in order to report it the next morning was determined by comparison of self-reported number of awakenings to their raw actigraphy data. Postpartum women's awakening thresholds were compared to

27 nulliparous controls (28 years, 100% white, 19 years of education) from a previous study, each of whom wore an actigraph for one week.
Results: Mean awakening duration threshold improved from postpartum week 2 (10.4m, SD±5.1m) to week 12 (7.2m, SD±5.1m; p<.001, d=.64). However, postpartum thresholds were significantly longer than controls (4.8m, SD±2.2m) at both week 2 (p<.001, d=1.43) and week 12 (p<.01, d=.63).
Conclusion: Compared to controls, postpartum women's memory for awakenings is impaired throughout the first 3 months postpartum, but improves significantly from week 2 to week 12. Longer durations of awakenings necessary for recall among postpartum women are potentially indicative of neurocognitive disturbance during the postpartum period. These findings also provide insight into discrepancies between objective and subjective reports among sleep-disturbed populations.
Support (If Any): Funding provided by NIH grant R21HD053836 (HMD).

0260

THE EFFECT OF RAPID-EYE-MOVEMENT SLEEP ON THE EMOTIONAL MEMORY TRADE-OFF EFFECT, CORTISOL AWAKENING RESPONSE, AND PSYCHOPHYSIOLOGICAL REACTIONS TO NEGATIVELY RATED SCENES

Cunningham T, Payne JD
Clinical Psychology, University of Notre Dame, Notre Dame, IN, USA

Introduction: Previous studies suggest that a night of sleep preferentially benefits memory for negative, relative to neutral, stimuli. Our lab has shown that negative objects are well-remembered compared to the neutral backgrounds on which they are placed, while neutral objects and backgrounds are remembered equivalently. This preferential reinforcement of negative arousing stimuli is known as an "emotional memory trade-off effect", and it has been shown to increase after periods of sleep.
Methods: In the current study, we asked participants to rate both negative and neutral scenes on their valence and arousal during encoding. Moreover, we collected heart rate and galvanic skin responses during encoding and recognition of the images, in order to match subjective ratings to each participant's physiological reaction. Post-encoding, the sleep group underwent an overnight polysomnograph (PSG) recording and was asked the following morning to provide saliva samples at 15 minute intervals to examine cortisol concentrations and the Cortisol Awakening Response (CAR).
Results: Behavioral results demonstrate an interaction between picture valence (negative vs. neutral) and description (object vs. background) with F(1,36)=62.14, p<.001, suggesting that emotional objects are preferentially remembered at the expense of their backgrounds, as well as a trend toward a 3-way interaction with group (sleep vs. wake) suggesting an intensified effect in the sleep condition.
Conclusion: Pending physiological analysis, cortisol assay, and PSG results, we predict that increased measures of rapid-eye-movement (REM) physiology will correspond with an increased CAR, as well as the magnitude of the emotional memory trade-off effect at recognition, and that a night of sleep will alter physiological reactions between encoding and recognition for negative stimuli, serving to blunt one's physiological emotional reaction to previously viewed negative stimuli.

0261

SPINDLES INCREASED DURING SLOW WAVE SLEEP IN NAP AFTER JUGGLING PRACTICE

Morita Y[1,2], Ogawa K[3], Nakashima Y[4], Tomita T[4], Uchida S[5]
[1]Graduate School of Sport Sciences, Waseda University, Tokorozawa, Japan, [2]Research Fellow of Japan Society for the Promotion of Science, , Chiyoda-ku, Japan, [3]Faculty of Integrated Arts and Sciences, Hiroshima University, Higashi Hiroshima, Japan, [4]Life Science Laboratory, Sony Corporation, Bunkyo-ku, Japan, [5]Faculty of Sport Sciences, Waseda University, Tokorozawa, Japan

Introduction: Past studies have presented that beneficial role of sleep in motor memory consolidation. However, a question arises whether the real whole body sport performance was improved by sleep. To answer the question, it is essential to examine similar task to real sport skill acquisitions. Thus, the purposes of this study is to examine whether the whole body movement learning could be enhanced by sleep. Additional purpose of this study is to investigate which sleep EEG component is directly related to this memory consolidation process.
Methods: Subjects were 16 female college students. They were divided into nap group and control group. All subject practiced juggling for 15min, and juggling technique was evaluated at 10:30. Nap group took a 2h nap from 14:00 while control group stayed awake. Both groups retested juggling at 17:30. One week before these experiments, nap group had taken 2h nap in the same environment as a baseline nap condition. Sleep EEG was recorded at 7 scalp sites (Fz, Cz, Pz, POz, Oz, C3, C4). EEG was subjected to fast Fourier transform analysis (FFT). Spindles were detected automatically using spectral analysis technique and image analysis technique.
Results: Only nap group improve the juggling performance after 2h nap ($p < .001$). Compared to the baseline nap, slow wave sleep (SWS) duration was significantly increased after motor learning ($p < .05$). FFT revealed that slow oscillation (0.3-1.0Hz) power and sigma EEG (12-16Hz) power significantly increased during SWS after motor learning. Number of spindles during SWS increased in nap after motor learning compared to baseline.
Conclusion: Sleep facilitates memory consolidation in three-ball cascade juggling. Our results suggested that increasing slow oscillation and spindle activities during SWS are related to the motor memory consolidation process.

0262

SLOW-WAVE MEG ACTIVITY IN PRIMARY VISUAL CORTICAL AREA DURING SLEEP AFTER VISUAL PERCEPTUAL LEARNING: THE ROLE OF SLEEP IN VISUAL PERCEPTUAL LEARNING

Khalilzadeh O[1,2], Bang J[2], Wakeman DG[1], Tamaki M[3], Hämäläinen M[1], Watanabe T[2], Sasaki Y[1]
[1]Radiology, Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, USA, [2]Vision Sciences Laboratory, Boston University, Boston, MA, USA, [3]Neuroinformatics, Advanced Telecommunications Research Institute International, Kyoto, Japan

Introduction: The underlying neural mechanism for the role of sleep in memory and learning is not completely understood. The aim of this study was to better clarify the mechanisms for the facilitatory effect of sleep on visual perceptual learning. We used a multimodal neuroimaging technique that combines magnetoencephalography (MEG) and magnetic resonance imaging (MRI) to measure fine-scaled spatio-temporal neural activity during sleep after training of texture discrimination task (TDT). A leading hypothesis suggests that the slow wave activity (SWA) during the sleep period is involved in the facilitatory effect. Since TDT is associated with changes in the region of the primary visual area (V1) that retinotopically corresponds to the trained visual field quadrant, we

tested whether the strength of SWA in V1 is correlated with the facilitatory learning effect during sleep on TDT.
Methods: Young and healthy participants underwent a MRI session after 4 nightly MEG sessions including 2 adaptation nights, pre-training, and post-training sleep. Before the post-training sleep, TDT was conducted twice; more training in one visual field quadrant and less training in another quadrant. After the post-training sleep, we conducted a re-test of TDT. Wavelet-transformed MEG during sleep was combined with high-resolution MRI to constrain the current locations to the cortical mantle individually. Based on the retinotopic mapping, we localized the 2 cortical quadrants that retinotopically corresponds to the more and less trained visual field quadrants in V1 and measured the strength of SWA in those areas.
Results: We showed that SWA in the trained V1 was markedly stronger in the post-training sleep compared to the pre-training sleep, and the SWA strength in each cortical quadrant was correlated with the performance improvement in each visual field quadrant.
Conclusion: The results suggest the feasibility of the hypothesis that the SWA is involved in the consolidation of TDT during sleep.
Support (If Any): Supported by NIH (R21EY018925, R01EY015980, R01EY019466, R01AG031941, R01MH091801), NSF (BCS-0964776), NCRR (P41RR14075, S10RR021110) and the Athinoula A. Martinos Center for Biomedical Imaging.

0263

SLEEP-DEPENDENT MEMORY CONSOLIDATION DURING SLEEP RESTRICTION: ASSOCIATION WITH SLOW WAVE AND THETA ACTIVITY

Hall-Porter JM, Schweitzer PK, Walsh JK
Sleep Medicine and Research Center, St. Luke's Hospital, St. Louis, MO, USA

Introduction: Evidence suggests that even brief periods of sleep facilitate memory consolidation. We examined sleep-dependent memory consolidation (SDMC) on declarative and procedural memory tasks during sleep restriction and the relationship between SDMC and EEG spectral power.
Methods: Following screening and baseline nights of 8-9 hours of sleep, twenty-one subjects (12F, 9M; mean age=26.8±8.3) underwent two consecutive nights without sleep, each followed by a 3-hour daytime (0800-1100) nap. EEG spectral power was obtained for all sleep periods. Training/initial testing on a declarative word pair task (WPT) and a procedural finger-tapping task (FTT) was conducted 60 minutes prior to each daytime nap. Retest occurred 5 hours later each day. SDMC was measured as the change from initial testing to retest (WPTΔ and FTTΔ). Spectral power, WPTΔ, and FTTΔ on sleep restriction Days 3 and 4 were averaged and expressed relative to baseline.
Results: Mean WPTΔ and FTTΔ during sleep restriction were 4.3 and 4.1, respectively. There was a positive correlation between relative-to-baseline WPTΔ and SWA (r=0.716, p=0.000) and theta power (r=0.477, p=0.029). No significant association was seen with sigma power and WPTΔ. There were no significant correlations between SDMC and power in any spectral band for FTT.
Conclusion: These data indicate that, even during a period of sleep restriction, improvement in memory is evident on a declarative and procedural task. Further, there is a positive relationship between SDMC on the WPT and SWA, as well as with theta power. This suggests that SWA and theta activity are important for declarative memory consolidation during sleep restriction.

0264

THE EFFECTS OF COGNITIVE REAPPRAISAL ON CONSOLIDATION OF EMOTIONAL MEMORY OVER SLEEP

Stare C[1], Payne JD[1], Kensinger EA[2]
[1]University of Notre Dame, Notre Dame, IN, USA, [2]Psychology, Boston College, Chestnut Hill, MA, USA

Introduction: Over periods of sleep, emotional memories are preferentially enhanced and consolidated over emotionally neutral ones. This aspect of memory consolidation has been observed in the "trade-off effect," in which memory of emotional objects is retained at the expense of information about the neutral backgrounds upon which the objects were presented. This effect has been shown to increase in potency after periods of sleep. Previous studies have examined cognitively upregulating and downregulating emotional responses as stimuli are presented in an effort to modulate this trade-off effect in memory tasks. However, the results indicated that both upregulating and downregulating emotional responses diminished this trade-off. We hypothesize that due to sleep's preferential treatment of emotional memories, cognitive reappraisal upon encoding may lead to increases and decreases in trade-off effects in memory for upregulated and downregulated stimuli, respectively, given a night of sleep for consolidation.
Methods: Participants were presented with images of neutral and emotional objects superimposed on neutral backgrounds, and they were given instructions to increase or decrease their emotional reaction to certain stimuli by creating a different mental contextual framework. They were then given a surprise recognition task after either 12 hours of wakefulness or 12 hours containing sleep.
Results: Despite the presence of the trade-off effect for emotional content, the current results do not show any significant interaction between sleep, view condition, and trade-off effect. Interestingly, however, there is a trend for greater memory of emotional objects $F(1,55)=3.044$, $p=.087$ and backgrounds $F(1,55)=3.624$, $p=.062$ in the emotional upregulation condition.
Conclusion: These findings suggest that current methods of cognitive reappraisal may not be an effective means of modulating emotional memory consolidation, regardless of sleep presence. However, the increases in overall performance in the upregulation condition over sleep raises interesting questions about sleep's role in consolidating memory for stimuli that have been specifically mentally attended to.

0265

BRAIN NETWORK STRUCTURES IN NON-REM SLEEP AND WAKE ARE OPTIMIZED FOR DIFFERENT FUNCTIONS

Sheth B[1,2], Wu WR[1]
[1]Electrical and Computer Engineering, University of Houston, Houston, TX, USA, [2]Center for Neuroengineering and Cognitive Science, University of Houston, Houston, TX, USA

Introduction: In wake, the brain integrates sensory data with existing short-term memory and is generally aware of the environment. In contrast, during sleep, sensory processing continues but without awareness, and offline mechanisms consolidate new memories. What properties of the brain distinguish non-REM sleep from wakefulness that could underscore these intrinsic differences in sensory processing? Global network structure, studies show, is a promising candidate to address this issue.
Methods: Cortical activity in stage 2 sleep and wake were recorded using 64-channel electroencephalography (EEG) in nine young adults. A pure tone was played about every 3 seconds throughout the recording. Functional corticocortical connectivity in (pre-stimulus) baseline and following the onset of the auditory stimulus was measured using cross-correlation and phase-lag index (PLI), and graph theoretic measures of global network structure were computed.
Results: Cross-correlation analysis reveal that in wake, but not in stage 2 sleep, different brain regions - in particular, the frontal areas - interact

at latencies of 50 ms in all our participants. Second, PLI measures show that auditory stimulation significantly perturbs brain networks, namely delta and theta connections, in sleep, but leaves the network in wake undisturbed. Third, graph theoretic analysis demonstrates significant differences in the alpha band (8-13 Hz): Baseline alpha networks in sleep, as compared to those in wake, were three-fold more cliquish as indicated by the higher values of the clustering coefficient; this accounts for their significantly greater small-world like nature. Auditory stimulation altered network structure as compared to baseline, but the pattern of differences in network structure between the two states was left intact.
Conclusion: Enhanced small-world like nature and redundancy of the alpha network in non-REM sleep are characteristics of a brain network that are suited for homeostasis and the consolidation of new learning, a role previously proposed for both sleep and alpha rhythms. Network stability to environmental perturbation and oscillatory interactions between the frontal region and the rest of the cortex are network characteristics suited for reliable sensory processing, sensory awareness, and the integration of *de novo* information into working memory.

0266

TASK DEPENDENT REORGANIZATION OF HIPPOCAMPAL MAP IS ENHANCED BY SLEEP

Sergeeva A, Cooper S, Poe GR
Anesthesiology, University of Michigan, Ann Arbor, MI, USA

Introduction: REM sleep is important to hippocampus-dependent learning. We tested the hypothesis that the sleep period just after introduction of a novel set of reward positions in a familiar maze would be important to the learning related reorganization of the spatial map.
Methods: Long Evans rats were pretrained on an 8-box octagonal maze for food reward in three of the eight box positions. The task was made hippocampal dependent by randomizing the start position and rotating the maze every 5 laps such that new boxes held food in the same room positions. Microdrive with 16 tetrodes was implanted in the CA1 and CA3 cell body layers. On the day of the experiment the rats were run for 15 laps on the familiar task and allowed to sleep for another 2 h. They were rerun on that familiar task for another 15 laps and then the positions of the baited boxes were changed (reversal task) and the rats run on this novel configuration for the next 15 laps. Rats were allowed to sleep another 2 h, and then were retested on the novel reversal maze configuration for a final 15 laps. Cells that could be traced for the entire recording session were analyzed for their place-specific activity on the maze and their firing during sleep.
Results: We found that the number of place fields in the CA1 subfield of the hippocampus (but not CA3) increased by 1/3rd after the reversal but doubled in number after the post reversal sleep period. As expected, the amount of REM sleep also increased in the post-reversal vs. pre-reversal sleep periods.
Conclusion: Therefore we conclude that sleep served to increase the resolution with which the rats mapped the maze when the task required identifying new positions within a familiar environment.

0267

EFFECTS OF ACUTE SLEEP LOSS ON DFABP EXPRESSION AND DFABP-INDUCED LONG-TERM MEMORY IN DROSOPHILA

Gerstner JR[1], Lenz O[1], Chan MT[1], Zimmerman J[1], Jerry YC[2,3], Pack A[1]
[1]Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [2]Genetics, University of Wisconsin, Madison, WI, USA, [3]Neurology, University of Wisconsin, Madison, WI, USA

Introduction: Fatty-acid binding protein (Fabp) gene expression has previously been shown to follow a diurnal rhythm in flies and rodents, with elevated levels during periods of sleep. Baseline levels of sleep are reduced in transgenic flies carrying Fabps, while chronic Fabp induction augments daytime sleep, and improves long-term memory (LTM) performance. Importantly, these effects persist even when Fabps are induced during late-periods of consolidation following training. This suggests changes in behavioral state during various stages of memory formation (learning, consolidation, retrieval) are able to differentially influence performance. Therefore we examined the effects of altering sleep on Fabp levels and performance in Fabp-induced LTM formation.
Methods: Microarray data was mined from flies subjected to 0, 2, 4, and 6hr sleep deprivation by gentle handling for changes in the endogenous Drosophila fatty-acid binding protein (dFabp) transcript levels. Sleep was assessed according to standard procedures in wild-type background strain and compared to transgenic (-tg) flies over-expressing either dFabp or the mouse Fabp7, using the Drosophila Activity Monitoring System (DAMS) developed by Trikinetics (Waltham, MA). Drosophila learning and memory was tested using automated and repetitive training regimens of the olfactory-avoidance classical conditioning protocol, with 3-octanol (OCT) and 4-methylcyclohexanol (MCH) odors.
Results: Following acute sleep deprivation, dFabp mRNA levels decrease with successive sleep loss. Following LTM training, wild-type flies show an experience-dependent increase in sleep not observed in dFABP-tg and Fabp7-tg flies. LTM enhancement in dFabp-tg and Fabp7-tg flies is resistant to short-term (4hrs) but sensitive to long-term (12hrs) sleep deprivation during the sleep phase after training.
Conclusion: This evidence suggests a relationship between lipid-binding protein signaling and sleep homeostasis, and that sleep disruption during specific temporal windows following training can influence Fabp-dependent LTM performance.
Support (If Any): NIH T32HL07713.

0268

BLOCKING THE PHOSPHODIESTERASE ISOFORM PDE4A5 IN THE HIPPOCAMPUS AMELIORATES PLASTICITY AND MEMORY DEFICITS INDUCED BY BRIEF SLEEP DEPRIVATION

Havekes R[1], Choi JH[1], Bruinenberg V[1,2], Baillie G[3], Park A[1], Day J[3], Aton S[4], Meerlo P[2], Houslay M[3], Abel T[1]
[1]Department of Biology, University of Pennsylvania, Philadelphia, PA, USA, [2]Department of Behavioral Physiology, University of Groningen, Groningen, Netherlands, [3]Molecular Pharmacology Group, University of Glasgow, Glasgow, United Kingdom, [4]Department of Neuroscience, University of Pennsylvania, Philadelphia, PA, USA

Introduction: We previously showed that 5 hours of sleep deprivation led to elevated hippocampal protein levels of PDE4A5 and an increase in PDE4 activity. This increase resulted in an attenuation of the cAMP pathway in the hippocampus. However, it has not been determined whether the elevated hippocampal PDE4A5 levels and activity are the key mediator of the memory and plasticity deficits observed after brief sleep deprivation.
Methods: We used Adeno Associated Viruses to locally express either of the following transgenes in excitatory neurons of the hippocampus: 1) wild-type PDE4A5 (PDE4A5WT), 2) a catalytically inactive dominant negative form of PDE4A5 (PDE4A5DN), or 3) enhanced green fluorescent protein (eGFP). Mice bilaterally injected with eGFP virus into the hippocampus served as controls. Four weeks after the bilateral injection of AAV, mice were trained in hippocampus-dependent or hippocampus-independent learning paradigms. From a different cohort of mice, tissue from the hippocampus and other brain regions was collected for biochemical and electrophysiological studies.
Results: Overexpression of PDE4A5WT impaired long-term memory formation in hippocampus-dependent contextual fear and object-location memory tasks, but not hippocampus-independent learning tasks. Furthermore, overexpression of PDE4A5WT impaired forskolin-mediated potentiation in hippocampal CA1 Schaffer collaterals mimicking the effects of brief sleep deprivation. Overexpression of the PDE4A5DN selectively in the hippocampus ameliorated the sleep deprivation-in-

duced memory deficits in the hippocampus-dependent object-location memory task. Overexpression of the PDE4A5DN did not affect memory formation under non-sleep deprivation conditions.
Conclusion: These findings show that increasing PDE4A5 activity selectively in the hippocampus is sufficient to induce memory and plasticity impairments as observed with brief sleep deprivation. In addition, these results indicate that blocking hippocampal PDE4A5 function in the hippocampus is sufficient to ameliorate cognitive deficits induced by 5 hours of sleep deprivation. Together, these studies may lead to novel therapeutic strategies to ameliorate the cognitive deficits observed after sleep loss.
Support (If Any): This research was supported by the Netherlands Organization for Scientific Research NWO-Rubicon Grant 825.07.029 (to R.H.), NIA (5P01AG017628-09 to TA; Principal Investigator Allan Pack), and NIMH (RO1 MH086415-01 to T.A.).

0269

DIFFERENCES IN MEMORY AND RAPID EYE MOVEMENT SLEEP BETWEEN BROWN NORWAY AND ZUCKER LEAN RATS

Fink AM[1,2], Topchiy I[1,3], Ragozzino M[4], Amodeo DA[4], Dokic M[1,5], Radulovacki M[1,5], Carley DW[1,2,3]
[1]Center for Narcolepsy, Sleep and Health Research, University of Illinois at Chicago, Chicago, IL, USA, [2]Department of Biobehavioral Health Science, College of Nursing, University of Illinois at Chicago, Chicago, IL, USA, [3]Department of Medicine, University of Illinois at Chicago, Chicago, IL, USA, [4]Department of Psychology, University of Illinois at Chicago, Chicago, IL, USA, [5]Department of Pharmacology, University of Illinois at Chicago, Chicago, IL, USA

Introduction: Rapid eye movement (REM) sleep may influence learning and memory consolidation. We hypothesized that REM sleep and apneas are associated with learning in Brown Norway (BN, N = 7) and Zucker Lean (ZL, N = 7) rats.
Methods: Rats underwent 6-day Morris water maze (WM) testing. The location of the platform was changed on Day 4 to test reversal learning. We calculated average daily latency (time to locate platform). Rats underwent daily 6-hour polysomnography (PSG). We computed averages for all available PSG parameters in each rat. We compared latency, sleep, and apnea between the strains (t-tests, repeated measures ANOVA; data are mean ± SEM).
Results: BN rats slept significantly longer (sleep efficiency: 64.2% ± 2.6 [BN], 54.7% ± 1.3 [ZL], $\rho = .02$) than ZL rats. The percent of sleep time in REM was greater in BN rats as well (14.1% ± 0.7 [BN], 10.1% ± 0.9 [ZL], $\rho = .01$). In addition, BN rats had a higher frequency of apneas during sleep (17.4 ± 1.1 apneas/hour [BN], 8.8 ± 2.3 apneas/hour [ZL], $\rho = .004$) and particularly during REM sleep (28.1 ± 1.9 apneas/hour [BN], 13.5 ± 2.5 apneas/hour [ZL], $\rho = .001$). In learning (Day 1 and Day 4), BN rats learned more slowly than ZL rats, and this was especially evident after controlling for REM sleep ($F = 15.2$, $\rho = .004$). Sleep efficiency and apneas were not found to be significant independent covariates.
Conclusion: BN rats exhibited longer sleep, increased REM, and higher apnea frequency compared to ZL rats. Increased REM sleep may reflect a compensatory response to more frequent apneas in BN rats. Because the quality and quantity of REM sleep may directly influence learning and memory, our findings suggest that the impact of apnea on these functions may be significantly mediated by alterations in REM sleep.
Support (If Any): Chancellor's Discovery Fund (University of Illinois at Chicago); National Institute on Aging (R01AG016303).

0270

AN NMDA RECEPTOR AGONIST BOOSTS SLEEP-INDEPENDENT SYNAPTIC PLASTICITY ASSOCIATED WITH ENHANCEMENT OF WORKING MEMORY CAPACITY

Kuriyama K, Honma M, Yoshiike T, Kim Y
Department of Adult mental Health, National Institute of Mental Health, National Center of Neurology and psychiatry, Japan, Kodaira, Japan

Introduction: Although working memory (WM) capacity improvement is impacted by sleep, andN-methyl-D-aspartate (NMDA) receptor antagonists suppress sleep-dependent memory processing, it is not well known how sleep and NMDA receptor agonists affect WM performance improvement, respectively.
Methods: In order to investigate the neural basis underlying relationships between WM skill learning and sleep, D-cycloserine (DCS), which is a NMDA receptor partial agonist, and both sleep and DCS together, we evaluated training-retest performance of n-back task in healthy subjects who were given either with wakefulness or sleep.
Results: All subjects showed improved WM capacity over successive n-back test trials. Among subjects retested 24 hours after the training session, greater WM capacity improvements occurred when individuals were treated with DCS rather than placebo. Among subjects retested 12 hours after the training session, who received only a placebo, greater improvements in task performance were observed when training session was followed by sleep rather than a period of wakefulness. However, among those who received DCS, greater improvements in task performance were observed only when the training session was followed by a period of wakefulness.
Conclusion: Results indicate that WM capacity enhancement is affected by disparity in synaptic plasticity between sleep and wakefulness. Further, these findings suggest potential methods for improvement general fluid intelligence, which is necessary in human for problem-solving activities, and may also influence learning, anti-aging processes, and rehabilitation of higher cognition.

0271

HYPNOTIC MEDICATIONS AND SLEEP-DEPENDENT MEMORY CONSOLIDATION

Hall-Porter JM, Schweitzer PK, Walsh JK
Sleep Medicine and Research Center, St. Luke's Hospital, St. Louis, MO, USA

Introduction: Sleep-dependent memory consolidation (SDMC) has been observed with declarative and procedural memory tasks. The objective of this study was to determine if the portion of the night during which drug is active affects SDMC.
Methods: Twenty-two healthy individuals (14F, 8M; age=29.4+/-6.7) with no sleep complaints participated in a crossover study. Conditions were counterbalanced across three overnight visits, separated by a 1-week washout: 1) zolpidem-ER 12.5mg at bedtime and placebo 3.5 hours later, 2) placebo at bedtime and zaleplon 10mg 3.5 hours later, and 3) placebo at bedtime and 3.5 hours later. Before bedtime, subjects completed training/initial testing on a word pair associates task (WPT; declarative memory) and a finger-tapping task (FTT; procedural memory). A retest was conducted 10.5 hours later, approximately 1 hour after morning wake time. SDMC was measured as the change from initial test to retest. Both raw change and percent change were evaluated.
Results: Repeated-measures MANOVAs (dependent variables: WPT and FTT) showed a significant effect of condition on SDMC, for both absolute change ($p=0.046$) and percent change ($p=0.023$). FTT absolute change and percent change were lower with zolpidem-ER (1.5; 8.0%), compared to zaleplon (2.8, $p=0.015$; 14.4%, $p=0.023$) and placebo (2.6, $p=0.041$; 15.4%, $p=0.018$). WPT absolute change and percent change were also lower with zolpidem-ER (3.4; 16.1%), compared to zaleplon (4.2, $p=0.044$; 19.1%, $p=0.016$) and placebo (4.2, $p=0.016$; 19.5%,

p=0.008). There were no statistical differences between zaleplon and placebo.
Conclusion: SDMC was reduced with zolpidem-ER, which was likely active during the majority of the sleep period. However, with middle-of-the-night zaleplon and a prior drug-free period of sleep, SDMC occurred at a magnitude similar to placebo. These data suggest that a period of drug-free sleep may be important for SDMC. Short-acting drugs that allow some drug-free sleep to occur may interfere less with SDMC than longer-acting drugs.
Support (If Any): American Sleep Medicine Foundation, Strategic Research Award.

0272

THE INDEPENDENT EFFECTS OF SLEEP DURATION AND MODERATE ALCOHOL INTAKE ON IMPAIRED COGNITION

Nash MC, Schwartz SW, Craig B
Epidemiology and Biostat, University South Florida, Temple Terrace, FL, USA

Introduction: Both short and long sleep duration have been associated with cognitive impairment. Moderate alcohol use is reportedly protective against cognitive impairment. We hypothesized that sleep duration would be associated with moderate alcohol intake and would partially explain the protective association seen between moderate alcohol use and cognitive impairment.
Methods: We used data (N=3,072) from the 2007-2008 NHANES population. Participants were asked if they were "limited in any way because of difficulty remembering." Short sleep duration was defined as less than 6 hours/night and long sleep was defined as 9+ hours/night. Moderate alcohol consumption was defined as 1-2 drinks/day. We excluded heavier drinkers. We included adults 21+ years with no history of stroke. Logistic regression was used to adjust odds ratios for demographics, BMI, cardiovascular risk factors, and physical activity.
Results: 209 people reported limitations due to memory problems. Our cohort was middle age (mean=52.6 years), female (60.5%) and tended to be white (46.9%) or Hispanic (25.7%). Moderate alcohol consumption was associated with lower cognitive impairment versus no alcohol consumption (OR =0.55, 95% CI =0.41-0.74). Likewise both short sleep (OR=2.53, 95% CI=2.00-3.19) and long sleep (OR=2.81, 95% CI=2.04-3.86) were significantly positively associated with cognitive impairment, and inversely associated with moderate alcohol consumption. After adjusting for sleep duration, the protective effect of moderate alcohol consumption on cognitive impairment was almost unchanged (OR=0.55, 95% CI=0.41-0.74 vs. OR=0.52, 95% CI=0.39-0.70, unadjusted for sleep). Fully adjusted ORs for cognitive impairment were almost identical to crude ORs (short sleep OR=2.59, 95% CI=1.82-3.69, long sleep OR=2.62, 95% CI=1.67-4.10, and moderate alcohol consumption OR=0.60, 95% CI=0.44-0.82).
Conclusion: Although healthy sleep duration is associated with both moderate alcohol use and lower risk of cognitive impairment, these associations do not explain the reported protective effect of moderate alcohol consumption on cognitive impairment.

0273

EFFECTS OF ACUTE HYPOXIA ON SLEEP AND COGNITIVE FUNCTION

Lemos VA[1,2], Santos RV[2,3], Antunes HK[2,3], Lira FS[2], Tufik S[1], de Mello M[1,2]
[1]Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [2]Centro de Estudos em Psicobiologia e Exercicio, Sao Paulo, Brazil, [3]Biociências, Universidade Federal de Sao Paulo, Santos, Brazil

Introduction: Hypoxia likely induces alterations in human physiology, including, but not limited to, changes in metabolic, cardio-respiratory, and cognitive functions. In addition, hypoxia may also disrupt normal patterns of sleep. Several studies have shown sleep disturbances and impairment in cognitive function during hypoxic conditions. However, there is no consensus about the minimum altitude that causes hypoxic symptoms. Therefore, we investigated the effect of 24 hours of hypoxic exposure on sleep patterns and cognitive function by simulating an altitude of 4500 m.
Methods: Ten healthy male volunteers between 23 and 30 years of age were included. All volunteers were subjected to the same conditions (normoxia and hypoxia) at a simulated altitude of 4500 m, which corresponds to a constant fraction of inspired oxygen (FiO2) of 13.5%. The simulation of altitude was performed in an adapted room with a normobaric chamber (CAT - Colorado Altitude Training™/CAT-12 Air Unit) that simulates altitudes of up to 4500 m. Sleep evaluations were performed using polysomnography (Polygrafy Embla® Digital N 7000 amplified with Somnologica Studio® version 4 software). Cognitive function was evaluated using a digit span test, the Letter-Number Sequencing Test, the Corsi block task, a random number generation test, and the Stroop Color and Word Test.
Results: Twenty-four hours after hypoxic exposure, several aspects of sleep were significantly disrupted relative to their basal state, including TTS, sleep efficiency, arousal, delta sleep, and REM sleep. With regard to cognitive function, during hypoxic exposure there were deficits in attention, memory, mental manipulation, executive function, and inhibitory control.
Conclusion: Exposure to hypoxia that simulates an altitude of 4500 m impairs cognitive function and sleep patterns.
Support (If Any): FAPESP/CEPID, CNPq, and AFIP.

0274

STATE OF REST IN 17-MONTH OLD INFANTS DIFFERENTIALLY AFFECTS ATTENTION TO NEW INFORMATION

Newman-Smith K, Yourison R, Gerken L, Bootzin R, Nadel L, Gomez R
Psychology, University of Arizona, Tucson, AZ, USA

Introduction: Although state of rest is thought to play a critical role in acquiring new information, few studies have examined the relationship between physiological states of restfulness and infant learning. Given findings by Gerken et al. (2011) who showed that infants attend longer to learnable than to unlearnable language stimuli, the current study examines whether state of rest influences the cognitive resources needed to assess whether information is learnable or unlearnable.
Methods: Based on the paradigm used by Gerken et al. (2011), eleven 17 month-olds were randomly assigned to a rested or an unrested condition. Infants in the rested condition were tested one half-hour after waking from a nap. Infants in the unrested condition were tested one half-hour before their regularly scheduled nap. Within each condition, infants were habituated to learnable or a logically-unlearnable language stimuli. Infants in the learnable condition were further tested for their ability to discriminate novel grammatical vs. ungrammatical stimuli to determine whether rested infants were more likely to learn than unrested ones.
Results: Consistent with Gerken et al., unrested infants took longer to habituate to learnable than to unlearnable language (ML= 235 sec, MUL= 169 sec). In contrast to Gerken et al., rested infants habituated to the learnable language more quickly than infants exposed to the unlearnable language (ML= 103 sec, MUL= 215 sec). Larger groups are needed to determine whether rested infants are more likely to show learning after exposure to the learnable language than unrested infants.
Conclusion: This research is the first to suggest that an infant's physiological state of rest substantially affects the amount of time they take to habituate to new information with implications for understanding the impact of state of rest on infants' ability to attend to new information and to subsequently learn. Data collection is ongoing.

0275

SLEEP PROBLEMS, FATIGUE, AND COGNITIVE PERFORMANCE IN CHINESE PRESCHOOL CHILDREN

Liu J[1], Zhou G[2], Wang J[1], Ai Y[2], Pinto-Martin J[1], Liu X[3,4]
[1]Schools of Nursing and Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Jintan People's Hospital, Jintan, China, [3]School of Medicine, Indiana University, Indianapolis, IN, USA, [4]School of Public Health, Shandong University, Jinan, China

Introduction: Sleep problems are highly prevalent in pediatric populations around the world. Poor sleep has been associated with a variety of behavioral and emotional problems. It may also be associated with cognitive outcomes and poor academic performance, although this relationship has been more inconsistently documented. This study examines sleep problems and fatigue and their associations with cognitive performance in Chinese kindergarten children.
Methods: A cross-sectional analysis of baseline data from Jintan Child Cohort Study was conducted, which includes a cohort of 1,656 kindergarten children in Jintan City, Jiangsu Province, China. The sample used in the current study consisted of 1,385 children (44.8% girls, mean age 5.72 (SD=4.99) years) for whom data on sleep problems or cognitive performance were available. Child Behavior Checklist was used to measure child sleep problems and fatigue, and Wechsler Preschool and Primary Scale of Intelligence - Revised was used to assess child intelligence quotient (IQ).
Results: Sleep problems were very prevalent, ranging from 8.9% for difficulty maintaining sleep (DMS) to 70.5% for unwilling to sleep alone. Other reported sleep problems were difficulty initiating sleep (39.4%), nightmares (31.6%), sleep talking (28%), sleeping less (24.7%), sleep resistance (23.4%), and waking up often during night (8.9%). Fatigue was also prevalent, with 29.6% of children reported to be overtired and 12.6% having lack of energy. Children with DMS, sleep talking, sleep resistance, or nightmares scored 2-3 points lower in full IQ than children without sleep problems. Children reported to have fatigue scored 3-6 points lower in full IQ than those children without fatigue.
Conclusion: Sleep problems and fatigue are prevalent in Chinese kindergarten children and associated with poor cognitive performance. The impact of poor sleep in young children on cognitive functioning and development is a serious concern and has important implications for educators, healthcare professionals, researchers, and policy makers.
Support (If Any): NIH/NIEHS K01ES015877, 1K02ES019878-01, and R01ES018858.

0276

THE EFFECT OF SLEEP ON FINAL GRADES, EATING HABITS, AND MOOD

Rijhwani A, Whitehurst L, Valacer J, Hall K, Comitz E, Powell S, Dyche J, Fogler KA
Dept of Psychology, James Madison University, Harrisonburg, VA, USA

Introduction: Recent research suggests that cognitive ability, through measures of driving ability and cognitive tasks, decline when individuals lack sufficient sleep (Nebes, 2010). Past data also shows that daily caloric intake increases as amount of sleep decreases (Nedeltcheva et al., 2000). The declared need of sleep is also associated with mood, especially nervousness, tension, and irritability (Galea et al., 2005). This study examined the effects of sleep quality on food intake and mood in a college population. We also measured how mood mediates the relationship between sleep and food intake. We hypothesized that final grades will be lower for participants with worse sleep quality and quantity during finals week compared to the week prior to finals. We also expected more negative affectivity and increased daily caloric intake when they received less sleep.
Methods: Participants were 22 students who were enrolled in Psychology courses at a public university. Participants were given actigraphs and diaries for 2 weeks--the week before finals and the week during finals. The Sleep and Daily Habits log was used to confirm the sleep quality and quantity and measured food intake while mood was assessed by the PANAS scale. The week before finals was used as the baseline for each participant.
Results: Preliminary data has shown that daily caloric intake increased on days where participants have slept less than their two week average. The days they slept least were days before an exam. Participants also showed higher negative affectivity on days with less sleep and days on an exam.
Conclusion: Our study shows similar results to previous research which demonstrates significant relationships between sleep and cognitive performance, sleep and mood, and sleep and eating habits.

0277

SLEEP DEPENDENT MEMORY CONSOLIDATION DURING A DAYTIME NAP IN ADOLESCENTS

Lau E, McAteer S
Psychology, The University of Hong Kong, Hong Kong, Hong Kong

Introduction: This study examined the sleep-dependent memory consolidation hypothesis through napping in adolescents in their naturalistic living environment. Previous controlled experimental studies suggested that a short nap could help support memory consolidation and learning in normally sleeping adults. This study attempted to extend previous findings by demonstrating memory consolidation effects of napping with multiple memory tasks in adolescents who commonly have inadequate sleep.
Methods: Forty healthy adolescents, aged 15-19 were recruited at a full time boarding English-speaking high school in Hong Kong. Volunteering participants were matched in pairs on age, sex and sleepiness, using the Cleveland Adolescent Sleepiness Questionnaire. They were then randomly assigned to either the "nap" (n=21) or the "no-nap" condition (n=19). Three verbal learning and recall tasks - prose recall, word pair associates, and word list learning were adopted. Task stimuli were presented to all participants at around 2.00pm on the testing day. The nap group was then instructed to take a nap at their own dormitory room between 3.15pm and 4.15pm while the no-nap group was instructed to stay awake as usual. Re-testing of recall and recognition tasks and learning of a new word list was scheduled at 5.15pm.
Results: The nap group was significantly better at recalling previously learnt proses [$F(1,36) = 9.11$, $p = .005$, $\eta^2 = .202$] and word pairs [$F(1,36) = 5.80$, $p = .021$, $\eta^2 = .139$]. These effects were not associated with self-reported sleep duration in the preceding seven nights and daytime sleepiness. The nap group also performed better in learning a new word list after napping than the no-nap group [$F(1,37) = 6.905$, $p = .012$, $\eta^2 = .157$].
Conclusion: Our results suggested that a short nap can be of benefit to students of diverse sleep status. Planned, polyphasic sleep complementary to good sleep hygiene may be advisable to help adolescents cope with increasing cognitive demands in modern societies.

0278

SLEEPINESS AND GRADE POINT AVERAGE

Hershner SD
Neurology, University of Michigan, Ann Arbor, MI, USA

Introduction: Sleep habits and daytime sleepiness may impact learning and grade point average. However, many of the available studies include mainly freshman students attending Psychology courses and may not be generalized to all college students.
Methods: Students were surveyed prior to attending an educational conference about sleep. The survey included: demographics, self-reported GPA, Pittsburg Sleep Quality Index(PSQI), Epworth Sleepiness Scale(ESS), Morning-Eveningness Questionnaire(MEQ), and Sleep Hygiene Index(SHI). A low GPA was defined as <3.0/4.0.

Results: 450 students were surveyed with 283 participating (63% response rate, 21.5±1.5years): Students were 41% graduates and 59% undergraduates. Mean sleep duration was 6.43±0.8hours; 54% of subjects had poor sleep quality (mean PSQI was 6.38 [PSQI >5 poor sleep quality]). 27% of students had ESS>10(mean 7.9±4.0). Most students were neither morning/evening types(MEQ 43.2±11.7). Sleep Hygiene Index was 32.2±8.5. 71% frequently had "all-nighters" and 38% often slept 2-4 hours before examinations. Partial sleep deprivation was associated with lower GPAs r=-.20(p= .002), while all-night sleep deprivation did not impact grades. Evening types were associated with poor sleep quality r= -.250(p= .01) and sleep hygiene r= -.286(p= .01). Compared to other MEQ categories, evening types had a lower GPA(F= 2.46 p<.05). Students with an ESS>10 had a lower GPA and worse sleep hygiene. After adjustment for age, gender, sleep duration, and BMI, an ESS>10 was 1.43 times more likely to have a low GPA(95% CI 1.53-12.8 p= 0.006). GPA was not associated with sleep duration, PSQI, or SHI.
Conclusion: Graduate and undergraduate students commonly report sleep deprivation, poor sleep quality, and sleepiness. Despite most students having a normal ESS, 83% of students reported that daytime sleepiness impaired academic performance. An evening preference may put students at risk of lower academic performance. When adjusted for some confounding variables, sleepy students are 1.4 times more likely to have a lower GPA.

0279

EFFECTS OF AGING ON SLEEP DEPENDENT PROCESSING OF EMOTIONAL REACTIVITY

Baran B[1], Spencer R[1,2]
[1]Psychology, University of Massachusetts Amherst, Amherst, MA, USA, [2]Neuroscience and Behavior Program, University of Massachusetts Amherst, Amherst, MA, USA

Introduction: Sleep disturbances and mood disorders show a high level of comorbidity suggesting that sleep may play a role in emotional processing. In fact, it has been suggested that sleep deprivation following trauma may prevent PTSD. However, emotional processing changes with age: The positivity bias suggests that older adults recruit active cognitive control mechanisms to inhibit processing of negative stimuli. Thus the present study investigated the effects of sleep on emotional reactivity in healthy older adults.
Methods: Forty-six older adults (mean age= 67.5, SD=4.37) and 106 young adults (mean age= 20.4, SD= 2.2) were tested over two sessions separated by either 12 hrs containing overnight sleep (Sleep groups) or daytime wake (Wake groups). Participants viewed neutral and negatively valenced picture stimuli and were asked to rate their valence in both sessions.
Results: Change in emotional reactivity (ΔValence) was measured as the difference in subjective valence ratings in session 2 minus the rating in session 1. In the young adult group the initial negative ratings were reduced over wake but were relatively preserved over sleep. Specifically an ANOVA for ΔValence in young adults revealed a significant Group (Sleep vs Wake) x Valence interaction, F(1,80)= 3.81, p= .05. In the older adult group the initial negative reactions were attenuated similarly regardless of group with no significant Group x Valence interaction, F(1,44)= .26, p= .61. Protection of emotional reactivity correlated with more time spent in late-night REM sleep in young adults (r= -.41, p=.04). No such relationship was found for older adults.
Conclusion: Our data shows that sleep preserves negative emotional reactivity in young adults, which can be regarded as an evolutionary adaptive mechanism. However, this protective effect of sleep is diminished with age. This may be due to age-related changes in motivational goals which may prioritize emotional well-being differently than in young adults. Alternatively, active protection of the emotions by sleep may be diminished in conjunction with reduced sleep quality in older adults.
Support (If Any): This project was supported by NIH R00 AG029710 to RMC Spencer.

0280

SLEEP PROTECTS DECLARATIVE MEMORIES FROM INTERFERENCE IN AN AGING POPULATION

Sonni A[1], Spencer R[1,2]
[1]Neuroscience and Behavior, University of Massachusetts Amherst, Amherst, MA, USA, [2]Psychology, University of Massachusetts, Amherst, MA, USA

Introduction: Healthy aging is associated with diminished sleep quality and cognitive decline. Several electrophysiological changes in sleep occur with age, most notably, the reduction in slow wave sleep (SWS). Previous studies involving young adults provide evidence for a role of SWS in the consolidation and stabilization of declarative memories. Given this, it was surprising to find that healthy older adults exhibit performance benefits following overnight sleep relative to equivalent intervals of wake on a declarative learning task. However, it is possible that these relative benefits following sleep reflect a passive role of sleep in protecting the memory from decay that occurs over wake, rather than an active role of sleep in enhancing the memory representation. If memories are actively stabilized over sleep, they should subsequently be more resistant to interference, as seen in young adults. For this reason, we compared post-sleep and post-wake interference in young and older adults using a spatial learning task.
Methods: The spatial learning task resembles the memory game "Concentration," involving 20 images located at specific locations on a computer screen. Participants were asked to recall these locations after a 12 hr period either spent awake or with overnight sleep. We tested 34 older adults (mean=66 yrs; SD=7.4 yrs) and 59 young adults (mean=24 yrs; SD=2.8 yrs) across "interference" and "no interference" conditions.
Results: In the interference condition, for young adults, performance was significantly superior in the Sleep group (n=8) relative to the Wake group (n=10) [F(1,16)=8.7, p=.009], and trends towards significance in older adults [Wake n=6; Sleep n=5; F(1,9)=4.027, p=.076]. The Age (Young v. Older) x Condition (Sleep v. Wake) interaction was not significant (F(1,25)=0.644, p=.43).
Conclusion: These results suggest that declarative spatial memories are actively processed over sleep, reducing the susceptibility to subsequent interference, in older adults equivalently to young adults.
Support (If Any): This project was supported by NIH R00 AG029710.

0281

PROFILE OF PSYCHOMOTOR VIGILANCE TASK PERFORMANCE IN THE GENERAL POPULATION

Kim H[1,2], Yun C[3], Thomas RJ[4], Cho E[1], Lee S[1], Shin C[1,2,5]
[1]Institute of Human Genomic Study, Korea University Ansan Hospital, Ansan, Republic of Korea, [2]Brain Korea 21 Program in Biomedical Sciences, Korea University School of Medicine, Seoul, Republic of Korea, [3]Neurology, Seoul National University Bundang Hospital, Bundang, Republic of Korea, [4]Division of Pulmonary, Critical Care and Sleep Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA, [5]Respiratory Internal Medicine, Korea University Ansan Hospital, Ansan, Republic of Korea

Introduction: Psychomotor vigilance task (PVT) is one of the most widely used measures of alertness and sustained attention in sleep research. There have been numerous clinical and experimental data that elucidate its sensitivity to sleep-related neurobehavioral impairment. Herein we present profile of PVT performance in a community-based cohort sample of Korean adults.
Methods: We administered the 10-minute PVT to 2922 participants (aged 57.3 ±7.4, 49.8% male) of the ongoing Korean Genome and Epidemiology Study (KoGES). All tests were performed in the morning (8:00 AM to noon) using a portable device (PVT-192). Main outcome variables included median reaction time (RT), mean reciprocal RT (RRT), and number of lapses and total errors (wrong keys and false

starts). Differences in PVT performance according to age and gender were analyzed.
Results: We documented the profile of PVT performance in the general population. Median RT was 267.0 ± 42.23 msec, mean RRT 3.7 ± 0.5 1/sec, lapses 3.1 ± 2.1, and total errors 2.3 ± 7.3. Age and gender was significantly associated with PVT performance. PVT performance was negatively correlated with increasing age: median RT, mean RRT, number of lapses and total errors ($p<0.05$). Gender difference was statistically significant, with men having faster median RT, higher 1/RT's, and smaller lapses and total errors (all with $p<0.01$). The interaction between age group and gender was also apparent for all variables mentioned above ($p<0.001$).
Conclusion: PVT performance in the general adult population was reported. PVT performance in adult deteriorates with aging and differs by gender.
Support (If Any): This study was supported by a grant of the Korea Centers for Disease Control and Prevention, Republic of Korea [Grant 2010-E71001-00, 2011-E7100400].

0282

SLEEP EXTENSION NORMALIZES WAKING AUDITORY SENSORY GATING IN SHORT SLEEPERS

Gumenyuk V[1], Roth T[1], Korzyukov O[2], Drake C[1]
[1]Internal Medicine, Henry Ford Hospital, Detroit, MI, USA, [2]2Department of Communication Sciences and Disorders, Northwestern University, Evanston, IL, USA

Introduction: As in awake, during sleep the brain reduces neuronal responsiveness (habituate) to sensory stimuli presented repeatedly. Electrophysiologically, this process can be measured by the brain event-related potential (ERP)-P50 and called auditory sensory gating (ASG). It has been shown that chronic short sleep time is associated with reduced ASG. The aim of this study was to evaluate whether one week of extended time in bed (TIB) in chronic "short sleepers" (SS) improves ASG.
Methods: 8 habitual SS (sleep-diary TST≤6h) (age: 32.7yrs±13yrs, 5F) and 8 normal sleepers (NS) (TST=7−8 h) (age 40.1yrs±10.2yrs, 6F) participated. Habitual (6.1h) and extended (9 h) TIB was counterbalanced in SS group. At the end of each week ERPs were recorded. In NS group, ERPs were recorded after one week of sleep diary records at their habitual TST. Double clicks S1/S2 with inter-stimulus interval=500ms and inter-pair interval=8s were presented binaurally. ERPs to S1 and S2 were processed separately. The P50 response (latency~50 ms) was analyzed using difference wave (ERPs to S1minus ERPs to S2). 3-way ANOVAS was used for comparison of the P50 difference between groups (factors: groups [NS vs. SS], across frontal/central/parietal (frontality) and left/central/right (laterality) locations). In a within-group analysis, TIB conditions, frontality and laterality as factors were evaluated.
Results: Amplitude of P50 was significantly larger in NS vs. SS group (1.0μV vs. 0.3μV; $F(1,14)=9.30$; $P<0.008$) across frontal-central electrodes. Amplitude of P50 significantly increased from 0.3μV to 0.9μV in SS with extended sleep ($F(1,7)=16.40$; $P<0.005$). TST (sleep dairy) was significantly correlated with P50 amplitude ($r=0.7$; $P<0.02$) across NS and SS subjects.
Conclusion: Using between - and within - groups comparison of P50 short sleep times results in decreased ASG, and is normalized with one week of sleep extension. Thus sleep loss is associated with inability to filter out extraneous sensory information.
Support (If Any): This study was supported by Zeo, Inc.

0283

ENDOGENOUS CORTISOL LEVELS PREDICT POORER EXTINCTION LEARNING IN THE MORNING BUT NOT THE EVENING

Pace-Schott EF[1,2], Vijayakumar S[2], Milad MR[1], Orr SP[1], Pitman RK[1], Spencer R[2]
[1]Psychiatry, Harvard Medical School, Boston, MA, USA, [2]Psychology, University of Massachusetts, Amherst, Amherst, MA, USA

Introduction: Elevation of corticosteroids enhances consolidation of emotionally arousing (but not un-arousing) material. Conversely, high corticosteroid levels impair retrieval of several forms of memory. We examined the relationship of endogenous cortisol to fear conditioning and its extinction at times of naturally occurring high (morning) or low (evening) levels.
Methods: 24 healthy young-adult males completed 2 sessions (S1 and S2) with intervening 3-hr awake delay. Participants completed sessions either at 19:00 and 23:00 (Evening group; n=11) or at 7:00 and 11:00 (Morning group; n=13). At S1, Fear Conditioning produced conditioned skin conductance responses (SCR) to 2 differently colored images of lamps (CS+s) using a mild shock. Immediately afterward, during Extinction Learning, one color (CS+E), but not the other (CS+U) was extinguished by multiple un-reinforced presentations. At S2, both CS+'s were presented (Extinction Recall). Saliva samples were collected before Conditioning, after Extinction Learning and before and after Extinction Recall. A subset (N=16) were analyzed. Diurnal cortisol curves obtained before the experiment provided area-under-the-curve normalization for individual differences.
Results: During Fear Conditioning, similar average SCR to CS+s occurred at morning and evening. However significantly greater SCR to the CS+Es occurred during evening Extinction Learning [$F(1,22)=8.11$, $p=.01$]. At Extinction Recall, there was trend for greater Evening SCR to the CS+E [$F(1,94)=3.23$, $p=.09$] and CS+U [$F(1,94)=4.88$, $p=.04$]. When separated by Group (N=8), higher pre-Conditioning cortisol significantly predicted lower maximum SCR during Conditioning in both morning ($R=.53$, $p=.04$) and evening ($R=.74$, $p=.04$). Higher morning, but not Evening, post-Extinction cortisol predicted higher mean Extinction SCR, i.e., lower Extinction Learning ($R=.97$, $p=.0001$).
Conclusion: Higher morning but not evening cortisol predicts poorer extinction learning. Such effects may require levels varying near the physiological maximum. Interestingly, such variation also predicts lower fear conditioning, another form of emotional learning. Paradoxically, however, extinction learning is poorer in the evening, a period of minimum cortisol levels.
Support (If Any): NIH/NIMH R21MH090357, NIA R00AG029710.

0284

CIRCADIAN EFFECTS ON EMOTIONAL MEMORY RETRIEVAL: EVIDENCE FROM FUNCTIONAL MAGNETIC RESONANCE IMAGING

Bennion KA[1], Kensinger EA[1], Payne JD[2]
[1]Psychology, Boston College, Chestnut Hill, MA, USA, [2]Psychology, The University of Notre Dame, Notre Dame, IN, USA

Introduction: With sleep research, it is important to investigate circadian effects to determine if these contribute to differences in activity and memory performance after a delay spent asleep or awake. The present study examines neural engagement on emotional memory retrieval as a function of the time of testing (morning, evening) and study-test delay length (20-minute, 12-hour).
Methods: Participants viewed 124 scenes consisting of a negative or neutral object on a neutral background, prior to a recognition test during fMRI. Sleep participants studied the images in the evening, prior to sleep, while Wake participants studied in the morning and were tested in the evening (~12-hour delay for both groups). Circadian control partici-

pants were tested on the images in either the morning or evening, after a 20-minute delay.
Results: Whole-brain analyses revealed more successful-retrieval activity in Circadian-AM than Circadian-PM participants, in regions of the prefrontal cortex, inferior frontal gyrus, middle temporal gyrus, superior frontal gyrus, and angular gyrus. No regions showed greater successful-retrieval activity in Circadian-PM than Circadian-AM participants. An ANOVA computed on the parameter estimates extracted from regions of interest, defined in an unbiased fashion regarding object valence (negative, neutral), delay length (20-minute, 12-hour), and time-of-testing (morning, evening), also revealed that activity in the anterior PFC (-30 62 6), dlPFC (52 28 26), and orbitofrontal cortex (24 42 -12) differed as a function of time-of-testing after a short delay (Circadian-AM>Circadian-PM; all $t(21)>2.24$, $p<.035$). This circadian effect, however, was not present after a night of sleep (Sleep=Wake; all $t(33)<1.28$, $p>0.21$).
Conclusion: Results suggest that circadian effects may contribute to changes in the memory retrieval network for negative and neutral information, with successful-retrieval activity typically stronger in the morning than in the evening. However, these effects may weaken as the study-test delay interval increases, possibly because a period of sleep counteracts the effect of time-of-day.
Support (If Any): National Science Foundation (BCS-0963581).

0285

TIME-OF-DAY INFLUENCES ON FEAR CONDITIONING, EXTINCTION LEARNING AND EXTINCTION RECALL

Pace-Schott EF[1,2], Spencer R[2], Vijayakumar S[2], Murphy M[2], Ahmed N[2], Milad MR[1], Orr SP[1], Pitman RK[1]
[1]Psychiatry, Harvard Medical School, Boston, MA, USA, [2]Psychology, University of Massachusetts, Amherst, Amherst, MA, USA

Introduction: Circadian factors influence skin conductance response (SCR), a physiological response associated with phasic sympathetic activation. However, sleep also influences conditioned SCR, for example by generalizing extinction memory.
Methods: 100 healthy young adults completed 2 sessions (S1 and S2) with intervening delays of 3, 12 or 24 hr. At S1, Conditioning produced conditioned SCRs to 2 differently colored images of lamps (CS+s) using a mild shock. Immediately afterward, during Extinction Learning, one color (CS+E), but not the other (CS+U) was extinguished by multiple un-reinforced presentations. At S2, both CS+s were presented (Extinction Recall). In the 3-hr delay, Evening-Awake participants (N=18, 11 male) completed S1 and S2 at 19:00 and 23:00 and Morning-Awake participants (N=18, 13 male) at 7:00 and 11:00. 12-hr-delay (all male) participants completed sessions at 20:00 and 8:00 (Sleep, N=10) or in reverse order (Wake, N=12). Sleep-First, 24-hr delay subjects (N=22, 8 male) completed 2 successive sessions at 20:00 and Wake-First (N=20, 5 male) at 8:00.
Results: Similar SCR to CS+s occurred in 50 participants (29 male) with evening versus 50 (30 male) with morning Conditioning. However significantly greater SCR to the CS+Es occurred during evening Extinction Learning [$F(1,98)=6.11$, $p=.02$]. At Extinction Recall, 2-way ANOVA showed a trend for greater Evening SCR to the CS+E [$F(1,94)=3.01$, $p=.09$] but no main effect of Delay or Delay x Testing Time interaction. Replacing the Delay factor with Sleep versus No-Sleep during the delay produced similar results. Replacing Delay with Gender, main effect trends appeared for both Testing Time and Gender (male SCR higher) but again no interaction. An identical pattern was seen for CS+U except Testing Time and Gender effects were significant ($p<.05$).
Conclusion: Time-of-day influences Extinction Learning independently of level of Conditioning, and Extinction Recall independently of duration or sleep-occurrence during delay. However, similar results for the un-extinguished CS+ suggest non-specific circadian effects on conditioned SCR.
Support (If Any): NIH/NIMH R21MH090357, NIA R00AG029710.

0286

CIRCADIAN PHASE AND TIME AWAKE INFLUENCE PERFORMANCE ON COMPLEX VISUAL TASKS

Pomplun M[1], Silva EJ[2], Ronda JM[2,3], Cain SW[2,3], Munch MY[2,3], Duffy JF[2,3]
[1]Department of Computer Science, University of Massachusetts Boston, Boston, MA, USA, [2]Division of Sleep Medicine, Brigham & Women's Hospital, Boston, MA, USA, [3]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Performance is influenced by both sleep-wake and circadian factors. Reports suggest that in visual search tasks, unlike throughput and attention tasks, accuracy is compromised at the expense of speed under adverse sleep or circadian phase conditions. Those studies used brief tasks requiring little use of working memory. The present study used search tasks requiring sustained interaction of visual working memory and attentional control to study the effects of circadian phase and time awake.
Methods: Twelve young adults took part in a study in which they lived on a 28-h rest-activity schedule for 3 weeks, allowing separation of effects of circadian phase and time awake. Two variants of a comparative visual search task were administered each day at ~5, 9, 13, and 17h after waketime, with 16 trials per type during each test. In both tasks, two nearly identical images of 16 triangles side-by-side were presented. The subject had to indicate the direction of a single mismatched triangle. In the "copy" task, the right panel was a translational copy of the left, while in the "mirror" task the right panel was a mirror image of the left, requiring a mental flip of visual working memory content.
Results: Response accuracy was 95.8%. The correlation between RT and proportion of correct responses was -0.353 suggesting little speed-accuracy tradeoff. The copy task had shorter RTs than the mirror task [8.00 vs. 8.75 s; $p<0.05$], due to less processing time per item [536 vs. 637 ms; $p<0.05$], rather than a difference in the proportion of missed targets [0.186 vs. 0.195; $p>0.2$]. There was a significant effect of circadian phase on RT, which did not differ between tasks. There was a significant effect of time awake on RT resulting from an increase of processing time per item rather than an increase in proportion of missed targets; both tasks were affected similarly. Furthermore, time awake strongly influenced RT for mirror trials where there was a large distance between targets [9.0 s for 5 hours awake vs. 10.7 s for 17 hours awake; $p<0.05$].
Conclusion: Comparing the two tasks, trials requiring few vs.many comparisons, and mirror task trials with small vs. large target separation, we found that while performance speed slowed with increased time awake and at adverse circadian phase, performance accuracy was relatively unaffected.
Support (If Any): The studies were supported by NIH grants AT002571 and AG09975 and were carried out in the Brigham and Women's Hospital Center for Clinical Investigation supported by UL1 RR025758 (Harvard Catalyst CTSC).

0287

THE EFFECTS OF SLEEP ON COGNITION IN PATIENTS WITH IMPLANTABLE CARDIOVERTER DEFIBRILLATORS (ICDS)

Roth AJ[1], Sears SF[2], Conti JB[3], Berry RB[3], Dzierzewski JM[1], McCrae C[1]
[1]Clincal & Health Psychology, University of Florida, Gainesville, FL, USA, [2]Psychology and Cardiovascular Sciences, East Carolina University, Greenville, NC, USA, [3]Medicine, University of Florida, Gainesville, FL, USA

Introduction: Implantable cardioverter defibrillators (ICD) are the treatment of choice to prevent death associated with lethal ventricular arrhythmias in patients with cardiac disease. Though sleep disturbances represent a significant comorbidity for ICD patients, there is a dearth of information regarding how sleep affects cognitive functioning in ICD

patients. The present study investigated the effects of sleep disturbances on cognitive tasks of varying degrees of difficulty. We hypothesized increases in sleep onset latency (SOL) and wake after sleep onset (WASO) and decreases in slow-wave and REM sleep would significantly predict performance on these cognitive tasks.

Methods: 38 ICD patients (Mage=59.74, SD=12.00) completed 14 days of actigraphy and 17 (Mage=56.35, SD=13.22) completed one night of ambulatory polysomnography. A cognitive test battery including the N-Back and Simple Reaction Time (SRT) tasks were also administered. Hierarchical multiple regressions were employed to examine whether SOL and WASO or percentage of total sleep time spent in slow-wave or REM predicted performance on the N-Back or SRT tasks.

Results: After controlling for age, depression, and anxiety, SOL and WASO significantly predicted 33% of the variance in reaction time across 1-back trials (R-square change=.159, p=.045), with greater SOL and WASO related to lower reaction times. On non-critical 1-back trials, SOL, WASO, age, and depression predicted 43% of the variance in reaction time (R-square change=.212, p=.010), with increased SOL and WASO associated with decreased reaction times. Only age was a significant predictor of reaction time on the SRT. Neither slow-wave nor REM predicted performance on either task.

Conclusion: Increased SOL and WASO may lead to more rapid responding on a complex memory task, which may be attributable to the cognitive hyperarousal observed in insomnia. Given the counterintuitive nature of these results, future research is needed to fully delineate the impact of sleep disturbance on cognition in ICD patients.

Support (If Any): The project described was supported by Award Number R01AR055160 and R01AR055160-S1 ARRA Supplement from the National Institute of Arthritis And Musculoskeletal And Skin Diseases. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Arthritis (Christina S. McCrae, PhD, PI).

0288

THE RELATIONSHIP OF NON-PATHOLOGICAL DREAM-ENACTMENT TO CONTAGIOUS AND IMITATIVE BEHAVIORS

Nielsen TA[1,2], Kuiken D[3], Svob C[3]
[1]Dream & Nightmare Lab, Center for Advanced Research in Sleep Medicine, Hôpital du Sacré-Coeur de Montréal, Montreal, QC, Canada, [2]Psychiatry, Université de Montréal, Montreal, QC, Canada, [3]Psychology, University of Alberta, Edmonton, AB, Canada

Introduction: Dream-enacting behaviors (DEBs), prevalent among college students, are behavioral expressions of perceptually and emotionally forceful dream imagery that often depicts the self interacting vigorously with other dream characters. DEBs may belie activity in a brain network that includes mirror neurons, i.e., a network underlying social cognitive behavior such as imitative learning and contagious emotions. We developed the Mirror Behavior Questionnaire (MBQ) to assess some dimensions of these behaviors and investigated relationships between MBQ factors and DEBs.
Methods: Subjects were 492 student undergraduates (188 males; 292 females; 12 not specified; age: 19.1±1.62 yrs; range: 17-29). DEBs were assessed with 6 items including speaking out, crying/sobbing, smiling/laughing, bodily fear, anger/defensive behavior, and other movement during dreaming (response scales: 0=never; 1=rarely; 2=sometimes; 3=often). The 18-item MBQ (same 0-4 scale) included common contagious emotions (smiling, laughing), communicative mirroring (speech/motor tics, body movements), motor skill imitation, contagious sleepiness, and empathy. Somnambulism and somniloquy (0-4 scales) were assessed and removed as covariates.
Results: Principal components analysis of MBQ items revealed a 4-factor solution (48.4% VE): 1) emotional contagion/empathy (15.2% VE), 2) behavioral imitation (13.5% VE), 3) sleepiness/anger contagion (9.9% VE), 4) motor skill imitation (9.7% VE). DEBs correlated with MBQ total score (r492=.340, p<.000001) and MBQ Factor1 (r492=.274), Factor3 (r492=.152) and Factor4 (r492=.180; all p<.004). Women (M=1.57±0.37) scored higher than men (M=1.41±0.39) on MBQ total score (p<.000001) and Factor1 (p<.000001); men scored higher on Factor4 (p<.000001). Specific DEBs (angry, crying) were correlated with specific MBs (contagious anger, sadness).
Conclusion: These cross-state relationships may reflect how a common mirror neuron system contributes to both a propensity to socio-cognitive mirror behaviors when awake and vivid dreamed social interactions that ultimately lead to DEBs.
Support (If Any): Social Sciences and Humanities Research Council of Canada; Canadian Institutes of Health Research.

0289

CONSCIOUSNESS AND COGNITION IN SLEEP: THE STRUCTURE OF STAGE 2 NON-REM

Porte HS
Psychology, Cornell Univ, Ithaca, NY, USA

Introduction: It is generally agreed that slow wave sleep excludes waking-like consciousness, while Stage REM can produce vivid conscious experience that the (non-lucid) dreamer does not distinguish from wakefulness. The status of consciousness in Stage 2 non-REM, however, is debated. This debate, which emphasizes reports of REM-like dreaming in Stage 2, is consequential for models of consciousness in both waking and sleep. Arguably, our understanding of Stage 2 remains insufficient to support a model of consciousness. Toward better characterizing Stage 2, its electrographic structure was analyzed across the sleep cycle.
Methods: Eight sleep recordings (sampling rate 1000 Hz) were analyzed using AcqKnowledge™ software. The EEG at C3 or C4 was used for stage scoring. To permit comparison and for adequate electrode separation, the EEG at FZ and at PZ was used for analysis. Sleep spindles, K complexes, and the Stage 2 inter-criterion EEG were quantified in respect to (1) surface morphology, and (2) physical structure after digital transformation. FFT: Sample sizes were powers of 2, calibrated to optimize frequency resolution while minimizing complexity in the observation interval. To offset windowing effects, samples were overlapped. FIR Bandpass Filters: Bandwidths were determined by each sample's configuration of FFT peaks. Maximal filter coefficients were used. Also in Stage 2 across the sleep cycle, the amplitude, duration, and velocity of eye movement were measured (DC EOG).
Results: In Stage 2 non-REM, the physical properties of sleep spindles, K complexes, and the inter-criterion EEG vary significantly across sleep. This variation is revealed by surface EEG measurements and to a greater degree by physical waveform analysis. The DC EOG varies in parallel, suggesting distributed changes in brain state within Stage 2.
Conclusion: Toward modeling consciousness in Stage 2 sleep, reports of cognition should be pinpointed within the sleep period, in relation to the local physical structure of criterion EEG events.

0290

DIFFERENCES IN THE COGNITIVE AND PSYCHOLOGICAL CONTENT OF LUCID AND NON-LUCID DREAMS

Rider RL[1], La Marca K[3], Pallais W[2], LaBerge S[2]
[1]Psychology, Drexel University, Philadelphia, PA, USA, [2]Psychology, Stanford University, Palo Alto, CA, USA, [3]Psychology, Alliant International University, San Diego, CA, USA

Introduction: Lucid dreams are generally characterized by an awareness that one is dreaming. We sought to determine whether lucid dreams might also be characterized by differences on other cognitive or psychological dimensions. To address this question, we tested for differences in self-reported cognitive and psychological constructs between lucid and non-lucid dream reports.
Methods: Participants were asked to submit narrative reports of their most recent and next lucid and non-lucid dreams. For each dream, the presence or absence of choice, internal commentary, public self-consciousness, event-related private self-consciousness, event-unrelated private self-consciousness, unexpected attention, unusual experience, emotion, and attention were assessed on a 'yes'/'no' basis. Dream reports were evaluated by two independent raters for compliance with strict inclusion criteria.
Results: N = 338 dreams from 181 participants were determined to be valid for further analysis. Chi square analyses were performed to test for differences between the frequency of any of the constructs assessed in lucid relative vs. non-lucid dreams. Relative to their non-lucid dreams, participants reported a greater percentage of their lucid dreams included choice (65% vs. 33%, $p < 0.001$), internal commentary (79% vs. 68%, $p = 0.011$), sustained attention (66% vs. 49.8%, $p < 0.001$), event-related private self-consciousness (48% vs. 30%, $p < 0.001$), event-unrelated private self-consciousness (17% vs. 9%, $p = 0.019$), and unusual experiences (65% vs. 51%, $p = 0.002$). Public self-consciousness was more frequently reported in non-lucid dreams (38% vs. 22.6%, $p < 0.001$). Lucid and non-lucid dreams did not differ with respect to reports of emotion (91% vs. 87%) or unexpected attention (60% vs. 53%).
Conclusion: These findings suggest that lucid dreams differ from non-lucid dreams on several cognitive and psychological dimensions. Lucid dreams involve either a greater capacity for, or awareness of: choice, sustained attention, and private self-reflection. Non-lucid dreams appear to involve a greater susceptibility to public self-consciousness.

0291

DREAMING UNDER ANTIDEPRESSANTS: A SYSTEMATIC REVIEW ON EVIDENCE IN DEPRESSIVE PATIENTS AND HEALTHY VOLUNTEERS

Tribl GG[1], Wetter TC[2], Schredl M[3]
[1]Neurology, SVA, Zurich, Switzerland, [2]Department of Psychiatry and Psychotherapy, Sleep Medicine Center, University Hospital Regensburg, Regensburg, Germany, [3]Sleep laboratory, Central Institute of Mental Health, Mannheim, Germany

Introduction: Typical symptoms of depression include depressed mood, impaired mental activity, and sleep disturbances such as sleep fragmentation, early morning awakening, decreased REM-sleep latency and increased REM density, as well as more negative dream content. Tricyclic antidepressants (AD) tend to stabilize sleep parameters by increasing total sleep time and decreasing waking time, while many SSRI have an opposite effect. However, almost all AD prolong REM sleep latency and reduce the amount of REM sleep. Case reports and research data indicate a strong effect of AD on dream recall and dream content.
Methods: We performed a systematic review from 1950 to August 2010 to determine the evidence of AD impact on dreaming in depressive patients and healthy volunteers.
Results: Twenty-one clinical studies and 25 case reports were eligible for review and document a clear effect of AD on dream recall and dream content. The major finding, both in depressed patients and in healthy volunteers, is a decrease of dream recall frequency (DRF) under AD. This is a rather consistent effect in tricyclic AD and phenelzine, less consistently documented also for SSRI/SNRIs. Dream quality is positively influenced by tricyclic AD towards more positive dream emotions. Withdrawal from tricyclic AD and from the monoamine oxidase inhibitors phenelzine and tranylcypromine may cause nightmares. The reviewed evidence on dream quality under SSRI/SNRIs is less consistent. Intake and even more withdrawal of SSRI/SNRIs seem to intensify dreaming, which may be experienced in different ways; a potential to cause nightmares has to be taken into account.
Conclusion: Though there are clear-cut effects of AD on DRF and dream content, the amount of published data on this topic during the past 60 years is surprisingly low. AD effects on dreams should be recognized and may be used in treatment.

0292

NEGATIVE EMOTIONS EXPERIENCED IN THE EVENING, DAYTIME, AND DREAMS AMONG FREQUENT AND NON-FREQUENT NIGHTMARE SUFFERERS

Antunes-Alves S, De Koninck J
Psychology, Univ Ottawa, Ottawa, ON, Canada

Introduction: Research has demonstrated a relationship between frequent nightmare sufferers and lower psychological well-being, higher levels of depression and anxiety, and sleep disturbance. The present study more specifically aimed to determine whether persons who report being frequent nightmare sufferers actually report stronger negative emotions in their everyday dreams and experience higher stress levels in the evening and in the morning than reported non-frequent nightmare sufferers.
Methods: Thirty participants who reported experiencing at least one nightmare per week, and 30 who reported experiencing less than one nightmare per month were given ten days to report their home dreams, as well as complete morning and evening questionnaires. At bedtime, in the morning and following the writing of each dream, they rated their experienced levels of apprehension, anger, sadness, fear, anxiety and stress levels Likert scales. Participants ranged in age from 13 to 58 years and were matched for age and gender.
Results: A MANOVA performed on their first reported dream revealed an overall significant difference in negative emotions ($p < .01$), which was significantly attributable to higher levels of dream fear and anxiety (both, $p < .01$) in frequent nightmare sufferers. They also reported experiencing significantly more negative emotions and higher stress levels in the evening and in the morning ($p < .01$). Finally, there were significant positive correlations between nighttime fear, dream fear and morning fear, with nighttime fear and morning fear accounting for more of the variance ($p < .01$).
Conclusion: These results support the continuity hypothesis between waking and dreaming. They also support the notion that nightmare sufferers' higher level of waking distress is indeed not mediated by their dreaming experience. Further investigation into the relationship between the everyday dream experience of nightmare sufferers and their daytime distress levels is required.
Support (If Any): Social Sciences and Humanities Research Council of Canada.

0293

SEX AND AGE DIFFERENCES IN THE RECALL OF BAD DREAMS: A PROSPECTIVE STUDY

Nielsen TA[1,2], Carr M[1,3], Dumel G[1,4], Carrier J[5,4]
[1]Dream & Nightmare Lab, Center for Advanced Research in Sleep Medicine, Hôpital du Sacré-Coeur de Montréal, Montreal, QC, Canada, [2]Psychiatry, Université de Montréal, Montreal, QC, Canada, [3]Biomedical Sciences, Université de Montréal, Montreal, QC, Canada, [4]Psychology, Université de Montréal, Montreal, QC, Canada, [5]Chronobiology Lab, Center for Advanced Research in Sleep Medicine, Hôpital du Sacré-Coeur de Montréal, Montreal, QC, Canada

Introduction: Meta-analyses indicate that women report nightmares more often than men during adolescence and young adulthood, while a large sample of internet respondents revealed that age-related changes were robust for women but not men. Most studies have failed to control a number of confounding variables, such as psychopathology, chronotype and self-selection bias. We explored this question prospectively, using results from sleep logs kept by healthy subjects who were screened for extreme chronotypes, deviations in sleep/wake cycle (no more than ±30m per night), and psychopathology, and who participated in chronobiology studies not advertised to be about dreams or nightmares.
Methods: Results were from 229 subjects (8 studies) who completed 1-2 week daily home logs. There were 119 women (age= 40.6±15.9) and 109 men (age=37.7±16.0) grouped into three age strata: Young, 18-24 (N=69; age=21.8±1.4), Middle, 25-50 (N=81; age=36.3±9.7) and Older, 51-70 (N=79; age=57.5±5.0). Men and women did not differ in age at any stratum. Each morning, subjects rated whether they recalled a dream (DR; yes/no), whether this was a bad dream (BDR; yes/no) and whether this dream woke them up (nightmare; yes/no). Nightmares were rare (2.18% days; at least one by 19.3% men vs. 21.0% women, p=NS) and not reported here. A per-week estimate of BDR was calculated as: (#bad dreams/#log days)*7. Chronotype was assessed with the Morningness-Eveningness Questionnaire (MEQ). Mann-Whitney U tests assessed sex differences across age strata, and Kruskal-Wallis ANOVAs examined age effects within sex.
Results: BDR differed by sex only for the Young stratum; women scored higher (0.45±0.65) than men (0.14±0.30; Z-adj=2.21, p=.027). For women, BDR differed by age ($H(2,119)=6.92$, $p=0.03$); it was high for Young (0.45±0.65, N=28) and Middle (0.44±0.68, N=48) strata but lower for the Older (0.14±0.31, N=43) stratum (both Z-adj>2.0, p<.05). For men, BDR was not different for the Young (0.14±0.31, N=40), Middle (0.33±0.63, N=33) and Older (0.30±0.57, N=36) strata ($H(2,109)=1.20$, $p=0.55$).
Conclusion: Results replicate, using a prospective procedure and carefully controlled sample, findings of more frequent dysphoric dreams in young and middle-aged women and of an apparent decrease in such dreams among older women.
Support (If Any): Canadian Institutes for Health Research; Social Sciences and Humanities Research Council of Canada; Natural Sciences and Engineering Research Council of Canada.

0294

IL-6 MEDIATES RELATIONSHIP BETWEEN SLEEP AND BODY WEIGHT

Hinjosa-Kurtzberg M[1], Buzzetti R[1,2], Patel K[1], Provencio N[1], Vedantam G[1,3], Parthasarathy S[1,2,4]

[1]Research Service Line, Southern Arizona VA HealthCare System, Tucson, AZ, USA, [2]Arizona Respiratory Center, University of Arizona, Tucson, AZ, USA, [3]Dept. of Veterinary Science, Microbiology, & Immunobiology, University of Arizona, Tucson, AZ, USA, [4]Department of Medicine, University of Arizona, Tucson, AZ, USA

Introduction: Sleep interruption in murine models is associated with weight loss and leads to elevated circulating levels of cytokines such as Interleukin-6 (IL-6). The abrogation of IL-6 in IL-6 knock-out mice (IL6-/-) is associated with an obese phenotype during adulthood. Whether the weight loss observed during sleep interruption in a murine model is mediated by IL-6 status is currently unknown, and may profoundly impact our understanding between sleep, body weight, and the immune system. Therefore, we set out to determine whether IL-6 status influences the relationship between sleep and body weight. We hypothesized that in a murine sleep interruption model, IL6-/- mice would manifest less weight loss than that observed in a wild-type mouse strain.
Methods: A 21-day study was performed with 32 IL6-/- mice (on a C57BL/6 background) of two different ages (<16 weeks old or >16 weeks old), and 25 wild-type (WT) C57BL/6 mice. All animals were subjected to either chronic sleep interruption (WT and IL6-/-) or a control condition involving no sleep interruption (IL6-/- only). Sleep interruption was performed only during the light cycle for 19 days and during both light and dark cycles on days 20 and 21.
Results: WT mice subjected to chronic sleep interruption lost weight (-8.4 + 4.5%) when compared to IL6-/- mice (-0.2 + 4.2%; P<0.0001). However, IL6-/- mice subjected to sleep interruption had no weight alteration over the 21-day period (P=0.9), and also did not lose weight compared to IL6-/- mice in the control group (P=0.3). The age of the mice did not impact these results.
Conclusion: IL6-/- mice do not exhibit weight loss in a murine chronic sleep interruption model. This argues for an important modulatory role for this cytokine in the relationship between sleep and body weight in mice.
Support (If Any): American Sleep Medicine Foundation.

0295

SLEEP DEPRIVATION DISRUPTS HUMAN BRAIN REACTIVITY IN RESPONSE TO FOOD DESIRE

Greer SM[1,2], Goldstein AN[1,2], Walker M[1,2,3]

[1]Sleep and Neuroimaging Laboratory, University of California, Berkeley, Berkeley, CA, USA, [2]Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, USA, [3]Department of Psychology, University of California, Berkeley, Berkeley, CA, USA

Introduction: Evidence supports a link between sleep loss and obesity, associated with changes in appetite and hormone regulation. However, the impact of sleep deprivation on central brain mechanisms underlying food appraisal remains unknown. Using fMRI and a food desire task, we discriminate between two potential brain mechanisms governing this sleep deprivation effect 1) amplifications in classical subcortical reward networks and primary taste areas, or 2) impaired integration of such primary signals in high-order cortical centers.
Methods: 16 healthy adults (8-female; age 18-25) participated in two fMRI sessions during which they rated their current desire for 80 foods: once after a night of normal sleep and once after 24-hr of deprivation in a repeated-measures cross-over design. Subjective taste ratings were taken after each scan.
Results: Sleep deprivation selectively and significantly impaired activity in high-order regions known to integrate affective signals, specifically the right anterior insula and dorsal anterior cingulate in response to desired foods. In contrast, equivalent reactivity was observed in classical subcortical reward regions as well as basic taste perception networks, including the medial orbital-frontal cortex, middle insula and caudate. Moreover, consistent with a failure of appetitive signal integration, sleep deprivation significantly decreased the correlation between food desire and taste ratings, indicating a compromised ability to utilize taste value in determining food desire, while no differences in mean ratings of either were observed.
Conclusion: These results describe a disruption in brain networks governing appetitive food stimulus evaluation under conditions of sleep deprivation. They demonstrate that sleep loss leads to a disregulation in systems integrating appetitive information, and not those coding primary food value. Such findings support a model in which sleep deprivation compromises appropriate food choices by impairing integration of complex appetitive signals, and provides a first mechanistic brain link between sleep loss and obesity; findings of broad public-health relevance.
Support (If Any): This work was supported by the National Institutes of Health: National Institute on Aging (RO1AG031164) and National Institute of Mental Health (R01MH093537).

0296

ALTERED NOCTURNAL SLEEP ARCHITECTURE IN RESPONSE TO PARTIAL SLEEP DEPRIVATION IS ASSOCIATED WITH INCREASED CARBOHYDRATE INTAKE

Shechter A[1], O'Keefe M[1], Roberts AL[2], Zammit G[3,4], RoyChoudhury A[5], St-Onge M[1]

[1]New York Obesity Research Center, St. Luke's/Roosevelt Hospital, Columbia University, New York, NY, USA, [2]School of Public Health, University of North Carolina-Chapel Hill, Chapel Hill, NC, USA, [3]Clinilabs Inc., New York, NY, USA, [4]Department of Psychiatry, Columbia University College of Physicians & Surgeons, New York, NY, USA, [5]Mailman School of Public Health, Columbia University, New York, NY, USA

Introduction: Reduced total sleep time (TST) is associated with weight gain and increased energy intake, though no study has explored the relationship between sleep stage percentages and energy balance.
Methods: Thirteen males and 13 females (BMI: 22-26 kg/m^2) participated in a crossover sleep curtailment study. Participants were studied under short (4 h/night; 01:00-05:00) and habitual (9 h/night; 22:00-07:00) sleep conditions for 5 nights. Ad libitum food intake was measured after 4 days of consuming a controlled diet and sleep was polysomnographically recorded nightly. Time in each sleep stage was expressed as a percentage of TST. Multiple regression analysis, with sleep stage percentages and number of REM periods as independent predictor variables and age, sex, body weight, and sleep condition as covariates was performed for energy and macronutrient intakes.
Results: During short compared to habitual sleep duration, stage 1 sleep was lesser (7.01% vs. 12.32%, p<0.01), stage 2 was lesser (49.17% vs. 54.23%, p=0.002), slow-wave sleep (SWS) was greater (23.95% vs. 12.00%, p<0.01), rapid-eye movement (REM) sleep was lesser (19.88% vs. 21.46%, p=0.05) and number of REM periods was lesser (2.5 vs. 5.27, p<0.01). Percent time spent in stage 1 (p=0.036), stage 2 (p=0.038), SWS (p=0.037), REM sleep (p=0.036), and number of REM periods (trend, p=0.079) were associated with carbohydrate intake. Sleep architecture was not associated with any other intake parameter.
Conclusion: Reductions in percentage of time in stage 1, stage 2, and REM sleep, and a raised SWS percentage are associated with higher carbohydrate intakes, indicating that the links between sleep and obesity extend beyond sleep duration alone. Future steps should explore changes in energy expenditure and subjective hunger/cravings as a function of altered sleep architecture. Studies demonstrated that reducing sleep leads to higher hunger for sweet foods. Our results suggest that specific changes in sleep architecture may be involved in this relationship.
Support (If Any): Funding support from the National Institutes of Health.

0297

SLEEP RESTRICTION ASSOCIATES WITH INCREASED FOOD INTAKE, WEIGHT GAIN AND CHANGES IN FOOD CRAVINGS IN HEALTHY ADULTS

Spaeth AM[1], Goel N[2], Dinges DF[2]
[1]Psychology, University of Pennsylvania, Philadelphia, PA, USA, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Short sleep duration disrupts the release of hormones that play a major role in appetite control and may be a novel risk factor for obesity and type 2 diabetes. The current study examined the effect of chronic partial sleep restriction (SR) on weight gain, food intake and food cravings under ad libitum feeding conditions.
Methods: N=180 healthy subjects (31.48±7.58y;99 males) participated in a laboratory-controlled protocol. Subjects underwent 2 baseline nights (10h TIB/night) followed by 5 SR nights (4h TIB/night). N=20 served as a 10h TIB/night control group. Subjects had 3 meals per day, access to snacks and an optional late night meal during SR nights. Height and weight were measured at the beginning and end of the study. A validated food craving inventory was completed nightly. In a subset of subjects (N=16), food intake was recorded daily and analyzed using The Food Processor SQL program. One-way and repeated measures ANOVAs were used for analyses.
Results: Although subjects in the control and SR conditions did not differ in body weight at study entry ($p=0.56$), SR subjects gained more weight than controls ($p<0.05$). Among SR subjects, males gained more weight than females and African Americans gained more weight than Caucasians (p's<0.05). While control subjects showed no changes in cravings, SR subjects unexpectedly showed decreased cravings for fats, sweets and carbohydrates ($p<0.05$). Among SR subjects, change in total cravings was negatively associated with BMI change in females ($p<0.05$) but positively associated with BMI change in males ($p<0.05$). Furthermore, more food was consumed after the first SR night compared with baseline ($p<0.05$), with a specific increase in protein and carbohydrates (p's<0.05).
Conclusion: Subjects undergoing sleep restriction experienced weight gain and an initial increase in food intake, but decreased food cravings during chronic sleep loss. Sleep restriction disrupts energy balance regulation in complex ways not yet fully understood.
Support (If Any): NIH NR004281; CTRC UL1RR024134; National Space Biomedical Research Institute through NASA NCC 9-58; the Department of the Navy, Office of Naval Research (Award No. N00014-11-1-0361).

0298

SLEEP RESTRICTION REDUCES SELF-REPORTED SATIETY AND INCREASES THE AMOUNT OF FOOD DESIRED AT NIGHT AS COMPARED TO DAY IN HEALTHY MEN

Banks S[1], Reynolds A[1], Harmer L[2], Liu P[3], Wittert G[2], Belenky G[4], Van Dongen H[4]
[1]University of South Australia, Adelaide, SA, Australia, [2]University of Adelaide, Adelaide, SA, Australia, [3]University of Sydney, Sydney, SA, Australia, [4]Washington State University, Spokane, WA, USA

Introduction: Sleep restriction (SR) has been found to impact energy intake and snacking behavior. However, there is limited data from laboratory controlled studies on the effect of SR and time of day on satiety and hunger. If the desire to eat is greater at night during SR, then this could explain why snacking behavior is increased at these times.
Methods: N=14 men (ages 23-32y) with an average BMI of 23.6kg/m2 completed a controlled, in-residence laboratory-based SR protocol of 2 nights baseline (B1 & B2, 10h TIB; 1000h-0800h) followed by 5 nights SR (SR1-5, 4h TIB; 0400h-0800h) and 1 night recovery (10h TIB; 1000h-0800h). Meals were timed (0910h, 1300h, 1830h), food intake was calorie controlled, snacking between meals was not permitted, and vigorous physical activity was not allowed. On B1 and SR5, visual analogue scales for hunger, food desired and satiety were completed at 1100h, 1230h, 1630h and 1930h (day) and 0000h and 0200h (night). Participants rated their hunger (1='not hungry at all' to 9='as hungry as I've ever felt'), amount of food desired (1='I could eat nothing at all' to 9='I could eat a large amount') and satiety (1='not at all full' to 9='as full as I've ever felt'). B1 versus SR5 and day versus night were compared using paired t-tests.
Results: Overall hunger ($p=0.43$), satiety ($p=0.32$) and amount of food desired ($p=0.28$) did not change with SR. However, on SR5, amount of food desired was increased ($p=0.039$) and satiety was decreased ($p=0.009$) at night compared to during the day. Self-reported hunger did not differ between night and day on SR5 ($p=0.15$).
Conclusion: While SR did not increase the overall desire to eat, satiety was decreased and amount of food desired was increased at night compared to during the day. This pattern suggests that the combination of SR and time of day could lead to an increased desire to consume more food even when not hungry.
Support (If Any): This study was supported by a University of South Australia Women in Science grant and in part through an international collaboration with the Sleep and Performance Research Center, Washington State University Spokane.

0299

ENERGY BALANCE CONSIDERATIONS DURING CHRONIC SLEEP RESTRICTION AND CIRCADIAN MISALIGNMENT

Buxton OM[1,2], Hu K[1,2], Wang W[1,2], Cain SW[1], Porter J[1], O'Connor SP[1], Mohamed YA[1], Duffy JF[1,2], Czeisler CA[1,2], Shea SA[1,2]
[1]Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Sleep restriction and circadian disruption affect energy balance. Acute circadian misalignment causes reduced leptin, and sleep restriction with controlled diet results in decreased leptin, and increased ghrelin and hunger, signaling negative energy balance. However, sleep restriction with ad lib diet, does not alter leptin or ghrelin but eating and weight increase. We examined whether a prolonged and combined exposure to sleep restriction and circadian disruption while on a stable diet leads to prolonged changes in energy balance in humans.
Methods: 21 non-obese, healthy adults (11 young, 11F) lived in controlled laboratory conditions with a controlled diet for ~5 weeks encompassing 3 conditions: (1) 6 baseline "sleep replete" days (>10 h sleep opportunity per 24 h); (2) 3 weeks of sleep restriction (5.6 h sleep/24 h) combined with circadian disruption (imposed 28-h sleep-wake, light-dark, and meal cycles); and a recovery period. Aspects of energy balance including body weight, basal metabolism, core body temperature, activity (actigraphy), leptin and ghrelin were assessed at controlled circadian phases or across all phases.
Results: Circadian disruption with sleep restriction (mean = 19 days) and constant consumed diet (average difference from baseline was 6 kcal/day, p=ns) was associated with a small reduction in body weight (young: -0.5 ± 3.9% mass, $p<0.04$; older: 0.5 ± 1.9% mass, $p<0.08$, n.s.), reduced resting metabolic rate (-8±7%, $p<0.0001$), a 55% increase in activity (actigraphy; $p<0.0001$), and a negligible decrease in average body temperature (-0.1 C; p=ns). Ghrelin increased significantly in older but not younger participants, whereas fat mass-adjusted leptin did not differ by condition or age.
Conclusion: Circadian disruption combined with sleep restriction for ~3 weeks while on a controlled stable diet caused a notable reduction in basal metabolism but did not result in weight gain. Presumably, the reduction in basal metabolism was offset by the increased energy expenditure associated with prolonged wakefulness.
Support (If Any): This work was supported by grants from the National Institute on Aging (P01 AG009975) and the National Heart, Lung, and Blood Institute (K24 HL76446), and was conducted in the Brigham and

Women's Hospital General Clinical Research Center supported by the National Center for Research Resources (NCRR M01 RR02635), the Center for Clinical Investigation of the Harvard Clinical and Translational Science Center (1 UL1 RR025758-01), and the Joslin Diabetes and Endocrinology Research Center Service (5P30 DK 36836) Specialized Assay Core. The content is solely the responsibility of the authors and does not represent the official views of the NCRR, NIA, NHLBI, or NIH. SWC was supported in part by a fellowship from Natural Sciences and Engineering Research Council of Canada.

0300

SLEEP RESTRICTION INCREASES THE NEURONAL RESPONSE TO UNHEALTHY FOOD STIMULI

Wolfe S[2], Sy M[3], Hirsch J[3], St-Onge M[1,2]
[1]New York Obesity Nutrition Research Center, St. Luke's/Roosevelt Hospital, New York, NY, USA, [2]Institute of Human Nutrition, Columbia University, New York, NY, USA, [3]Department of Radiology, Columbia University, New York, NY, USA

Introduction: Restricted sleep leads to increased food intake relative to habitual sleep in healthy individuals. Moreover, self-reported desire to eat sweet and salty foods is higher following a period of restricted sleep relative to habitual sleep. However, no study has differentiated neuronal activation patterns between healthy and unhealthy food stimuli after periods of restricted sleep.
Methods: Functional magnetic resonance imaging (fMRI) was used to compare the neural circuitry implicated in the hedonic response to unhealthy and healthy food stimuli after 5 nights of restricted sleep (4 h/night) and habitual sleep (9 h/night) in normal weight men and women (n =25). Unhealthy food (nutrient-poor: candy, pepperoni pizza), healthy food (nutrient dense: fruits and vegetables, oatmeal) and nonfood (office supplies) images were presented in a block design. Activated brain regions ($\geq$ 10 voxels, voxel-level $P < 0.05$) for healthy and unhealthy foods were contrasted to nonfood items.
Results: Following a period of restricted sleep, unhealthy foods led to greater activation in the superior and middle temporal gyrus, hypothalamus, right inferior frontal gyrus, right superior and inferior parietal lobules and right lateral insula relative to healthy food stimuli. Similar contrasts after a period of habitual sleep do not show marked differences in activity patterns specific to unhealthy foods.
Conclusion: Restricted sleep increases activation of specific brain regions, such as the insula and hypothalamus, in response to unhealthy food stimuli. We conclude that this effect is specific to restricted sleep as this neuronal pattern is not observed following a period of habitual sleep. These results suggest that restricting sleep may lead to an increased susceptibility to unhealthy foods by modulating the brain's homeostatic control system and may partly explain the increased overall appetite and desire for high fat and sweet foods that are recorded after a night of restrictedsleep.
Support (If Any): This study was funded by the National Institutes of Health grant #1R01HL091352-01A1 and 1 UL1 RR024156 from the National Center for Research Resources (NCRR), the National Institutes of Health (NIH), and NIH Roadmap for Medical Research.

0301

DIETARY INTAKE FOLLOWING EXPERIMENTALLY RESTRICTED SLEEP IN ADOLESCENTS

Simon S[1], Strotman D[1], Hemmer S[1], Summer S[3], Beebe DW[1,2]
[1]Beh Med & Clin Psychology, Cincinnati Children's Hosp Med Cntr, Cincinnati, OH, USA, [2]Pediatrics, University of Cincinnati College of Medicine, Cincinnati, OH, USA, [3]Clinical Translational Research Center, Cincinnati Childen's Hosp Med Cntr, Cincinnati, OH, USA

Introduction: One-third of US adolescents are overweight or obese. Greater rates of obesity have been observed in short-sleeping children and adults, and some studies suggest that short sleep predicts weight gain over time. Sleep deprivation in adults increases caloric intake, consumption of carbohydrates and fat, and cravings for sweet and salty foods. Adolescence is characterized by chronic sleep deficit and more autonomy in food choices, but the relationship between sleep and dietary intake has not been examined experimentally in teens.
Methods: 41 healthy-weight adolescents age 14-16 successfully completed a 3-week experimental sleep manipulation protocol. After a week establishing baseline sleep patterns, teens were assigned in counterbalanced order to 5 consecutive nights of sleep restriction (6.5 hours in bed Monday-Friday) versus healthy sleep duration (10 hours). Weekends served as a washout period between conditions. Actigraphy corroborated compliance with the sleep protocol, and participants completed validated 24-hour diet recall interviews on the Saturday following each condition. Paired-sample t-tests examined differences between conditions for consumption of key macronutrients (total calories, glycemic index and load, and grams fat, protein, and carbohydrate) and food choices from conceptually-distinct dietary categories.
Results: Compared to the healthy-sleep condition, during sleep restriction the teens' diets were characterized by higher glycemic index (GI) and load ($p<.05$, one-tailed), and a trend towards more calories and carbohydrates. No differences in fat or protein consumption were found. Exploratory analyses revealed that adolescents consumed significantly more sweets/desserts during sleep restriction than during healthy sleep ($p<.05$, two-tailed).
Conclusion: Sleep restriction appears to cause increased consumption of high GI foods, particularly sweets/dessert items. Eating high GI foods spurs rapid changes in serum glucose and hormonal/metabolic shifts that have been linked to subsequent overeating. The chronic sleep restriction that is common during adolescence may cause changes in dietary behaviors that increase risk of obesity and associated morbidity.
Support (If Any): National Institutes of Health (R01 HL092149, UL1 RR026314).

0302

THE IMPACT OF SLEEP DEPRIVATION ON HUMAN BRAIN FUNCTION: A COMPREHENSIVE WHOLE BRAIN META-ANALYSIS

Greer SM[1,2], Slattery PJ[1,3], Walker M[1,2,3]
[1]Sleep and Neuroimaging Laboratory, University of California, Berkeley, Berkeley, CA, USA, [2]Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, USA, [3]Department of Psychology, University of California, Berkeley, Berkeley, CA, USA

Introduction: Over the past two decades, a sizable collection of brain imaging investigations have examined the impact of sleep deprivation on a broad array of human brain functions, ranging from cognition to emotion. However, it remains unknown what, if any, common profile of neural consequences are systematically imposed by sleep loss. Using a validated analysis approach, here we perform the first meta-analysis of neuroimaging studies characterizing the impact of sleep deprivation on human brain function.
Methods: Limiting studies only to those examining the impact of total acute sleep deprivation, relative to normal sleep rested conditions, a total of 20 functional neuroimaging reports (fMRI, PET) were entered into an Activation Likelihood Estimate (ALE) meta-analysis. These studies spanned domains of sustained and directed attention, long-term and working memory, emotional reactivity, reward processing and logical reasoning.
Results: Significant common regions of increased (re)activity under conditions of sleep deprivation were identified in subcortical mesolimbic networks including the left amygdala and caudate, right anterior insular, as well as bilateral thalamus and left superior frontal gyrus. In contrast, regions associated with memory and spatial attention networks consistently showed impairments of activation under conditions of sleep loss, included bilateral visual cortex, bilateral superior parietal cortex, and left superior frontal cortex.

Conclusion: These data provide the first systematic characterization of the impact of sleep deprivation on the human brain. Rather than unidirectional impairments, a striking bi-direction disconnect was observed between basic subcortical motivation centers and higher order cortical regions. Specifically, following sleep deprivation, amplified reactivity was identified in a classical mesolimbic subcortical networks, combined with impoverished activity in memory and visuospatial attention networks, together with left lateral prefrontal cortex. Beyond the public-health and professional implications, such findings are of special clinical relevance in understanding the mechanistic relationships between sleep loss and both psychiatric mood disorders and addiction disorders.
Support (If Any): This work was supported by the National Institutes of Health: National Institute on Aging (RO1AG031164) and National Institute of Mental Health (R01MH093537).

0303

CHRONIC SLEEP RESTRICTION IMPAIRED BRAIN TISSUE OXYGENATION IN FRONTAL LOBE

Miyata S[1], Noda A[1], Iwamoto K[2], Ozaki N[2]
[1]Department of Biomedical Sciences, Chubu University, Kasugai, Japan, [2]Department of Psychiatry, Nagoya University Graduate School of Medicine, Nagoya, Japan

Introduction: Cumulative sleep restriction increases the risk of neurobehavioral deficits. Near infrared spectroscopy (NIRS) has enabled the noninvasive investigation of brain functions in psychiatric disorders with measurement of oxyhemoglobin (oxyHb) concentrations. We demonstrated that the acute sleep restriction (time in bed < 4h/night) impaired cortical oxygenation response during word fluency task. The purpose of this study was to investigate the effect of chronic sleep restriction on cerebral blood flow response.
Methods: Eight healthy university students (age 20.1±1.6 yrs) were included in this study. All participants spent > or = 7h/night in bed prior to study day (sufficient sleep), followed by < 4h/night in bed for 3 days. The oxyHb concentration by a word fluency task was measured with NIRS on the mornings following sufficient sleep and sleep < 4h/night. The profile of mood states (POMS) - short form and Stanford sleepiness scale (SSS) were administered in the same days. All subjects recorded sleep logs and worn actigraphy to monitored sleep/wake rhythm. The peak oxyHb, SSS and POMS were compared among sleep < 4h/night and sufficient sleep using one-way analysis of variance with Sheffe's test. Pearson's correlation test was used to examine the relationship between NIRS and SSS and POMS from sufficient sleep to insufficient sleeps.
Results: SSS after third night of sleep < 4h significantly increased compared with that after sufficient sleep. The peak oxyHb during the word fluency task was significantly reduced after sleep < 4h/night than that after sufficient sleep. Decrease in peak oxyHb on NIRS significantly related with increase in SSS. There was no significant difference on POMS among sufficient- and insufficient sleeps.
Conclusion: Chronic sleep restriction impaired cortical oxygenation response during word fluency task and related with sleepiness.

0304

CONVERGENCE OF VIGILANCE DECREMENTS AND SLEEP DEPRIVATION EFFECTS IN BRAIN AREAS RECRUITED BY AN ATTENTION-DEMANDING TASK

Asplund CL, Mulick D, De Havas JA, Chee M
Neuroscience and Behavioral Disorders, Duke-NUS Graduate Medical School Singapore, Singapore, Singapore

Introduction: Sustaining attention over an extended duration and sleep deprivation both result in impaired behavioral performance on many attention-demanding tasks. Accompanying the behavioral alterations are changes in brain activation in fronto-parietal attention networks and extrastriate cortex. Here we tested whether the brain regions recruited by a demanding visual search task would also show shifts in activation as a result of time-on-task effects compounded by sleep deprivation.
Methods: The task consisted of a rapid serial visual presentation (RSVP) search, in which subjects responded to target letters amongst distractors. Each of 20 subjects performed the task twice, once when rested and once when sleep deprived. The task was presented in four 6.5-minute runs, each containing six 32-second task blocks. In half of these blocks, the contrast was reduced to 30%, allowing us to assess perceptual and attentional effects separately. Concurrently, subjects were scanned using pulsed arterial spin labeling (PASL). The parameters enabled us to measure both cerebral blood flow (CBF) and BOLD signals.
Results: The RSVP search was demanding, as evidenced by poorer target detection and longer response times across time, state, and contrast levels. The task recruited canonical regions mediating attention in the frontal-parietal cortex as well as bilateral insula and visual cortex. Regions showing reduced activation during sleep deprivation included bilateral intra-parietal sulcus (IPS), lateral frontal cortex, and ventrolateral extrastriate cortex. Reduced contrast affected different regions, most notably striate and extrastriate visual cortex (VC). Decreased CBF corresponding to a time-on-task effect was observed in the IPS and VC.
Conclusion: These results indicate that there are perceptual and attention aspects to time-on-task effects. Regarding the latter, sleep deprivation's deleterious effects on attention may include time-on-task effects in select task-activated brain regions, especially the IPS.
Support (If Any): This work was funded by the Defense Science and Technology Agency, Singapore (POD 00713897), and by a National Research Foundation STaR Award (00004/2008), both to MWLC.

0305

NEUROBEHAVIORAL AND PHYSIOLOGICAL EFFECTS OF HIGH COGNITIVE WORKLOAD AND CHRONIC SLEEP RESTRICTION

Braun ME, Goel N, Dinges DF
Psychiatry, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Although sleep loss degrades cognitive functions, little attention has been devoted to determining whether waking cognitive activity potentiates the effects of sleep loss, even though time on task is often considered an important fatigue factor in addition to time awake. This experiment evaluates the effects of variation in cognitive workload and variation in sleep restriction on neurobehavioral performance, self-rated perceptions, and NREM EEG slow-wave energy (SWE).
Methods: N=63 healthy adults (33.2 ± 8.7y; 29 females) of N=80 total subjects to be tested, completed a 10-day laboratory experiment with randomization to 1 or 4 conditions (moderate cognitive workload [MW] + sleep restriction [SR]; high cognitive workload [HW] + SR; MW + no sleep restriction [NSR]; HW + NSR). SR entailed 5 nights at 4h TIB; NSR entailed 5 nights at 8h TIB. Subjects had 3 workload test sessions/day of either 180 min (HW) or 90 min (MW). Mixed-model (night×condition) ANOVAs compared differences across the 4 experimental conditions.
Results: Preliminary data analyses indicate that higher cognitive workload under sleep-restricted conditions potentiated deficits in perceptions of fatigue (as measured by a visual analog scale; $p < 0.05$), but did not significantly increase deficits in Psychomotor Vigilance Test (PVT) performance or executive functioning (measured by COWAT and Hayling tests), or degrade the ability to resist sleep [as measured by the Maintenance of Wakefulness Test (MWT); all p's >0.05].
Conclusion: The results from this experiment suggest that the combination of high workload and sleep restriction exacerbates perceptions of fatigue but not behavioral or physiological indices. If these findings hold up with the final sample size, they will provide the first evidence that the duration of cognitive work performed during periods of chronic sleep restriction can have additive effects on subjective fatigue.
Support (If Any): National Space Biomedical Research Institute through NASA NCC 9-58 and CTRC UL1RR024134.

0306

ESTIMATING RELATIVE VULNERABILITY TO SLEEP LOSS FROM FEATURES OF DAYTIME PSYCHOMOTOR VIGILANCE PERFORMANCE

Chua EC[1], Lee I[1], Yeo S[2], Tan L[1], Lau P[1], Puvanendran K[2], Gooley JJ[1]
[1]Program in Neuroscience and Behavioral Disorders, Duke-NUS Graduate Medical School, Singapore, Singapore, [2]National Neuroscience Institute, Singapore, Singapore

Introduction: Some individuals show severe cognitive impairments in response to sleep loss, whereas others are able to maintain high levels of performance. At present, there is no reliable method for predicting how well a person will cope with sleep deprivation. Here, we examined whether daytime performance on the psychomotor vigilance task (PVT) can be used to estimate a person's relative vulnerability to the effects of sleep deprivation on sustained visual attention.
Methods: Healthy volunteers (n = 45, ages 21-30) were kept awake for 26 hours in a controlled laboratory environment. Every two hours, participants completed a 10-minute PVT, and sleepiness was assessed objectively by percentage eye closure (PERCLOS). We stratified participants into top, intermediate, and bottom performance groups based on the number of PVT lapses during the usual hours of sleep.
Results: Between the top and bottom performance groups, there was no difference in pre-study sleep wake behavior. PERCLOS, EEG delta activity, and subjective sleepiness were also similar during rested wake. These suggest that differences in vulnerability to sleep loss were not due to differences in baseline sleepiness levels. However, variability in PVT response times when participants were well-rested correlated with the number of PVT lapses and percentage eye closure (PERCLOS) during subsequent sleep deprivation. Participants whose rested PVT variability was high had relatively more PVT lapses and closed their eyes more frequently during sleep deprivation. In contrast, participants with low PVT variability during the daytime were more sleep deprivation resilient based on PERCLOS and PVT performance.
Conclusion: Our findings raise the possibility that it may be possible to estimate a person's relative vulnerability to sleep loss by assessing features of his/her daytime performance.
Support (If Any): Research was supported by the Duke-NUS Signature Research Program funded by A*STAR and the Ministry of Health, Singapore; National Medical Research Council, NIG09may007; SingHealth Foundation, SHF/FG410P/2009.

0307

THE ACCURACY OF EYELID MOVEMENT PARAMETERS FOR DETECTING LAPSES FOLLOWING SLEEP RESTRICTION

Howard M[1], Wilkinson VE[1], Jackson ML[1], Barnes M[1], Stevens B[1], Westlake J[1], Swann P[2], Rajaratnam S[3]
[1]Institute for Breathing & Sleep, Austin Health, Heidelberg, VIC, Australia, [2]Department of Road Safety, Vicroads, Kew, VIC, Australia, [3]School of Psychology & Psychiatry, Monash University, Clayton, VIC, Australia

Introduction: Changes in the frequency, velocity and duration of eyelid movements occur in drowsy subjects. We evaluated the accuracy of several eyelid movement parameters for detecting behavioural lapses following sleep restriction using the Optalert™ Drowsiness Measurement System (ODMS), including: Percent Long Closures (%LC): proportion of time eyes are closed; Inter-Event Duration(IED): time between maximum closing/opening velocity of eyelid, Blink Total Duration (BTD): total duration of blinks, Positive Amplitude-Velocity Ratio (AVR): AVR for closing phase of blinks.
Methods: 20 participants completed two 40 minute Oxford sleep resistance tests (OSLER) and the Psychomotor Vigilance Task (PVT) following a night of sleep restriction to four hours with simultaneous ODSM recordings. We assessed the accuracy of eyelid movement variables for detecting frequent missed signals on the OSLER using ROC curve analysis (ROC AUC). We selected optimal cut-offs from the most accurate variable and assessed their accuracy for detecting behavioural lapses on the PVT.
Results: The ROC curve AUC for detecting four or more missed signals on the Osler in a minute were 0.64 for %LC, 0.83 (IED), 0.77 (BTD) and 0.76 (AVR). We assessed the accuracy of the IED for detecting different lapse frequencies within a one minute period on the PVT using a cut-off of 0.206 s. This provided sensitivities and specificities of: 32.7% & 91.1% for 1 lapse; 53.7% & 89.0% (2 lapses); 71.0% & 88.3% (3 lapses); 78.6% & 86.8% (4 lapses); 100% & 86.3% (5 lapses).
Conclusion: In this sleep restriction paradigm, measurement of eyelid movements accurately detected frequent episodes of failure to respond to visual signals, with those measuring the average duration of episodes of eye closure (IED & BTD) providing the greatest accuracy. A high average IED was a specific indicator for having lapses on the PVT and was sensitive for detecting frequent behavioural lapses, but not single lapses.
Support (If Any): Vicroads, Australia.

0308

EFFECT OF BASELINE LEVEL OF PHYSICAL ACTIVITY ON THE MAGNITUDE OF ITS DECLINE IN RESPONSE TO SLEEP LOSS

Bromley L[1], Booth JN[1], Kilkus J[2], Alcantar L[1], Imperial J[2], Penev P[1]
[1]Department of Medicine, University of Chicago, Chicago, IL, USA, [2]Clinical Research Center, University of Chicago, Chicago, IL, USA

Introduction: Self-reported sleep <6 h/day is associated with increased incidence of obesity and type-2 diabetes. Sleep-loss-related reduction in physical activity may contribute to this association. Adults with a parental history of type-2 diabetes have a high risk of developing the disease, particularly in the setting of physical inactivity. This study tested whether sleep curtailment results in decreased physical activity in such at-risk individuals.
Methods: Eighteen participants with parental history of type-2 diabetes (9F/9M, age 27 [SD 3] y, BMI 23.7 [2.3] kg/m2) completed two week-long inpatient sessions with 8.5 and 5.5-h nighttime sleep opportunity in random crossover fashion. Approximately 40% of participants exercised regularly (exercise group) and could follow their usual workout routines during the study. Non-exercisers could spend up to 60 min/day outside of the laboratory on the university campus. Sleep and total body movement were measured by wrist actigraphy and waist accelerometry. The main outcome was the comparison of total activity counts between sleep conditions with exercise category as a between-subject factor. Ancillary endpoints included changes in sedentary, light, and moderate-plus-vigorous activity.
Results: Daily sleep was reduced by 2.3 h and total activity counts were 31% lower (P=0.020) during the 5.5-h time-in-bed condition. This was accompanied by a 24% reduction in moderate-plus-vigorous activity time (P=0.005) and more sedentary behavior (+21 min/day; P=0.020). Participants in the exercise group had more total daily movement (P=0.012), and were responsible for most of the sleep-related decrease in physical activity (-39 vs. -4% in exercisers vs. non-exercisers; P=0.027). These subjects re-allocated almost a third (31%) of their moderate-plus-vigorous activity time during the 8.5-h time-in-bed condition (-30 [12] min/day) to less intense light and sedentary activities when their sleep was curtailed.
Conclusion: Sleep restriction leads to decreased amount and intensity of physical activity in non-sedentary adults at risk for type-2 diabetes.
Support (If Any): NIH grants R01-HL089637, CTSA-RR024999, and P60-DK020595.

0309

TIRED, ANXIOUS AND EXPECTING THE WORST: THE IMPACT OF SLEEP DEPRIVATION AND ANXIETY ON EMOTIONAL BRAIN ANTICIPATION

Goldstein A[1,2], Greer SM[1,2], Saletin JM[1,3], Harvey AG[3,4], Walker M[1,2,3]
[1]Sleep and Neuroimaging Laboratory, University of California, Berkeley, Berkeley, CA, USA, [2]Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, USA, [3]Psychology, University of California, Berkeley, Berkeley, CA, USA, [4]The Golden Bear Sleep and Mood Research Clinic, University of California, Berkeley, Berkeley, CA, USA

Introduction: Anticipation is a fundamental brain process supporting the adaptive prediction of impending danger. However, excessive anticipatory reactions can be maladaptive, and represent a core feature of various psychopathologies that display co-occurring sleep abnormalities, especially anxiety disorders. Despite the striking overlap in limbic brain networks that mediate anticipation, specifically the amygdala and insula, and those known to be altered by sleep loss, the impact of sleep-deprivation on the neural mechanisms of anticipatory reactivity remains unknown, as does the influence of anxiety status on this interaction.
Methods: 18 healthy adults (19.6±1.45yrs; 9-female) participated in a repeated-measures cross-over design, performing an emotional anticipation task during fMRI scanning twice: once after a normal night of sleep and once after 24hrs of total sleep-deprivation. The anticipation task contained three cue conditions: (1) aversive-anticipation, followed by an aversive-stimulus, (2) neutral-anticipation, followed by a neutral-stimulus, and (3) ambiguous-anticipation followed by either an aversive- or neutral-stimulus. Participant trait-anxiety levels were additionally assessed using a validated inventory.
Results: Sleep-deprivation markedly amplified anticipatory activation in bilateral regions of the amygdala, with no difference in profile or extent of amplification across the cue types. Moreover, the extent of deprivation-induced increase in anticipation activity within the insula was determined by anxiety status, such that those with higher trait-anxiety showed the greatest amplifications in insula activity. Finally, the extent of deprivation-induced amygdala activation during the anticipation phase significantly predicted the subsequent magnitude of amygdala reactivity to the actual stimuli, most dramatically for the aversive-anticipation--aversive-stimulus condition.
Conclusion: These findings demonstrate that sleep-deprivation markedly exaggerates anticipatory activity within the human brain, with dissociable aspects of this amplification being governed by participant's degree of anxiety. Considering the importance of appropriate anticipation, and its maladaptive contribution to anxiety disorders, which express co-occurring sleep disruption, the clinical and public health ramifications of such findings are significant.
Support (If Any): Supported by National Institutes of Health: [RO-1AG031164] and [R01MH093537] (MPW), and [5F31MH094075-02] (AG).

0310

IN-CAR COUNTERMEASURES OPEN WINDOW AND MUSIC REVISITED ON THE REAL ROAD: POPULAR BUT HARDLY EFFECTIVE AGAINST DRIVER SLEEPINESS

Schwarz JF[1], Ingre M[1], Fors C[2], Anund A[2], Taillard J[3], Philip P[3], Kecklund G[1], Åkerstedt T[1]
[1]Stress Research Institute, Stockholm University, Stockholm, Sweden, [2]The Swedish Road and Transport Institute, , Linköping, Sweden, [3]University of Bordeaux, , Bordeaux, France

Introduction: Sleepiness accounts for approximately 20% of motor vehicle accidents. Effective countermeasures against driver sleepiness could consequently add great benefit to traffic safety. According to a recent survey, listening to music and opening the window are the second and third most commonly used countermeasures.
Methods: In total, 24 individuals participated in the study. Sixteen participants received intermittent 10min intervals of (i) open window and (ii) listening to music, during both day and night driving on an open motorway (each drive approximately 90min). 8 participants served as control groups. The effects of open window and music on driver sleepiness were investigated using multilevel mixed effects regression modelling for subjective sleepiness (KSS) and physiological sleepiness (blink duration).
Results: Both subjective sleepiness and physiological sleepiness (blink duration) was estimated to be significantly reduced when subjects listened to music, but the effect was only minor compared to the pronounced effects of night driving and driving duration. Open window had no attenuating effect on the sleepiness measures. No significant long-term effects beyond the actual countermeasure application intervals occurred as shown by comparison to the control group.
Conclusion: In summary, music showed only slight beneficial effects and opening the window was ineffective in countering sleepiness during real road driving. Thus, these countermeasures are presumably of little practical relevance in overcoming the substantial effects of night-time and prolonged driving, and should not be used as sole countermeasures, and when used, perhaps only in order to find a suitable place to apply more effective strategies, such as taking a nap or consuming caffeine.
Support (If Any): The study was financed by VINNOVA (a government research funding organization) and coordinated by the EU programme ERAnet.

0311

PERIOD3 VNTR POLYMORPHISM MODIFIES SLEEPINESS DURING REAL ROAD DRIVING

Schwarz JF[1], Ingre M[1], Anund A[2], Fors C[2], Karlsson JG[3], Kecklund G[1], Van der Veen DR[4], Archer SN[4], Dijk D[4], Åkerstedt T[1]
[1]Stress Research Institute, Stockholm University, Stockholm, Sweden, [2]The Swedish Road and Transport Institute, , Linköping, Sweden, [3]University of Surrey, Surrey Sleep Research Centre, Faculty of Health and Medical Sciences, Guildford, Sweden, [4]Autoliv AB, , Vårgarda, Sweden

Introduction: Individual differences in response to sleep loss have been described in various settings including driver sleepiness. A potential biological marker for this differential vulnerability is a PERIOD3 (PER3) Variable Number (4 or 5) Tandem Repeat polymorphism (rs57875989), for which homozygosity for the 5 repeat (PER35/5) has been associated with increased homeostatic sleep pressure and cognitive performance deficits in laboratory conditions. This is the first study so far experimentally investigating the effect of this polymorphism on sleepiness and performance outside the laboratory.
Methods: 18 PER3 4/4 homozygotes and 10 PER3 5/5 homozygotes drove during day, evening and night for approximately 90 minutes on real roads. Subjective sleepiness was measured every 5th minute, physiological sleepiness (blink duration, delay of eyelid reopening) was measured continuously. Driving performance was averaged over the whole condition.Statistical analyses were conducted using multilevel mixed effects regression modelling.
Results: Subjective sleepiness showed a steeper rise during evening and night conditions in PER3 5/5 individuals. The PER3 polymorphism was also associated with individual differences observed in one of the physiological sleepiness indicators (delay of eyelid reopening). While the standard deviation of lateral position and blink duration showed clear effects of condition and time on task, PER3 genotype was not significantly related to individual differences in these measures.
Conclusion: The PER3 VNTR polymorphism contributed significantly to individual differences in subjective and physiological sleepiness during real road driving; yet observed individual differences were still pronounced.
Support (If Any): This study was funded by the Swedish government research funding organization for Intelligent Vehicle Systems (IVSS).

0312

WHAT COMES BEFORE TERMINATING A NIGHT DRIVE BECAUSE OF DANGEROUS SLEEPINESS - A STUDY OF REAL MOTORWAY DRIVING AT HIGH LEVELS OF SLEEPINESS

Akerstedt T[1,2], Anund A[3], Fors C[3], Sandberg D[3], Kecklund G[1,2]
[1]Stress research, Stockholm University, Stockholm, Sweden, [2]Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden, [3]VTI - Swedish Road and Transport Research Institute, Stockholm, Sweden

Introduction: Sleepiness is a major cause of occupational and other accidents. Most of the evidence derives from inference from the setting (e.g. night work), or from retrospective reports as well as from laboratory simulations. Since laboratory simulations may not generalize to real life, the present study aimed to describe the level of sleepiness during night driving on a motorway before the driver aborted because of excessive sleepiness (a proxy for an accident).
Methods: 18 participants drove on a motorway for 90 minutes during an afternoon (15p.m -20 p.m), and late night session (1a.m to 5a.m). The vehicle was an instrumented car, which recorded speed, road position, steering wheel patterns, and breaking. EEG and EOG, measures were used to monitor sleepiness, as well as sleepiness ratings every 5 minutes (Karolinska Sleepiness Scale - KSS). The drivers were instructed to stop driving if they felt that safety was compromised. A driving inspector monitored the drive from the right front seat (with double command). The study had ethical permission from the regional committee, as well as a special permission from the government. The data was analyzed using repeated measures ANOVA.
Results: 7 of the 18 drivers aborted the drive prematurely after 45-60 minutes. Before aborting, this group showed significantly increased: subjective sleepiness (KSS= 8.1 on the 1-9 scale vs controls at KSS = 7.0), number of (2-3 times) intrusions of alpha and theta activity in the EEG, blink duration (133ms vs 116ms), number of unintentional line crossings (0.4 vs 0.05 per 5 min), and lateral variability (28 vs. 22cm).
Conclusion: Aborting driving in the face of dangerous sleepiness is associated with increased levels of physiological indicators of sleepiness, erratic driving and high levels of perceived sleepiness.The results probably comes close to maximum sleepiness before falling asleep at the wheel and causing an accident.
Support (If Any): Autoliv Inc.

0313

UNOBTRUSIVE TRACKING OF SLOW EYELID CLOSURES AS A MEASURE OF FATIGUE FROM SLEEP LOSS

Jones CW[1], Basner M[1], Yu X[2], Yang F[2], Goel N[1], Metaxas D[2], Dinges DF[1]
[1]Division of Sleep and Chronobiology, Department of Psychiatry, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, USA, [2]Center for Computational Biomedicine Imaging and Modeling Center, Rutgers University, Piscataway, NJ, USA

Introduction: Sleep loss results in deficits in behavioral alertness and cognitive performance. Techniques are needed that objectively and unobtrusively identify fatigue while people are engaged in safety-sensitive work. Double-blind controlled trials by our laboratory have found tracking slow-eyelid closures (PERCLOS) as one of the most reliable ways to detect reductions in behavioral alertness as measured by lapses of attention due to sleep loss. In a collaboration to develop an unobtrusive and practical way to track PERCLOS, we used video of the human face during Psychomotor Vigilance Test(PVT) performance to determine if a computational model-based tracker of eyelid closures based on optical computer recognition(OCR) could predict PVT lapses during sleep deprivation.
Methods: N=33 healthy adult subjects (35±8y; 12f) completed a 3-night laboratory experiment and were randomized to either acute total sleep deprivation (TSD; 0h TIB) or no sleep deprivation (NSD; 9h TIB) on the second night. Subjects completed a 20-min PVT every 2h while awake. Images of the face were recorded during each PVT test bout using a high-definition digital camera. PERCLOS was automatically scored by a special OCR algorithm developed by Metaxas et al.
Results: Analyses from N=9 TSD subjects validate that the OCR algorithm can successfully track and score the state of the eyelid in an on-line, real-time manner, and detect the occurrence of PVT lapses of attention ($r=0.57-0.93$; $p<0.0001$). In an increasingly fine-grained analysis, coherence decreased as the length of the time interval decreased (i.e. 20, 10, 5min, etc.) but remained relatively large even based on 1-minute intervals. OCR also accurately detected no PERCLOS (with low PVT lapse frequency) for N=8 NSD subjects.
Conclusion: Results validate the potential of an automated OCR detection algorithm using video of the face during performance to accurately detect fatigue. Development of an unobtrusive fatigue monitoring system will improve safety and performance in situations involving sleep loss.
Support (If Any): Supported by the National Space Biomedical Research Institute through NASA NCC 9-58 and CTRC UL1RR024134.

0314

SEX DIFFERENCES IN THE RESPONSE TO ACUTE SLEEP DEPRIVATION

Cain SW[1], Chua EC[2], Cooper EA[3], Gooley JJ[2], Lockley SW[1]
[1]Division of Sleep Medicine, Harvard Medical School, Brigham and Women's Hospital, Boston, MA, USA, [2]Graduate Medical School, Duke-NUS, Singapore, Singapore, [3]Department of Psychiatry, Clinical Medicine, Brighton and Sussex Medical School, Brighton, United Kingdom

Introduction: Women have been reported to respond more poorly than men to shift work schedules. Women have more health complaints, higher absenteeism from work, a higher prevalence of sleep disturbances and more drowsiness at work than men. The constellation of symptoms may be considered a shift work "intolerance syndrome" to which women are particularly susceptible. To examine sex differences in subjective and objective measures of alertness under controlled laboratory conditions, we studied healthy young women and men across 50 hours of continuous wakefulness in a constant routine protocol (CR).
Methods: After three baseline days in the laboratory subjects began a CR, during which they were on a regimen of enforced semi-recumbent wakefulness in constant dim lighting conditions for 50 hours. Subjects completed 9-point Karolinska Sleepiness Scales (KSS) to measure subjective sleepiness every hour. Objective alertness was measured using the Psychomotor Vigilance Test (PVT) every two hours. For the PVT, lapses of attention, mean reaction time (RT) and anticipations were recorded.
Results: Women and men reported greater subjective sleepiness and displayed decrements in performance with continued wakefulness. Women had a significantly higher overall KSS score than men, indicating decreased subjective alertness. Women also had significantly more lapses of attention, slower RTs, but similar anticipations to men. KSS scores for men and women were overlapping until the mid biological night (~20 hours after waking). The pattern of mean PVT RTs was similar to the KSS, with overlapping values for the two sexes until the biological night. Women demonstrated more lapses of attention throughout most of the CR. Women did not demonstrate fewer anticipations. Though sex differences in subjective and objective measures of alertness (KSS and mean PVT RT) were most evident in the biological night, women continued to report greater sleepiness and display more lapses of attention into the following biological day.
Conclusion: These results suggest that women may be more vulnerable to the effects of acute sleep deprivation on alertness, independent of biological time.
Support (If Any): 5R01MH045130 (NIMH).

0315

INDIVIDUAL DIFFERENCES IN LAPSES OF ATTENTION DURING SLEEP DEPRIVATION ARE STABLE ACROSS THE BIOLOGICAL NIGHT AND SUBSEQUENT BIOLOGICAL DAY

Tucker AM[1], Czeisler CA[2,3], Wright KP[1,2,3]
[1]Sleep and Chronobiology Laboratory, Department of Integrative Physiology, University of Colorado, Boulder, CO, USA, [2]Division of Sleep Medicine, Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [3]Department of Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Here we explore whether individual differences in cognitive impairment due to sleep loss are stable across the biological day and the biological night.
Methods: Fifteen healthy adults (7 female) aged 27.5±10.1 participated. Following 3 baseline days, participants were sleep deprived under constant routine (CR) conditions for 40h, had 3 intervening nights with 8h, 4h and 8h time in bed respectively, and then repeated a 40h CR. Every 2h participants performed the auditory psychomotor vigilance task (aPVT). Lapse (RT>400ms) data were linearly interpolated to align with the dim light melatonin onset (DLMO25%) separately for each CR. Data were averaged across 8h of the first CR, beginning on average at 3.2±0.2h awake, as baseline; across 10h beginning with the DLMO25% (on average at 15.2±0.2h awake) as the biological night, and across the subsequent 8h as the biological day. Difference scores were calculated by subtracting baseline from biological nights and biological days. A mixed-effects ANOVA was used with the difference scores in aPVT lapses as the dependent variable (4 data points per subject), subject as a random factor, first or second CR as a fixed factor, and the following covariates: phase angle of entrainment between DLMO25% and habitual waketime, sex, age, morning-eveningness score, and a categorical variable marking biological day versus biological night. From this model an intraclass correlation coefficient (ICC) was calculated to determine the stability of individual differences.
Results: Stable individual differences were signitficant and explained half of the attributable variance (ICC = 0.52, $p<0.001$). No covariates were significant.
Conclusion: These preliminary findings suggest that individual differences in the magnitude of aPVT lapses of attention during sleep deprivation are stable comparing the entirety of the biological night and the following biological day. These differences were not explained by demographic characteristics such as sex, age, or morning-eveningness score.
Support (If Any): Supported by NIH R01-MH45130, NIH T32-DK07529, General Clinical Research Center Grant GCRC-M01-RR02635 from the National Center for Research Resources, and by The Medical Foundation & Harold Whitworth Pierce Charitable Trust.

0316

NEUROPSYCHOLOGICAL PREDICTORS OF RESILIENCE TO SUBJECTIVE AND OBJECTIVE SLEEPINESS DURING SLEEP DEPRIVATION

Tucker AM[1], Stern Y[2]
[1]Integrative Physiology/Sleep and Chronobiology Laboratory, University of Colorado, Boulder, Boulder, CO, USA, [2]Cognitive Neuroscience Division of the Department of Neurology, Columbia University College of Physicians and Surgeons, New York, NY, USA

Introduction: Inter-individual differences to the consequences of sleep deprivation are trait-like and span an order of magnitude, but are poorly understood. Further, the inter-individual differences in objective performance impairment on the one hand, and subjective symptoms such as increased sleepiness on the other hand, appear to be dissociated. This study identifies neuropsychological predictors of resilience to subjective and objective consequences of sleep deprivation.
Methods: In three separate studies, subjects were exposed to 48 hours of total sleep deprivation while being supervised continuously in the sleep laboratory of an academic medical center. Neuropsychological testing was administered at baseline, prior to the start of the sleep deprivation period. Participants were 54 healthy young men and women (aged 20-35 years).
Results: Those with faster speeded processing and set switching at baseline, as measured by the Digit Symbol Substitution and the Trail Making Test, were more resilient against subjective sleepiness during sleep deprivation ($F=4.18$, $p<0.05$). By contrast, those who made fewer perseverative errors on the Wisconsin Card Sorting Task - a measure of good performance monitoring - at baseline were more resilient during sleep deprivation against performance decrements on Psychomotor Vigilance Task performance, operationalized in terms of false starts, slowing, and lapses (all $Fs \geq 4.19$, all $ps<0.05$).
Conclusion: Here we identify separable baseline neuropsychological predictors of resilience for subjective versus objective sleepiness. Those with better baseline speeded processing and set switching were resilient to subjective sleepiness while those with better baseline performance monitoring were resilient to objective performance decrements.
Support (If Any): Defense Advanced Research Projects Agency (DARPA) grant DAAD 19-02-01-01147, and National Institute of Aging (NIA) grant T32 AG00261.

0317

RELATIONSHIP OF CIRCADIAN PHASE TO NEUROBEHAVIORAL VULNERABILITY TO SLEEP RESTRICTION

Goel N, Dominguez J, Braun ME, Dinges DF
Division of Sleep and Chronobiology, Department of Psychiatry, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, USA

Introduction: Subjects undergoing sleep restriction (SR) show differential neurobehavioral vulnerability to sleep loss, but reliable markers for predicting such inter-individual differences remain elusive. This study determined whether circadian phase, as measured by dim light melatonin onset (DLMO), is a predictor of neurobehavioral vulnerability responses to chronic sleep restriction.
Methods: 17 healthy adults (30.2±8.9y;7 females) completed 2 baseline (10h TIB) nights followed by 5 consecutive SR nights (4h TIB) in a laboratory experiment. Neurobehavioral testing occurred every 2h during wakefulness. Modified MWTs were conducted between 1445h-1600h during the 1st and 5th SR days. Sleep onset latency was defined as time to the first microsleep (10-sec EEG theta) or 30 minutes if no sleep occurred. Subjects provided 13 saliva samples at 30-minute intervals, under <50 lux, from 1930h-0130h after the 2nd baseline night and the 4th SR night. DLMO was defined as the first interpolated point at 3.0 pg/ml on the rising curve of melatonin concentration.
Results: As a result of dim light conditions, DLMO significantly phase delayed from baseline to the 4th SR night (paired t-test, $p<0.0001$). Baseline DLMO did not predict PVT (lapses, 1/RT) or DSST performance, MWT sleep onset latency, or KSS scores during the 1st day after SR (rank order correlations; $p's>0.05$). DLMO on the 4th SR night failed to predict PVT or DSST performance, or KSS scores during the 5th day after SR (rank order correlations; $p's>0.05$), but significantly related to MWT sleep onset latency ($rho=-0.64$; $p=0.006$), whereby earlier phase predicted a greater ability to resist sleep.
Conclusion: Circadian phase after several nights of sleep restriction predicts the ability to resist sleep the next afternoon, but does not relate to diurnal neurobehavioral performance. Circadian phase may be a biomarker for predicting individual differences in physiological alertness in response to sleep restriction, though more data are needed to confirm this finding.
Support (If Any): Supported by NIH NR004281 and by CTRC UL1RR024134.

0318

EFFECTS OF ONE NIGHT OF TOTAL SLEEP DEPRIVATION ON ERROR PROCESSING

Liang Y[1], Ko C[1,2], Tsai L[1], Hsieh S[2,3]
[1]Psychology, National Chung-Cheng University, Chiayi, Taiwan, [2]Psychology, National Cheng-Kung University, Tainan, Taiwan, [3]Institute of Allied Health Sciences, National Cheng-Kung University, Tainan, Taiwan

Introduction: A previous study (Padilla et al. 2006) found that performance errors were related to disruptions in preparatory attention processes and action monitoring. The contingent negative variation (CNV) is an event-related slow wave that indexes preparatory attention. Error-preceding positivity (EPP) reflects the deficiency in the function of action monitoring system prior to actual execution of an error.
Methods: We recorded the two brain potential components to examine whether deficiencies in preparatory attention and action monitoring during performance errors are affected by sleep deprivation. The event-related potentials (ERPs) were obtained during Flanker letter discrimination task tested in the morning after a normal sleep (NS) night and after one night total sleep deprivation (TSD) in a counterbalanced repeated-measures design. All participants (six men and three women) maintained the same level of performance accuracy in the two sleep conditions.
Results: The difference in CNV amplitudes between correct and erroneous trials under the TSD condition was similar to that of the NS condition. However, the EPP was observed only in the NS condition ($p = 0.02$).
Conclusion: These data suggest that the two mechanisms involved in performance errors are differentially affected by TSD: error-related deficiency in preparatory attention is not affected by TSD but error-related attenuation in action monitoring is absent after TSD.
Support (If Any): This study was supported by the National Science Council , Taiwan, ROC, Grant No. NSC99-2314-B-194 -001 -MY2.

0319

EFFECTS OF SLEEP FRAGMENTATION ON ERROR MONITORING

Fang Y[1], Ko C[1,3], Tsai L[3], Hsieh S[1,2]
[1]Psychology, National Cheng-Kung University, Tainan, Taiwan, [2]Institute of Allied Health Sciences, National Cheng-Kung University, Tainan, Taiwan, [3]Psychology, National Chung-Cheng University, Chiayi, Taiwan

Introduction: Sleep fragmentation (SF) involving frequent arousals from sleep, no matter they are aware or not, may lead to partial sleep loss and/or bad sleep quality, and thereby relates to daytime sleepiness. Experimentally manipulated SF is commonly applied by giving intermittent arousing stimuli such as auditory noises. Our previous studies found that one night of total sleep deprivation impaired error monitoring functions, both in behavior performance and brain activity (Tsai et al., 2005; Hsieh et al., 2007, 2009, 2010). This study further examined the effect of one night of artifially fragmented sleep on error monitoring.
Methods: After an acclimatization night, all participants (five men and three women) underwent an undisturbed sleep night and a tone-induced SF study night in a counterbalanced, repeated-measures design. The event-related brain potentials were obtained during Flanker task performance tested in the morning following each sleep night. The error negativity or error-related negativity (Ne/ERN) and the error positivity (Pe) seen immediately after errors were analyzed.
Results: Compared to the undisturbed sleep condition, SF showed a tendency to lower response speed ($p < .01$), increased post-error slowing ($p < .01$), and impaired post-error improvement in accuracy ($p < .01$) but none of the effects reached statistical significance. The amplitude of the Ne/ERN was reduced in the SF condition ($p = 0.046$).
Conclusion: These data suggest one night of SF impaired both the error detection and error remedial actions and led to making more successive errors. The negative effect of one night of SF on error monitoring is comparable to that of one night of total sleep deprivation.
Support (If Any): This study was supported by the National Science Council , Taiwan, ROC, Grant No. NSC99-2314-B-194 -001 -MY2.

0320

EFFECTS OF ONE NIGHT OF TOTAL SLEEP DEPRIVATION ON POST-ERROR ADJUSTMENTS IN PREPARATORY ATTENTION

Ko C[1,3], Liang Y[3], Tsai L[3], Hsieh S[1,2], Shaw F[1]
[1]Psychology, National Cheng-Kung University, Tainan, Taiwan, [2]Institute of Allied Health Sciences, National Cheng-Kung University, Tainan, Taiwan, [3]Psychology, National Chung-Cheng University, Tainan, Taiwan

Introduction: Error monitoring, including error detection, error correction and posterror adjustments (PEAs), is an essential function in behavioral performance and has been found to be impaired by one-night total sleep deprivation (TSD; Tsai et al., 2005; Hsieh et al., 2007, 2009, 2010). A previous study (Padilla et al., 2006) found that performance errors were related to reduced preparatory attention processes. This study attempted to examine whether the impairment of error monitoring following one night TSD involves deficits in preparatory attention following performance errors.
Methods: Event-related brain potentials were obtained during Flanker letter discrimination task tested in the morning after a normal sleep (NS) night and after a TSD night in a counterbalanced repeated-measures design. All participants (six men and three women) maintained the same level of task performance accuracy in the two sleep conditions.
Results: The preparatory-related contingent negative variation immediately after errors was significantly increased only in the NS condition ($p = 0.038$).
Conclusion: The result of this study suggests that impairment of error monitoring following TSD involves deficits in preparatory attention following performance errors.
Support (If Any): This study was supported by the National Science Council, Taiwan, ROC, Grant No. NSC99-2314-B-194 -001 -MY2.

0321

SLEEP DEPRIVATION ALTERS EFFORT DISCOUNTING BUT NOT DELAY DISCOUNTING OF MONETARY REWARDS

Libedinsky C, Chee W, Ling A, Asplund CL, Chee M
Duke-NUS Graduate Medical School, Singapore, Singapore

Introduction: The subjective value we assign to rewards decreases as these rewards become more uncertain (probability discounting, PD), more delayed (delay discounting, DD) or require more effort to acquire (effort discounting, ED). Neuroimaging studies have shown that brain regions involved in the processing of discounted reward values in PD, DD and ED are partially overlapping, suggesting both common and dissociable mechanisms. Previous studies have shown that, under certain conditions, sleep deprivation (SD) may alter PD. However, there is conflicting evidence regarding the effect of SD on DD. Further, the effect of SD on ED has not been explored. Here we tested the hypothesis that the effect of SD on PD is due to an alteration of the common mechanisms underlying the three types of discounting. To this end, we explored the effect of SD on DD and ED.
Methods: Subjects were tested in 2 counterbalanced sessions: after a normal night of sleep under rested wakefulness (RW) and after 24hrs of sleep deprivation. They performed a DD and ED task. In the DD task subjects were repeatedly presented 2 offers, one smaller and sooner, and one larger and later. For example: “Would you rather get $20 in 5 months or $17 now?”. In the ED task subjects were also presented with 2 offers, one smaller and without effort, and one larger and with effort. Effort comprised having to type a number of words backwards. For example: “Would you rather get $20 typing 45 words or $17 typing no

words?". We then calculated discount indices for both effort and delay and compared these across states.
Results: We calculated discount rates for both ED and DD. Sleep deprivation significantly increased discount rate in the ED task - meaning that effortful rewards were valued less during SD. In contrast, we observed no changes the discount rate for DD, contrary to what would be expected if a common mechanism governed different discounting behaviors.
Conclusion: Since SD differentially affected DD and ED, our results suggest that dissociable mechanisms underlie its impact on different types of discounting. The effect of SD on ED could have practical implications for example, if medical doctors were make less effortful but less effective choices when sleep deprived.
Support (If Any): This work was funded by the Defense Science and Technology Agency, Singapore (POD 00713897), and by a National Research Foundation STaR Award (00004/2008).

0322

SLEEP RESTRICTION AND STEREOTYPING: A POTENTIALLY FATAL MISTAKE

Lust SA, Bartholow BD, Saults J
Psychology, University of Missouri, Columbia, MO, USA

Introduction: It is known that sleep deprivation can result in a host cognitive decrements including impaired executive function and slowed reaction time. Some research has investigated physiological correlates of error-reactivity and sleep restriction, however prior work has not utilized tasks involving socially relevant paradigms. The focus of this research was to understand the effect of sleep deprivation on performance monitoring and adjustment as it relates to stereotyping in the Weapons Identification Task.
Methods: Students (N=42) at the University of Missouri were randomly assigned to sleep 4 or 8 hours the evening prior to the 8AM experiment session. In the lab, participants responded to questionnaires about their sleep and then engaged in the computer task while event-related potentials (ERPs) were recorded. The task required Ps to respond to gun or hand-tool targets that followed black or white face primes.
Results: Results showed an overall slowed response in the 4-hour sleep group compared to the 8-hour group. Sleep deprived participants also struggled to respond accurately to stereotype inconsistent trials. Furthermore, those in the 4-hour group were less likely to correctly judge the accuracy of their responses. . There appeared to be a greater effect of Sleep Group on error-related negativity (ERN) responses for gun-prime trials, however number of hours of sleep did not appear to have a significant effect on error-positivity (Pe) responses.
Conclusion: These results indicate that sleep restriction can diminish individuals' ability to appropriately respond to targets that are related to stereotypes. In addition, sleep restriction leads to poorer recognition of one's own mistakes posing the risk of a slippery slope into more error commission. Such results have important implications for situations that require quick decisions, for example whether a police officer should shoot a suspect.
Support (If Any): University of Missouri Department of Psychological Sciences.

0323

EFFECTS OF TWO TYPES OF SLEEP DEPRIVATION ON MORAL JUDGMENTS

Ta J[1,4], Straus LD[1,3], Drummond SP[2,3,5]
[1]Research Services, VA San Diego Healthcare System, San Diego, CA, USA, [2]Psychology Services, VA San Diego Healthcare System, San Diego, CA, USA, [3]Joint Doctoral Program in Clinical Psychology, SDSU/UCSD, San Diego, CA, USA, [4]Department of Psychology, UCSD, San Diego, CA, USA, [5]Department of Psychiatry, UCSD, San Diego, CA, USA

Introduction: A prior study in military personnel showed total sleep deprivation (SD) alters moral judgments (MJ) depending on the type of MJ required and emotional intelligence (EQi). Following SD, lower EQi individuals were more likely to endorse the appropriateness of their taking direct action to harm someone to help a greater number of people (i.e., utilitarian decisions). Higher EQi individuals showed no change with SD. Here, we seek to extend these findings by examining the effects of two types of SD in civilians.
Methods: Thirty-nine subjects were randomized to either 30h total SD (n=23, 13F, age=25.4±5.0, EQi=107±2) or partial SD (4h TIB/night for 5 nights; n=16, 10F, age=25.4±6.1, EQi=108±4) and administered the Moral Judgment (MJ) task while well-rested (WR; 9h TIB/night for 6 nights) and during SD (counterbalanced order). MJ task contains 3 question types: non-moral (NM), moral impersonal (MI: does not require direct action on the part of the individual), and moral personal (MP: does require direct action). 2x2x2 (Night x Type SD x EQi high/average) ANOVAs evaluated each question type separately. The outcome variable was the proportion of utilitarian answers endorsed (i.e., it is appropriate to harm one to help many).
Results: There was no effect of night, type of SD or EQi on decisions made for NM or MI questions. For MP decisions there was a main effect of night ($p=.05$), but no effects or interactions involving type of SD or EQi. During SD, subjects endorsed more utilitarian answers on MP decisions than during WR.
Conclusion: These data suggest MJs of a personal nature are impacted by SD in civilians, but unlike military personnel, emotional intelligence may not play a role. SD may lead individuals to adopt different philosophical heuristics relative to when WR to answer morally challenging questions. This may have implications for first responders and physicians working while SD.

0324

CAFFEINE IMPROVES THE EFFICIENCY OF PLANNING AND SEQUENCING ABILITIES DURING SLEEP DEPRIVATION

Killgore WD[2,1], Kamimori G[3], Balkin T[3]
[1]Psychiatry, Harvard Medical School, Boston, MA, USA, [2]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Belmont, MA, USA, [3]Behavioral Biology, Walter Reed Army Institute of Research, Washington, DC, USA

Introduction: Executive functions include a diverse set of highly complex cognitive processes. Some components of these processes appear to be adversely affected by sleep deprivation while others appear robust against insufficient sleep. Stimulant medications such as caffeine also appear to have selective effects on executive functions during sleep deprivation. Here we examined the effects of repeated overnight doses of caffeine on planning and sequencing performance using the Tower of London (TOL) task during 75 hours of sleep deprivation.
Methods: Twenty-four healthy volunteers (19 men; age range 20-35) were deprived of sleep for 77 hours. Participants received double-blind administration of 200 mg caffeine gum (n=12) or identical placebo gum (n=12) bi-hourly from 0100-0700 during each overnight sleep deprivation session (i.e., total 800 mg/session). The TOL requires participants to move an arrangement of colored beads on pegs of differing heights until

they match a goal arrangement. The objective is to move the beads, one at a time, in the fewest moves possible without sacrificing speed. The TOL was administered at 1045 on the first morning following a full night of sleep (8 hours time in bed), again following 52 hours of continuous wakefulness, and finally after 76 hours of wakefulness.

Results: Caffeine had no significant effect on the number of moves taken to complete the task across sessions (p=.64), but did improve the speed of responding for each trial (p=.03) relative to placebo. Moreover, an index of throughput (i.e., the number of correctly placed beads per minute) showed significant improvement among the caffeine group across three days of sleep deprivation, whereas the placebo group failed to show these gains in learning (p=.05).

Conclusion: Repeated overnight administrations of moderate doses of caffeine significantly improved throughput (i.e., speed x accuracy performance efficiency) of a planning and sequencing task during sleep deprivation.

0325

BRAIN CONNECTIVITY ANALYSIS TO STUDY CHRONIC SHORT SLEEP

Babajani-Feremi A[1], Gumenyuk V[2], Roth T[2], Drake C[2], Soltanian-Zadeh H[3,4]

[1]Department of Anatomy and Neurobiology, Washington University School of Medicine, St. Louis, MO, USA, [2]Sleep Disorders and Research Center, Henry Ford Hospital, Detroit, MI, USA, [3]Image Analysis Lab., Radiology Department, Henry Ford Hospital, Detroit, MI, USA, [4]CIPCE, ECE Department, University of Tehran, Tehran, Islamic Republic of Iran

Introduction: Model-based brain connectivity analysis (MBCA) facilitates assessment of roles of different areas in cognitive functions. Neurophysiological processes underlying auditory memory and attention are impaired on habitually short sleepers. MBCA is expected to open a new window to study mechanisms of these in chronic short sleepers. The aim of this study was to use MBCA and study mechanism of auditory attention in short sleepers.

Methods: Nine normal sleepers [NS] (TST=7-8hrs;age=30±6yrs;6F) and 10 habitual short sleepers (TST≤6hrs;age=35±10yrs;5F) participated in this study. Time in bed was increased from habitual (~6hrs) to extended (9hrs) for one week in the short sleep [SS] group. ERPs were recorded via 64-EEG cap using oddball auditory task in two conditions: "IGNORE" and "ATTEND." Three sets of ERP data for two groups [NS and SS] and extended sleep [ES] in IGNORE and ATTEND tasks were processed separately. Then 14 physiological plausible models were considered using different configurations of connections among six areas: left and right primary auditory cortices, superior temporal gyri (STG), and inferior temporal gyri (IFG). Finally, all models were fitted to each of the six grand mean datasets using Bayesian model inversion to find the best model.

Results: For IGNORE condition, connection from right-STG to right-IFG for [NS] was significantly smaller than [SS] and [ES]. In fact, the type II error for testing "[NS] < [SS]" and "[NS] < [ES]" were both less than 10-20. However, this connection did not show any significant difference between [SS] and [ES] (type II error>0.43). For ATTEND condition, the connection from right-STG to right-IFG for [NS] is significantly larger than [SS] and [ES]. Type II error for testing "[NS] > [SS]" and "[NS] > [ES]" were 0.0017 and 9.4×10-6. However, this connection did not show any significant difference between [SS] and [ES] (type II error>0.10). In addition, connection from left-STG to left-IFG for [ES] was significantly smaller than [NS] or [SS] (type II error were 2.5×10-12 and 0.015). Our results showed that [SS] had deficiency in activity of frontal areas as compared to [NS]. In addition, strengths of connections of frontal areas (right-IFG and left-IFG) of [SS] were not normalized to their values in [NS] by extending sleep. Therefore, one week of extended time in bed was not enough to reverse impairments in [SS].

Conclusion: MBCA provides an effective approach to study mechanisms of auditory dysfunction associated with chronic short sleep.

0326

SLEEPINESS BY SLEEP DEBT ENHANCED AMYGDALA ACTIVATION FOR SUBLIMINAL SIGNALS OF FEAR

Motomura Y[1], Oba K[1], Terasawa Y[1], Katayose Y[1], Kitamura S[1], Enomoto M[1], Hida A[1], Moriguchi Y[1], Higuchi S[2], Mishima K[1]

[1]Department of Psychophysiology, National Institute of Mental Health: National Center of Neurology and Psychiatry, Kodaira, Japan, [2]Faculty of Design, Kyushu University, Fukuoka, Japan

Introduction: Sleep loss often causes maladaptive emotional and mood regulation, and many psychiatric and neurological mood disorders are accompanied with abnormalities of sleep. These evidences suggest a potential intimate interaction between sleep and affective brain function. Also emotional experiences are easily influenced even if we are not consciously aware of the presence of emotional stimulus. Since such automatic (unconscious) emotional processing is insusceptible to other cognitive processing, it is suitable for examining emotional brain function more directly. Thus, in this study, we investigated the relationship between sleep debt by partial sleep deprivation and the automatic (unconscious) emotional responses to masked fearful face stimuli that are biologically salient signals of potential danger.

Methods: Fourteen healthy male volunteers (21-32years old) underwent tasks in MRI following a 5-day regular sleep night (8h sleep: Sleep Control condition (SC)) and following 5-day sleep restriction night (4h sleep: Sleep Debt condition (SD)) in a within- subjects counter-balanced design. Using fMRI, we investigated the amygdala responses to seeing the conscious and unconscious (backwardly masked) fearful faces stimuli.

Results: In the responses to conscious stimuli, no differences were found between SC condition and SD condition on the amygdala activity. On the other hand, in the responses to unconscious stimuli, we found the larger amygdala activity in SD condition than SC condition. Furthermore, the amygdala activity to conscious stimuli were negatively correlated with the sleepiness scale during the task, whereas the amygdala activity to unconscious stimuli were positively correlated with the sleepiness scale during the task, independent of whether condition is SC or SD.

Conclusion: These findings suggested that sleepiness by sleep debt increases the effect of automatic (unconscious) emotional processing.

0327

SUBJECTIVE SYMPTOMS DURING ACUTE TOTAL SLEEP DEPRIVATION

Grant DA[1], Jackson ML[2], Waggoner L[1], Van Dongen H[1]

[1]Sleep and Performance Research Center, Washington State University Spokane, Spokane, WA, USA, [2]School of Social Sciences and Psychology, Victoria University, Melbourne, VIC, Australia

Introduction: The effects of acute total sleep deprivation on general well-being have not been systematically investigated. We compared self-reported symptoms in subjects undergoing 62h of total sleep deprivation versus controls to examine whether symptomology is influenced by sleep loss.

Methods: 26 healthy, non-smoking young adults (ages 22-37; 10 females) with regular sleep schedules spent 6 consecutive days and nights in a sleep laboratory. Following two baseline days (10h TIB/day), subjects were randomized to either 62h total sleep deprivation (n=13) or matching control (10h TIB/day; n=13), which was followed by two recovery days (10h TIB/day). Assignment to condition was announced just before bedtime at the end of the second baseline day. Throughout most of scheduled wakefulness, at 2h intervals subjects completed the 58-item, 5-subscale Hopkins Symptom Checklist (HSCL), the Karolinska Sleepiness Scale (KSS), and a 10min Psychomotor Vigilance Test

(PVT). Mixed-effects ANOVA and principal component analysis (PCA) were performed to examine the effects of condition and time-in-study on HSCL subjective symptoms, KSS subjective sleepiness, and PVT lapses (RT>500ms).
Results: Significant effects of condition were found for HSCL Obsessive-Compulsive ($F[1,666]=4.5$, $P=0.034$), HSCL Interpersonal Sensitivity ($F[1,668]=5.4$, $P=0.020$), KSS sleepiness ($F[1,671]=5.5$, $P=0.012$) and PVT lapses ($F[1,670]=23.8$, $P<0.001$). Significant condition by time interactions were found for HSCL Somatization ($F[28,665]=3.6$, $P<0.001$), HSCL Obsessive-Compulsive ($F[28,666]=1.6$, $P=0.024$), KSS sleepiness ($F[28,671]=8.1$, $P<0.001$) and PVT lapses ($F[28,670]=10.7$, $P<0.001$). PCA indicated that the 5 HSCL subscales clustered together (16.8% variance explained); and that KSS and PVT clustered together (57.1% variance explained) but with a pattern distinct from the HSCL. Only the KSS/PVT cluster showed an overall significant condition by time interaction ($F[28,656]=14.0$, $P<0.001$).
Conclusion: Subjects in the sleep deprivation condition exhibited higher levels of self-reported symptomology, which remained elevated throughout the experiment but were below published norms for clinical samples. The temporal profiles of subjective symptoms were distinct from those of subjective sleepiness and psychomotor vigilance, suggesting symptoms may have been related to condition assignment and not solely to the loss of sleep.
Support (If Any): NIH grant HL105768 and FAA grant DTFAAC-11-A-00003.

0328

EXPLORING THE ASSOCIATION BETWEEN DISRUPTED SLEEP AND MOOD ISSUES IN UK ADOLESCENTS

Broglia EL[1], Arora T[2], Thomas G[3], Taheri S[2]
[1]School of Psychology, University of Birmingham, Birmingham, United Kingdom, [2]College of Medical and Dental Sciences, University of Birmingham, Birmingham, United Kingdom, [3]Public Health, Epidemiology and Biostatistics, University of Birmingham, Birmingham, United Kingdom

Introduction: Short sleep duration has been associated with poorer health and mood issues, but investigations of the impact of disrupted sleep are sparse. We sought to explore whether there is an association between night time awakenings in UK adolescents and reports of feeling sad/depressed; hopeless about the future; nervous/tense and worried.
Methods: Data were collected in 2011 using the Schools Sleep Habits Survey (SSHS) from 959 volunteers (55.7% boys), aged 11-13 years. We examined the cross-sectional data collected from the Midlands Adolescent Schools Sleep Education Study (MASSES) using chi square tests. Volunteers were classified for night-time awakenings (no awakenings or one or more awakenings). Mood issues were also assessed 2 weeks retrospective of data collection (sad/depressed, hopeless about the future, nervous/tense, worried).
Results: Volunteers who experienced night-time awakenings were more likely to answer "somewhat" or "a lot" compared to "never" when asked whether they had felt sad/depressed, nervous/tense and worried in the last two weeks compared to those who reported no night-time awakenings $\chi2=27.777$ (2), $p<0.001$, $\chi2=22.276$ (2), $p<0.001$, $\chi2=33.859$ (2), $p<0.001$. Those with night-time awakenings were also more likely to answer "somewhat" and "a lot" compared to "never" for feeling hopeless about the future compared to those with no night-time awakenings, but this was borderline statistically significant $\chi2=5.859$ (2), $p=0.053$.
Conclusion: Night-time awakenings in UK adolescents are significantly associated with feelings of sadness/depression, nervousness/tense and worried in UK adolescents. Night-time awakenings had the largest impact on feeling worried followed by sadness/depression and lastly nervous/tense. As reports of mood issues were based on a 2 week period, it is not known whether these feelings are restricted to a short term issue. To establish the potential long term impact, it would be interesting to repeat mood assessments annually to observe possible changes over time.

0329

MOOD STATES IN EARLY AND LATE CLASS START TIMES AT A MILITARY COLLEGE

Fogler KA, Powell S, Rijhwani A, Whitehurst L, Dyche J
Dept of Psychology, James Madison University, Harrisonburg, VA, USA

Introduction: Research shows that reduced sleep leads to significant daytime sleepiness and decreased performance and mood. Military data at the US Air Force Academy demonstrates that early start times have a negative effect on GPA, physical fitness, and health (Dyche, Zumas, & Fogler, 2010). The current study examines the effects of class start time on mood and extends our knowledge of the effects of fixed start times to a college population.
Methods: The Profile of Mood States (POMS) questionnaire is a self-report inventory designed to measure six mood states: Tension-Anxiety, Depression, Anger-Hostility, Vigor, Fatigue, Confusion. The POMS was administered to 139 cadets in fall 2006, when class start times were at 7 a.m., and to 176 cadets in fall 2007, when start times were at 7:50 a.m. Cadets were surveyed across the day to avoid circadian effects.
Results: Results indicate that early start times were associated with elevated levels of anger-hostility, fatigue, and confusion, with low vigor. A main effect of start time was found for anger-hostility, $p < .001$, fatigue, $p < .001$, and confusion, $p < .001$, such that cadets with early class start times reported significantly higher scores on these subscales than cadets with late start times. Cadets with early start times reported significantly lower scores for vigor, $p < .001$.
Conclusion: Research has demonstrated that students who have to get up earlier will not go to sleep earlier (Hiveley, Wilson, Fogler, & Dyche, 2009). This project demonstrates that the ensuing sleep loss can lead to significant mood changes. The difference in start times between 7:00 a.m. and 7:50 a.m. are sufficient to significantly increase anger-hostility, fatigue, and confusion, while significantly lowering vigor. These results have important implications for higher education, as mood impairments are associated with deficits in cognitive functioning, decision making, and overall well-being.
Support (If Any): DARPA.

0330

SLEEP AND PERFORMANCE: THE IMPACT OF PERSONALITY

Comitz E[1], Valacer J[1], Lindsay D[3], Scaduto A[2], Fogler KA[1], Dyche J[1]
[1]Dept of Psychology, James Madison University, Harrisonburg, VA, USA, [2]Psychology, Pennsylvania State University, University Park, PA, USA, [3]Behavioral Sciences and Leadership, US Air Force Academy, Colorado Springs, CO, USA

Introduction: Chronic partial sleep deprivation (PSD) is known to negatively impact academic performance, as well as physical health (Fogler, Hiveley, & Dyche, 2009; Lindsay, Lee, & Dyche, 2006). Scant research has looked at the role that personality factors play in this relationship between sleep behavior and academic and physical performance. The current study examined the relationship between personality, sleep behavior, and individual performance in 536 cadets from the United States Air Force Academy, a population that suffers from chronic PSD.
Methods: Subjects took an adapted Pittsburgh Sleep Quality Index and Collegiate Sleep Habits Survey to assess sleep quality and quantity. Subjects' performance was based on grade point average (GPA), military performance average (MPA), and physical fitness assessment (PEA). Additionally, organizational citizenship behaviors (OCBs) and negative counterproductive work behaviors (CWBs) were measured. Personality traits were based on a traditional scale for determining the Big Five factors.
Results: A positive significant relationship was found between conscientiousness and sleep quantity ($r = .10$, $p < .05$), and negatively correlated to neuroticism ($p < .01$). There was also a significant negative

relationship between conscientiousness and sleep quality ($r = -.16$, $p < .01$). Several significant correlations were found between sleep quality/quantity and performance. Most notably among the personality factors was that openness to experience was positivity related to OCB ($r = .25$, $p < .05$) and negatively related to CWB ($r = -.12$, $p < .05$).
Conclusion: The goal this study was to examine relationships between personality, sleep behavior, and performance variables. The results suggest that personality factors do play a role in sleep and performance, however more research needs to be done to examine why openness to experience stood out as a significant variable.

0331
HIGH CORRELATION AND PREDICTIVE VALUE BETWEEN AAERTNESS MEASURED BY REACTION TIME AND PHYSICAL PERFORMANCE

Therrien M[1,2], Hébert M[3], Gartenburg D[4], DeKoninck J[3], Forest G[5]
[1]Neuro Summum Inc, Gatineau, QC, Canada, [2]CSSSG, Gatineau, QC, Canada, [3]Universté d'Ottawa, Ottawa, ON, Canada, [4]George Mason University, Fairfax, VA, USA, [5]Université du Quebec en Outaouais, Gatineau, QC, Canada

Introduction: Reaction time is often used to evaluate decreased alertness associated with sleep deficiency. No clear correlation between alertness levels and physical performance has been demonstrated due in part to complex methodology requirements. Reaction time tests on a smartphone now facilitate evaluation of these relationships. The aim of this study was to look at these correlations in a subject executing repeatedly the same motor tasks in different alertness states over a long period of time.
Methods: A 3 minutes reaction time test on a smartphone was performed first. Then the maximal Push-ups, Sit-ups and touches at the Ipsilateral Contralateral Overhead Touch Test (ICOTT) (PSICOTT) over 1 minute each were executed. Testing starting March first 2011 was done up to 5 times per day in different time frames. Pearson's correlations and linear regression based predictions were calculated between the mean reciprocal reaction time scores and all 3 tasks independently for the 8:00AM-12:00AM time frame from October 1rst to December 6 2011.
Results: Mean reciprocal reaction time scores were correlated with number of push-ups ($r=.48$, $p<.005$), sit-ups ($r=.50$, $p<.001$) and touches at the ICOTT ($r=.73$, $p<.001$). With minimal non-linear transformation, reaction time test results predicted the physical performance results with a mean prediction error of 5.79 (range of 27) for the number of push-ups, 1.73 (range of 7) for the number of sit-ups and 9.00 (range of 48) for the number of touches at the ICOTT.
Conclusion: These results suggest that alertness levels and physical performances are highly correlated. Moreover, alertness levels measured with a reaction time test on a smartphone was a good predictor of physical performance. The implications of being able to optimise physical capacity by measuring and improving alertness naturally through sufficient sleep are important. Additional analyses for other time frames and periods recorded from our subject are needed to support these findings.

0332
EFFECT OF FIVE DAYS SLEEP SHORTAGE ON PHYSICAL FUNCTIONS

Kubota C[1], Shioda K[1], Morita Y[1], Kojima T[1], Sumitomo J[1], Uchida S[2]
[1]Graduate school of Sport Sciences, Waseda University, Tokorozawa, Japan, [2]Faculty of Sport Sciences, Waseda University, Tokorozawa, Japan

Introduction: Sleep loss has been a large issue health science. This study focuses on physical and vigilance performance to investigate how sleep shortage(SS) affect physical functions.
Methods: After a regular sleep night, subjects slept five SS nights. Exercise performances (EX) (aerobic: VO_2, VCO_2, RER, V_E, RPE during 5min pedaling exercise of a moderate intensity, anaerobic: peak power during 7s maximum pedaling) and Psychomotor Vigilance Test (PVT) were examined on two conditions (regular sleep condition: RSC, sleep deprivation condition: SDC).In the SDC, sleep was shortened to 50% of regular sleep length for each subject. EX was measured at 18:00 of the 1, 3, 5 day, and PVT was measured at 9:00 and 17:00 every day. Standard PSG was done on the regular sleep night and 1, 3, 5 shortened sleep nights.
Results: There were no significant differences in exercise performances. PVT was impaired after three SS nights. Frequency analysis revealed that total delta density increased on the third and fifth night. There was significant negative correlation between reaction time of fifth day PVT and total delta power on the fifth SS night ($p<0.05$, $r=-0.864$).
Conclusion: Results of experiment suggested that five nights shortened sleep didn't affect EX. While PVT was impaired after three days SS. This may be because these experimentally measured physical performances are not much affected by sleep shortage. Since PVT and delta did not show significant negative correlation on the third, but did on the fifth day, increased delta recovery did not compensate after three nights.

0333
SLEEP DURATION AMONG 64 ASTRONAUTS ON SPACE SHUTTLE MISSIONS

Flynn-Evans EE[1,2], Kubey A[1,2], Wang W[1,2], Wright KP[3], Czeisler CA[1,2], Barger L[1,2]
[1]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [2]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [3]Sleep and Chronobiology Laboratory, Department of Integrative Physiology, University of Colorado, Boulder, CO, USA

Introduction: Astronauts are often required to perform during the biological night while also under acute and chronic sleep deprivation. Findings from prior studies in small cohorts have shown that sleep duration is shorter during spaceflight compared to on Earth. The aim of this study was to test the hypothesis that objective sleep duration would be shorter during spaceflight compared to sleep on Earth among a large cohort of astronauts.
Methods: Sixty-four astronauts (12F; mean age: 46.3 ± 4.52y) from 76 Space Shuttle subject missions participated. Data collection occurred at four time points: approximately 90 days prior to launch (L-90), 11 days prior to launch (L-11), throughout a spaceflight mission (flight) and for seven days immediately following return from space (R+7). Sleep duration was estimated using wrist-borne actigraphy (Actiwatch-L; Minimitter-Respironics, Bend, OR). Data were analyzed using mixed-effects regression models with nested random effects, comparing sleep duration at each segment. Post-hoc paired t-tests were used to compare flight to L-90 sleep duration.
Results: Findings from the present study confirm that sleep duration is significantly shorter in space (mean 5.98 ± 0.08 h) compared to baseline at L-90 (mean 6.27 ± 0.08h; $p<0.0001$). Mixed-effects models confirmed that sleep during spaceflight was significantly shorter than during all Earth-based data collection periods ($p<0.01$ with Bonferroni adjustment).
Conclusion: Findings are consistent with prior reports that the average sleep duration in space is approximately 6h. Furthermore, the current findings suggest that astronauts face a significant chronic sleep debt, even 90 days prior to launch and that sleep restriction is sustained throughout spaceflight. It is possible that the L-90 data collection point does not represent a true baseline due to mission preparation demands. Use of sleep medications in flight should be further explored and future research should assess astronaut sleep need to determine the magnitude of the sleep deficit.
Support (If Any): This work was supported by NASA grant 98 HEDSO2E394. Dr. Evans was supported by a post-doctoral fellowship from the Harvard Medical School Training Program in Sleep, Circadian and Respiratory Neurobiology (Grant HL07901-08).

0334

SLEEP LOSS IN AIRLINE CABIN CREW: IMPLICATIONS FOR FATIGUE RISK MANAGEMENT IN OPERATIONAL CONTEXTS

James F[1], Roma PG[1], Hursh S[1], Mead AM[2], Nesthus TE[2], Mallis M[1]
[1]Operational and Fatigue Research, Institutes for Behavior Resources, Baltimore, MD, USA, [2]Civil Aerospace Medical Institute, Federal Aviation Administration, Oklahoma City, OK, USA

Introduction: Accumulated sleep loss can significantly impact the quality of performance in a variety of occupational contexts. Where a primary responsibility of airline cabin crew is to ensure passenger safety, this investigation was mandated by the U.S. Congress as a part of a comprehensive study of the impact of fatigue on flight operations.
Methods: A total of 202 flight attendants working both domestic and international operations were recruited for the study through industry-related announcements. Mean age of the flight attendants was (±SD) 43 ±11 years and participants were drawn from all levels of experience (mean: 12 ±10 years). Throughout a 3-4 week field data collection, wristband actigraphy was used to obtain an objective estimation of sleep duration on work and rest days. Rest/activity logs and subjective assessments of workload and fatigue were completed on a smartphone assigned to each participant and customized for this field study.
Results: Subjectively estimated sleep need was 8.1 ±1.1 and 7.8 ±2.0 hours for cabin crew on domestic and international operations, respectively. During non-work days, total sleep time estimated from actigraphy was 6.2 ±1.4 hours for crew working domestic operations and 6.5 ±1.5 hours for those on international operations. During work days, total sleep time was estimated as 5.9 ±1.5 hours for crew working domestic operations and was significantly shorter for those working international operations (4.9 ±1.8 hours, [$F(1,167) > 9.8$, $p<0.01$]). On average, the midpoint of sleep periods during work days on international operations were delayed by 1.8 ±3.4 hours relative to sleep on days off.
Conclusion: These data suggest a likely accumulation of sleep loss in airline cabin crew that is exacerbated on work days. A circadian misalignment with the rest/activity cycle may contribute to the deterioration of sleep quality in crewmembers working international operations. Field assessments and approaches to minimize sleep loss in the occupational environment are integral to a comprehensive fatigue risk management approach.
Support (If Any): Office of Aerospace Medicine, Federal Aviation Administration.

0335

RECOVERY IN AIRPLANES: SLEEP AND OXYGEN SATURATION

Elmenhorst E, Rooney D, Pennig S, Wittkowski M, Vejvoda M, Wenzel J
Flight Physiology, German Aerospace Center, Institute of Aerospace Medicine, Cologne, Germany

Introduction: With increasing number and duration of long-haul flights the topic of crews' on-board sleep and recovery gets progressively more important. At travelling altitude sleep takes place under hypobaric conditions corresponding to an altitude of 8000 ft.
Methods: We investigated 24 healthy subjects (12 female, average age 27 years ± 4 SD) sleeping in a pressure chamber furnished as crew-rest-compartment. The flight simulation was realistic concerning the atmospheric conditions, the in-flight noise, and the 4h time in bed. Sleep-EEG, blood oxygen saturation (SpO2), and subjective sleep quality were recorded. Results were compared to a control group of 23 healthy subjects (9 female, average age 26 years ± 6 SD) that spent 4h time in bed in private rooms of the DLR-sleep laboratory under normobaric and silent conditions.
Results: The recuperative value of sleep (to date subgroup of n=16) was reduced in hypobaric conditions since deep sleep ($p<0.05$) and REM sleep ($p<0.01$) were reduced whereas the light sleep phases (N1 $p<0.05$, N2 $p<0.01$) were increased. Sleep period time (SPT) and sleep efficiency did not differ between groups. The objective measures were emphasized by the subjective ratings (calmness of sleep: $p<0.001$; sleep depth: $p<0.05$). "In-flight", subjects spent 83% (± 5%) of SPT in a state of hypobaric hypoxia (<90% SpO2), 4% of SPT even below 85% SpO2. The mean SpO2 level in-flight was 88% (± 1 SD) with a mean minimum of 81% (± 3 SD) while the control group had a mean SpO2 level of 96% (± 1 SD) ($p<0.0001$).
Conclusion: Hypobaric hypoxia reduced the recuperative value of sleep. Young and healthy subjects were clearly affected. Older flight crews or diseased passengers might suffer from stronger effects while sleeping on board.

0336

A SMARTPHONE PVT APPLICATION IS SUCCESSFULLY USED TO IDENTIFY ONE'S SLEEP SCHEDULE ASSOCIATED WITH BETTER DAYTIME ALERTNESS

Therrien M[1,2], Gartenburg D[3], Forest G[4]
[1]Neuro Summum Inc, Gatineau, QC, Canada, [2]CSSSG, Gatineau, QC, Canada, [3]George Mason University, Fairfax, VA, USA, [4]Université du Québec en Outaouais, Gatineau, QC, Canada

Introduction: The recent development of smartphone applications has led to new, easy and innovative ways to keep track of various cognitive, motor and mood changes across daytime in individuals. The goal of this study was to verify the usefulness of a new 3 minutes PVT smartphone application in identifying the sleep schedule that leads to better daytime alertness in one individual.
Methods: Sleep questionnaires and PVTs were completed during three consecutive months in a 39 years old healthy subject. A 3 minutes PVT was incorporated into a mobile health smartphone application and was performed four times a day (between 8:00AM-12:00PM, 12:00PM-4:00PM, 4:00PM-800PM and 8:00PM-12:00AM). Pearson product moment correlations were computed between mean reciprocal PVT reaction times for each time window and estimated total sleep time (ETST), bedtime and risetime.
Results: Results showed significant correlations between ETST and the 8:00AM-12:00PM PVT ($r = .33$, $p < .05$) and between risetime and the 8:00AM -12:00PM PVT ($r = .38$, $p < .05$), the 12:00PM-4:00PM PVT ($r = .27$, $p < .05$). There was a marginal correlation between the 4:00PM-8:00PM PVT and bedtime ($r = .19$, $p = .05$).
Conclusion: These results confirm that longer sleep accompanied by later risetimes has positive impacts on daytime alertness in an individual and suggest that morning alertness is most affected by changes in the preceding night's sleep schedule and total sleep time. This study also points out the usefulness of using a short PVT smartphone application to monitor daily alertness. We propose that this application could therefore be used as an easy way to identify one's better sleep schedule associated with improved alertness and possibly better cognitive performance.

0337

THE EFFECTS OF CHRONIC SLEEP RESTRICTION ON SLEEP AND PERFORMANCE IN A PHYSIOLOGICALLY BASED MODEL OF SLEEP

Phillips AJ, Klerman EB
Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Current understanding of the sleep homeostatic process is primarily derived from experimental protocols involving acute total sleep deprivation or short-term sleep restriction. These protocols reveal a timescale of hours to days for both homeostatic build-up and dissipation. However, recent experiments have shown that when sleep restriction is chronic, performance decrements continue to accumulate over a timescale of weeks (Cohen et al., 2010), and may require similarly long timescales to recover. This response is not reproduced by traditional

two-process models of sleep/wake regulation, although a recent model (McCauley et al., 2009) extended the two-process model to incorporate an additional timescale. Here, we modify a physiologically based model of sleep (Phillips et al., 2011) to incorporate a slow homeostatic timescale in the form of changes in homeostatic sensitivity that could represent adenosine receptor density.
Methods: A slow timescale variation (~200 h) in sensitivity to the homeostatic sleep drive was added to the model of Phillips and Robinson (2007), recently modified to include a dynamic circadian oscillator (Phillips et al., 2011). This model was then compared to sleep and performance data from (i) a forced desynchrony protocol in which human subjects lived on a 42.85 h day with chronic sleep restriction through a sleep:wake ratio of 1:3.3 (Cohen et al., 2010), and (ii) a 14-day sleep restriction protocol, in which subjects were allowed 2, 4, 6 or 8 h time in bed (Van Dongen et al., 2003).
Results: The model reproduces the experimental results of sleep efficiency increases and PVT performance decrements that continue over a period of three weeks on a forced desynchrony with chronic sleep restriction protocol. The model also quantitatively reproduces PVT data from the 14-day sleep restriction protocol, with a near linear increase in the frequency of lapses across the 14 days that depends on the amount of sleep allowed.
Conclusion: The Phillips and Robinson model has previously been used in a variety of contexts, including fatigue prediction (Fulcher et al., 2010) and the effects of pharmaceuticals (Puckeridge et al., 2011). Extending the model to include chronic sleep restriction will greatly improve its utility in real world settings. Further experimental and modeling work is required on the timescales of recovery from chronic sleep restriction.
Support (If Any): Research supported by RC2-HL101340 and K24-HL105664 (EBK), NSBRI HFP01603 (EBK) and PF02101 (AJKP) through NASA NCC 9-58, and AFOSR FA9550-06-0080/ O5NL132.

0338

RECOVERY SLEEP IN A NATURALLY OCCURRING SLEEP DEPRIVED POPULATION

Fogler KA[1], Thoreson K[3], Glidewell RN[2], Orr W[2], Zumas B[4], Hall K[1], Whitehurst L[1], Dyche J[1]
[1]Dept of Psychology, James Madison University, Harrisonburg, VA, USA, [2]Sleep Medicine, Lynn Institute of the Rockies, Colorado Springs, CO, USA, [3]Behavioral Sciences and Leadership, US Air Force Academy, Colorado Springs, CO, USA, [4]Graduate School in Applied Psychology, Rutgers University, Piscataway, NJ, USA

Introduction: Partial sleep deprivation (PSD) is common among college students (e.g., Lund, Reider, Whiting, & Prichard, 2010) and is associated with deficits in cognitive functioning, health, and overall well-being (Hiveley, Wilson, Fogler, & Dyche, 2008). Cadets at the United States Air Force Academy (USAFA) experience naturally occurring sleep deprivation due to strict military and class schedules. Cadets receive approximately 5-6 hours sleep per night, much lower than the recommended 9 hours sleep for this age group (Lindsay, Lee, & Dyche, 2006). The current study examined the effects of PSD and recovery sleep on sleep architecture and cognitive performance.
Methods: Two hundred USAFA Cadets were prescreened and thirty were identified as the most (MSC; n = 15) and least (LSC; n = 15) sleepy cadets based on the Epworth Sleepiness Scale. Cadets wore an actigraph to measure total sleep time (TST) the week prior to multiple sleep latency tests (MSLT) at the Lynn Institute of the Rockies. MSLT testing (four 20 minute naps per day) was conducted on a Friday and Sunday, after recovery sleep. Naps were followed by cognitive tasks measuring vigilance, learning, and memory.
Results: Actigraph data indicated Cadets did not differ in TST per weeknight (MSC M = 6.21, SD = .85; LSC M = 6.26, SD = .61) or in recovery sleep (MSC M = 7.43, SD = 1.41; LSC M = 7.61, SD = 1.30); recovery sleep was significantly greater than weeknight sleep. MSLT data showed MSC had significantly more REM episodes and shorter sleep onset latencies (SOL) than LSC. Post-recovery sleep, SOL did not differ between groups. Post-recovery sleep, reaction times for both groups were significantly faster and memory was significantly more accurate.
Conclusion: The present data indicate that recovery sleep increases SOL and cognitive performance, especially for Cadets who reported greater subjective sleepiness.
Support (If Any): DARPA.

0339

THE NON-REM SLEEP EEG SPECTRUM FOLLOWING TOTAL SLEEP DEPRIVATION IS TRAIT-LIKE

Tarokh L[1,2], Van Dongen H[3], Rusterholz T[1,4], Achermann P[1,4,5]
[1]Institute of Pharmacology and Toxicology, University of Zurich, Zurich, Switzerland, [2]Department of Psychiatry and Human Behavior, Alpert Medical School at Brown University, Providence, RI, USA, [3]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA, [4]Neuroscience Center, University and ETH Zurich, Zurich, Switzerland, [5]Zurich Center for Integrative Human Physiology, University of Zurich, Zurich, Switzerland

Introduction: A number of studies have shown that the sleep EEG spectrum is unique to an individual and stable across multiple recordings, leading to the suggestion that the sleep EEG spectrum is a trait. These studies typically examine baseline sleep after approximately 16 hours of wakefulness. The aim of the current study was to examine whether the sleep EEG spectrum after 36 hours of wakefulness also represents a trait.
Methods: As part of an 11-day in-laboratory study, polysomnography was recorded in sixteen healthy subjects between the ages of 22 and 40 years on six consecutive nights. Three nights of baseline sleep (12 hours time in bed, 22:00-11:00, following 12 hours of wakefulness) were interleaved with three nights of recovery sleep (12 hours time in bed, 22:00-10:00, following 36 hours of sustained wakefulness). Sleep was scored visually according to the criteria of Rechtschaffen and Kales, and the non-REM sleep EEG (C3/A2 derivation) was subjected to spectral analysis. Interclass correlation coefficients (ICCs) were calculated for 0.25 Hz frequency bins between 0.75 and 16 Hz, for the baseline and recovery night spectra separately.
Results: As found previously, ICCs were high (from 0.50 to 0.87) and significant ($P<0.05$) across the entire frequency range for the non-REM sleep EEG spectra of the baseline nights. ICCs were also high (from 0.48 to 0.91) and significant ($P<0.05$) across all frequencies for the non-REM sleep EEG spectra of the recovery nights.
Conclusion: Our results indicate that the spectrum of the non-REM sleep EEG following sleep deprivation is trait-like, which may be a reflection of functional neuroanatomy.
Support (If Any): This work was supported by Swiss National Science Foundation Grant 320030-130766 (to PA), NIH grant HL70154 (to HVD) and ONR grant N00014-11-C-0592 (to HVD).

0340

EFFECT OF COGNITIVE WORKLOAD ON POLYSOMNOGRAPHIC MEASURES UNDER SLEEP RESTRICTED AND NON-SLEEP RESTRICTED CONDITIONS

Abe T, Goel N, Braun ME, Dinges DF
Division of Sleep and Chronobiology, Department of Psychiatry, Division of Sleep and Chronobiology, Philadelphia, PA, USA

Introduction: Sleep physiology reflects the interaction of homeostatic and circadian processes, but aspects of sleep may also reflect plastic processes occurring during wakefulness. This experiment determined the effects of high versus moderate cognitive workload on PSG and SWE measures during sleep restriction (SR) and non-sleep restriction (NSR).
Methods: In a 10-day laboratory experiment currently underway, N=63 healthy adults (33.2±8.7y;29f) were assigned randomly to 1 of 4 conditions: (1) moderate workload (MW)+SR; (2) high workload (HW)+SR; (3) MW+NSR; or (4) HW+NSR. Subjects had 3 baseline nights (8h

TIB) followed by 5 SR (4h TIB) or 5 NSR (8h TIB) nights. Subjects received three workload testing sessions per day of 180 minutes (HW) or 90 minutes (MW) of continuous work on a wide range of cognitive tasks. PSGs were recorded on baseline night 3 (B3) and experimental night 5 (SR5/NSR5). Sleep was scored blind to condition. Subjects with missing or artifact-ridden data were excluded, yielding N=58 (33.2±8.5y;26f) subjects for analyses. ANCOVAs using B3 measures as covariates and t-tests compared PSG and SWE (%baseline) differences between conditions, respectively.

Results: Preliminary data analyses indicate that subjects in the HW+NSR had longer sleep onset latencies (SOL) than subjects in the MW+NSR by the fifth experimental night (NSR5;$p<0.05$). By contrast, an effect of high workload on SOL was not evident in the SR condition. Furthermore, no other PSG measures or SWE, the putative marker of sleep homeostasis, showed effects of cognitive workload under conditions of SR or NSR (p's >0.05).

Conclusion: High workload delays sleep onset when there is no additional pressure for sleep from sleep restriction. This novel finding suggests that high workload may contribute to some of the sleep onset difficulties experienced by workers in different occupational settings. It also suggests that when sleep restriction occurs simultaneously with high workload, sleep onset and sleep homeostasis are not impacted.

Support (If Any): Supported by the National Space Biomedical Research Institute through NASA NCC 9-58 and CTRC UL1RR024134; in part by JSPS Postdoctoral Fellowships for Research Abroad and a Grant-in-Aid for Scientific Research from the Japanese Ministry of Education, Culture, Sports, Science, and Technology (No. 22730598).

0341

DOES NAPPING ON THE NIGHT SHIFT AFFECT THE EFFICIENCY OF DAYTIME RECOVERY SLEEP?

Kan K[1], Mollicone D[1], Van Dongen H[3], Basner M[2], Dinges DF[2]
[1]Pulsar Informatics Inc., Philadelphia, PA, USA, [2]Department of Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [3]Sleep and Performance Research Center, Washington State University, Spokane, WA, USA

Introduction: Many occupational settings are considering adopting napping strategies during the night shift to mitigate fatigue risk associated with extended duty hours and night work. This study investigated the effect of a range of restricted sleep schedules with and without naps where the primary sleep was scheduled during the biological day and the nap was scheduled during the biological night. The objective of our analysis was to determine whether a nap during the night shift affected the efficiency of the subsequent daytime primary sleep period.

Methods: N=79 healthy adults (aged 22-48y; 27 females) participated in a 10-day sleep restriction protocol and were assigned to one of 18 sleep regimens. These involved restricted diurnal sleep (4.2h, 5.2h, 6.2h or 8.2h TIB) and a nocturnal nap (0.4h, 0.8h, 1.2h, 1.6h, 2.0h or 2.4h TIB) or no nap. Total sleep time (TST) was assessed with polysomnography. Response surface maps were constructed to examine diurnal sleep efficiency as a function of anchor sleep and nap sleep durations.

Results: SE of the primary diurnal sleep period was found to be adequately described by a linear function of daily total TIB (i.e., anchor + nap), with greater total TIB per 24h resulting in lower diurnal SE ($\chi2[1]=18.3$, $p=<0.001$). For every hour of additional TIB per 24h, diurnal SE dropped by 4.8% (sem 1.0%).

Conclusion: Across a range of chronic sleep restriction conditions with the primary sleep period (4.2h to 8.2h TIB) placed diurnally and a nap (0h to 2.4h TIB) placed nocturnally, diurnal SE was primarily a function of total TIB per 24h-regardless of how sleep was divided among diurnal primary sleep and nocturnal nap sleep periods. This suggests that napping on the night shift does not degrade subsequent daytime SE above and beyond SE reduction associated with daytime sleep or increasing overall TIB.

Support (If Any): Supported by the National Space Biomedical Research Institute through NASA NCC 9-58.

0342

EFFECTS OF NIGHTTIME CAFFEINE ADMINISTRATION ON SKIN AND CORE BODY TEMPERATURES AND DAYTIME SLEEP FOLLOWING SLEEP DEPRIVATION

McHill AW, Smith BJ, Wright KP
Department of Integrative Physiology, University of Colorado Boulder, Boulder, CO, USA

Introduction: Caffeine is used to promote wakefulness during sleep deprivation and night shift work, although it can also disturb subsequent daytime sleep. One mechanism by which caffeine is reported to improve alertness is by increasing core body temperature (CBT). In contrast, a lower CBT and a higher distal-to-proximal skin temperature gradient (DPG) has been reported to promote sleep. We tested the hypothesis that caffeine use during one night of sleep deprivation would reduce the distal-to-proximal skin temperature gradient (DPG), increase CBT and disturb daytime recovery sleep.

Methods: Thirty healthy adults (9 females), BMI (22.45±2.13 kg/m^2) aged (21.6 ± 3.5y) participated. After one-week of maintaining an 8h nightly sleep schedule at home and a baseline 8h in lab sleep opportunity, participants were sleep deprived for 28h under modified constant routine conditions. At 23h of wakefulness, 5h before the daytime recovery sleep episode, subjects in the caffeine group (n=9) were administered double-blind caffeine (2.9 mg/kg). Skin (iButton, Maxim, Sunnyvale CA) and core (Vitalsense, Mini Mitter Respironics, Bend OR) body temperatures were recorded every minute. Baseline and daytime recovery sleep were manually scored from C3XA2.

Results: Caffeine significantly decreased the DPG ($p< 0.001$), increased CBT ($p< 0.001$) and disrupted daytime recovery sleep when compared to placebo. Significant interactions between group and sleep episode were observed for percentages of stage 1 ($p<0.05$), stage 2 ($p<0.05$), and stage 3/4 ($p<0.05$) sleep with non-significant interactions for the percentage of wakefulness ($p=0.057$) and sleep onset latency (SOL10 $p=0.09$).

Conclusion: A reduction in the DPG and increase in CBT following caffeine use during sleep deprivation may represent a possible mechanism by which caffeine disturbs recovery sleep. Furthermore, our findings suggest that shift-workers consuming caffeine at night are at high risk of sleep disturbance even when caffeine is consumed approximately one-half life or 5h prior to daytime recovery sleep.

Support (If Any): Support: NIH R01 HL081761 and NIH/NCRR Colorado CCTSI Grant Number UL1 RR025780.

0343

EXPERIMENTAL SLEEP DEPRIVATION IS ASSOCIATED WITH AN INCREASED TENDENCY TO SUSTAINED SPONTANEOUS MOTOR ACTIVITY IN HEALTHY HUMAN SUBJECTS

Lim AS[1], Simpson N[2], Haack M[2], Mullington JM[2]
[1]Neurology, University of Toronto, Toronto, ON, Canada, [2]Neurology, Beth Israel Deaconess Medical Center / Harvard Medical School, Boston, MA, USA

Introduction: Sleep problems are common in children with attention deficit hyperactivity disorder and in these children, sleep restriction can worsen neurobehavioural function. In the laboratory, it has been well demonstrated that sleep deprivation can lead to attentional and other cognitive deficits. However, the effects of sleep deprivation on spontaneous motor behavior have not been as thoroughly experimentally characterized.

Methods: We studied 20 individuals in an inpatient sleep deprivation protocol. Subjects underwent 2 baseline in-lab habituation days and were then randomized to either 2 days of 63 consecutive hours of sleep de-

privation (N=14) or 2 days of 9 hours of sleep per night (N=6) followed by 2 nights of recovery sleep. Participants wore actigraphs throughout the study period, and we quantified nocturnal and diurnal total activity, percentage of time spent active vs. inactive, as well as rest and activity fragmentation/consolidation using a recently developed state transition metric.
Results: Compared to control individuals and compared to their own baseline values, individuals subjected to sleep deprivation experienced an increased tendency to sustained spontaneous motor activity (p=0.003) throughout the sleep deprivation period, an effect that persisted despite 2 nights of recovery sleep (p=0.003).
Conclusion: Experimental sleep deprivation leads to an increased tendency to sustained spontaneous motor activity in healthy human volunteers, and this effect persists even after 2 nights of recovery sleep. This may reflect an inability to maintain quiet wakefulness under conditions of sleep loss. These findings may explain some of the clinically noted correlations between short sleep times and symptoms of hyperactivity.
Support (If Any): NIH Grants AG28324, HL07901(T32), RR025758. AAN Clinical Research Training Fellowship. CIHR Bisby Fellowship.

0344

LONGER SLEEP TIME THAT LEADS TO INCREASED WASO AND LOWERED SLEEP EFFICIENCY IS ASSOCIATED WITH GREATER RESTFULNESS UPON FINAL AWAKENING: A FOURTEEN MONTHS LONGITUDINAL PSG STUDY ON A SINGLE SUBJECT

Duncan J[1], Forest G[1], Therrien M[2]
[1]Université du Quebec en Outaouais, Gatineau, QC, Canada, [2]CSSSG, Gatineau, QC, Canada

Introduction: Many studies have established a link between sleep quality and various aspects pertaining to quality of life such as alertness, mood, and cognition. For instance, slow wave sleep (SWS) and high sleep efficiency have consistently been associated with recuperative functions. This study verified the associations between sleep architecture and restfulness.
Methods: Daily polysomnography was recorded and questionnaires were completed by a healthy 29-years-old Caucasian male during 404 consecutive nights. All EEGs were visually scored according to the AASM 2007 criteria: 361 nights showed no artefacts or technical problems, and were thus included in the analyses. Spearman correlations were performed between scores on the restfulness upon final awakening scale (0= extremely low to 10= extremely high), total sleep time (TST), number of minutes in stages N1, N2, N3 and REM sleep, WASO, and sleep efficiency (SE; %). Additional correlations were computed between sleep variables.
Results: Restfulness was significantly correlated with TST (r= .461, p< .001), N2 (r= .369, p< .001), REM sleep (r= .401, p< .001), WASO (r= .276, p< .001), and SE (r= -.232, p< .001). TST was significantly correlated with N1 (r= .257, p< .001), N2 (r= .905, p< .001), REM sleep (r= .756, p< .001), and SE (r= -.232, p< .001), but not with N3. Moreover, N2 was significantly correlated with N3 (r= -.167, p< .001) and SE (r= -.196, p< .001).
Conclusion: Our results suggest that longer sleep duration composed of more N2 and REM sleep, but not more SWS, is associated with a greater feeling of restfulness upon final awakening. Interestingly, increased WASO and lower SE also seem to be part of a more restful sleep, which contrasts with the classical view that a good night's sleep is one determined by minimal nocturnal awakenings and maximal SWS. We thus believe that the concept of SE should be reconsidered.

0345

SLEEP INERTIA EFFECTS ON PERFORMANCE ARE TRAIT-LIKE DURING THE BIOLOGICAL NIGHT BUT APPEAR TO BE MORE STATE-DEPENDENT DURING THE BIOLOGICAL DAY

Signal L[1], Mulrine HM[1], van den Berg MJ[1], Gander PH[1], Van Dongen H[2]
[1]Sleep/Wake Research Centre, Massey University, Wellington, New Zealand, [2]Sleep and Performance Research Center, Washington State University Spokane, Spokane, WA, USA

Introduction: Performance impairment due to sleep loss has been demonstrated to be highly variable between individuals, but stable within individuals and thus trait-like. It has not been established whether the performance impairment associated with sleep inertia is also trait-like. In two laboratory protocols designed to simulate night work and extended operations, we found that sleep inertia significantly degraded 2-back working memory performance. These effects lasted for less than 15 minutes, and were most pronounced following 40- and 60-min naps as compared to a 20-min nap or no nap. Here we examine trait-like individual differences in the sleep inertia effect during the biological night versus day.
Methods: Data from two within-subjects laboratory protocols involving 24 healthy young men were analyzed (Protocol 1 (P1) n=12, mean age 25.1 y; Protocol 2 (P2) n=12, mean age 23.2 y). As part of larger studies, subjects were given nap opportunities of 40- or 60-min ending at 02:00 after ~20 h wakefulness (P1) or at 12:00 after ~30 h wakefulness (P2). A 6-min test battery including a 4-min 2-back Working Memory Task (WMT) was administered immediately after scheduled awakening. Mixed-effects ANOVA was used to separate between-subjects variance (VARbs) from within-subjects variance (VARws) and calculate the intraclass correlation coefficient (ICC).
Results: In P1 (night-time awakening), ICCs were substantial for WMT Reaction Time (RT) (VARbs=79173, VARws=42006, ICC=0.65), Correct Matches and Non-Matches (CMCN) (VARbs=86.6, VARws=45.6, ICC=0.65) and Omissions (VARbs=37.2, VARws=19.8, ICC=0.65). In P2 (day time awakening), ICCs were considerably smaller (RT: VARbs=16899, VARws=29041, ICC=0.37; CMCN: VARbs=59.6, VARws=108.3, ICC-0.35; Omissions: VARbs=62.6, VARws=129.2, ICC=0.34).
Conclusion: After waking from a 40- or 60-min nap during the biological night (02:00 after ~20 h awake), working memory performance levels showed trait-like variability among subjects - but this trait was much less pronounced after waking from a 40- or 60-min nap during the biological day (12:00 after ~30 h awake). Whether this trait is modulated by circadian time, or masked by state-dependent variables varying over time of day remains to be determined.
Support (If Any): Marsden Award 08-MAU-108, AFOSR grant FA4869-06-1-0041, and Massey University Research Fund grant 03/3016 (LS) and ONR grant N00014-11-C-0592 (HVD).

0346

RECOVERY SLEEP ENHANCES SURVIVAL DURING BACTERIAL INFECTION IN DROSOPHILA

Kuo T, Williams JA
Center for Sleep and Circadian Neurobiology, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, USA

Introduction: Excess sleep associated with immune challenge has been documented in a wide range of animals, including Drosophila. However, the function of this excess sleep during infection, or recovery sleep, is not clear. The innate immune response in Drosophila is well characterized and has many features that are shared with that in mammals. We evaluated the impact of sleep on the ability of flies to fight infection with *S. marcescens*, which is pathogenic to flies.

Methods: We used both mechanical and genetic approaches to manipulate sleep during infection. NFκB activity, which is central to an innate immune response, was measured using a real-time luciferase reporter assay in living flies, and by performing quantitative PCR on NFκB target genes, antimicrobial peptides (AMPs).
Results: Manipulations that enhanced sleep after infection improved the flies' ability to survive the infection. Sleep deprivation before infection (early SD) enhanced recovery sleep and was associated with an early rise in NFκB activity during the infection. Increasing sleep using a genetic approach also enhanced baseline expression levels of a subset of AMPs. Both these manipulations of sleep improved the flies' ability to clear the infection, which indicates increased resistance to infection. In contrast, SD after infection (late SD) or reducing sleep by a genetic method had little or no effect on survival outcome. However, late SD was accompanied by greater increases in NFκB activity during infection than that in non-SD flies. Interestingly, reducing sleep during infection had no impact on AMP expression levels nor on the ability of flies to clear the infection.
Conclusion: Sleep boosts immune function and is beneficial to the host during recovery. Given the high degree to which molecular components of innate immune responses are shared between flies and humans, these results suggest that finding ways of enhancing restorative sleep will have a positive impact on clinical outcome in human disease.
Support (If Any): This work was supported by a grant from the National Science Foundation #IOS-102567.

0347

INFLUENCE OF SLEEP DEPRIVATION AND MORPHINE ON THE EXPRESSION OF MEDIATORS INVOLVED IN WOUND HEALING IN MOUSE

Egydio F[1], Ribeiro D[2,3], Noguti J[2], Tufik S[1], Andersen ML[1]
[1]Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [2]Pathology, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [3]Biosciences, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: Skin performs a host of primordial functions that keep the body alive. Morphine is a drug with immunosuppressant properties whose chronic use may lead to increased infection and delayed wound healing. Sleep is a fundamental biological phenomenon that promotes the integrity of several bodily functions. Sleep deprivation (SD) adversely affects several systems, particularly the immune system.
Methods: Adult hairless male mice were distributed into the following groups: Control, morphine, SD, and morphine+SD. Morphine (10 mg/kg, subcutaneous) was injected every 12 hours for 9 days. The animals were submitted to paradoxical sleep deprivation (PSD) for 72 hours. At the end of protocols the animals were euthanized by decapitation and a skin biopsy was removed from the dorsal region (Ethical Committee #1771/10).
Results: Morphine induced immunoexpression of COX-2 and iNOS. Sleep-deprived did not modulate outcomes induced by morphine. No remarkable histopathological changes were detected in the group subjected to SD or morphine.
Conclusion: Our findings suggest that morphine is able to induce COX-2 and iNOS immunoexpression in the skin of hairless mice and that SD does not modulate this outcome. Further studies are warranted to provide additional evidence of the long-term consequences of using morphine with or without SD.
Support (If Any): Associação Fundo de Incentivo à Pesquisa (AFIP), CNPq, and Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP (CEPID #98/14303-3).

0348

INCREASED PAIN SENSITIVITY AFTER CHRONIC SLEEP RESTRICTION IN MICE

Latremoliere A[1,3], Alexandre C[2,3], Yamamoto M[2,3], Woolf CJ[1,3], Scammell TE[2,3]
[1]FM Kirby Neurobiology program, Children's Hospital Boston, Boston, MA, USA, [2]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA, [3]Neurobiology, Harvard Medical School, Boston, MA, USA

Introduction: In the last few decades, the average amount of sleep has decreased in the general population to levels significantly less than the amount required for restorative sleep. In various experimental conditions, sleep deprivation lowers pain thresholds and increases attention to pain of healthy subjects. These protocols however represent drastic sleep deprivations, which are rarely experienced in natural settings. We thus developed a novel protocol that produces chronic sleep restriction in mice to study the effects of prolonged, moderate sleep restriction on pain sensitivity.
Methods: C57BL6/J mice were instrumented for sleep recordings and were sleep-deprived 6 hours per day for 5 consecutive days from the onset of the light period (7:00 AM) using gentle, minimally-stressful procedures. Pain sensitivity was assessed the days before and after the first, third and fifth sessions of sleep restriction.
Results: Chronic sleep restriction gradually shortened the heat withdrawal latencies starting after the first sleep restriction session with a maximum effect after the fifth session. Responses to von Frey filaments were increased only after the fifth sleep deprivation session, whereas responses to pinprick or acetone application were not changed. Latencies for withdrawal reflexes upon tail immersion at 47C were decreased in sleep-deprived mice, suggesting alterations occurring at the spinal level. Pain sensitivity returned to basal values when the animals were allowed to sleep normally.
Conclusion: Our results show that partial restriction of sleep over several days induces major changes in pain sensitivity that affect different modalities. Those changes appear to involve spinal and supra-spinal structures.
Support (If Any): This work was supported by NIH grant 3R01NS038253-11S1.

0349

INFLUENCE OF SLEEP DEPRIVATION ON CARDIOVASCULAR REACTIVITY AND PAIN PERCEPTION TO COLD PRESSOR TEST

Larson RA[1], Durocher JJ[1], DellaValla JP[2], Yang H[1], Carter JR[1]
[1]Kinesiology & Integrative Physiology, Michigan Technological University, Houghton, MI, USA, [2]Center for Sleep Medicine, Androscoggin Valley Hospital, Berlin, NH, USA

Introduction: 24-hour total sleep deprivation (TSD) and cardiovascular reactivity have been independently linked to the development of hypertension. TSD influences perceived pain (PP), and cold pressor test (CPT) elicits increases in mean arterial pressure (MAP) and heart rate (HR). We hypothesized that TSD would increase cardiovascular reactivity and perceived pain responses to CPT.
Methods: We examined 26 subjects (age 23±1 yr; 14 men and 12 women) following a normal night of sleep (NS) and TSD. Sleep durations preceeding the testing sessions were monitored with actigraphy. Resting blood pressures were measured via three consecutive recordings in the supine position with an automated sphygmomanometer. Continuous beat-by-beat arterial blood pressure (Finometer) and HR (electrocardiogram) were recorded during a 3 minute resting baseline, and a 2 minute CPT. PP was recorded using a Modified Borg scale (i.e. 6-20 a.u.) every 15 seconds during CPT. Resting variables were compared using paired t-tests, and responses to CPT were analyzed with repeated measures ANOVA.

Results: Resting MAP increased following TSD (72±1 vs. 75±1 mmHg, p<0.01), while HR demonstrated no change (59±2 vs. 59±1 beats/min, p=0.84). In contrast, TSD elicited an augmented HR response to CPT (Δ9±1 vs. Δ12±1 beats/min, p<0.04), but MAP responses were not altered (Δ12±1 vs. Δ13±1 mmHg, p=0.57). PP during CPT was significantly elevated following TSD (Δ6.9±0.5 vs. Δ8.3±0.5 a.u., p<0.01).
Conclusion: MAP responses to CPT were not altered by TSD. However, CPT-mediated increases in HR and PP were elevated following TSD. It remains unclear how these responses may influence long-term blood pressure function.
Support (If Any): Supported by NIH (HL-098676).

0350

INFLUENCE OF 24-HOUR SLEEP DEPRIVATION ON SYMPATHETIC AND CARDIOVAGAL BAROREFLEX FUNCTION IN HUMANS

Yang H[1], Durocher JJ[1], Larson RA[1], DellaValla JP[2], Carter JR[1]
[1]Kinesiology and Integrative Physiology Department, Michigan Technological University, Houghton, MI, USA, [2]Center for Sleep Medicine, Androscoggin Valley Hospital, Berlin, NH, USA

Introduction: Sleep deprivation has been shown to be associated with the development of hypertension. Baroreflex impairment contributes to sympathetic overactivity and increases in blood pressure (BP). The present study examines the influence of 24-hour total sleep deprivation (TSD) on sympathetic and cardiovagal baroreflex function. We hypothesized that TSD would elicit attenuated sympathetic and cardiovagal baroreflex sensitivities (BRS) compared to normal sleep (NS).
Methods: Resting heart rate (HR), BP, and muscle sympathetic nerve activity (MSNA) were measured in 13 healthy subjects (age 21±1 yr; 8 men and 5 women) during 10 min supine rest and 3 Valsalva maneuvers at 40mmHg expiratory pressure (15s, 1min recovery between each maneuver). Subjects were studied twice, once after normal sleep and once after TSD (randomized crossover design). Sympathetic BRS to Valsalva maneuver was determined as the ratio of all sympathetic bursts occurring during 15s straining and the maximum diastolic pressure reductions during early phase II. Cardiovagal BRS was derived from slope of the linear relationship between changes in systolic pressure and the corresponding changes in R-R interval during early phase II (i.e. hypotensive stimulus) and phase IV (i.e. hypertensive stimulus). All variables were compared using paired t-test between NS and TSD.
Results: TSD increased mean arterial pressure (72±2 to 76±2 mmHg; P=0.004), reduced MSNA (13±1 to 9±2 bursts/min; P=0.044), but did not alter HR at rest. Sympathetic BRS was not altered by TSD (-0.8±0.2 vs. -0.7±0.1 bursts/15s/mmHg; P=0.19). TSD did not alter cardiovagal BRS during the hypotensive stimulus (8±2 vs. 10±3 ms/mmHg; P=0.194), however TSD tended to elicit attenuated cardiovagal BRS during the hypertensive stimulus (18±2 to 15±2 ms/mmHg; P=0.058).
Conclusion: TSD increases resting BP, decreases resting MSNA and tends to elicit an attenuated cardiovagal baroreflex during hypertensive stimulus (i.e. phase IV of Valsalva maneuver).
Support (If Any): Supported by NIH (HL-098676).

0351

BEAT TO BEAT BLOOD PRESSURE (BP) ANALYSIS DURING PROLONGED WAKEFULNESS AND SLEEP

Osuji VC[1,2], Thawani A[1,2], Ariss TN[1,2], Serrandor J[1,2], Haack M[1,2], Mullington JM[1,2]
[1]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Harvard Medical School, Boston, MA, USA

Introduction: This study investigates the effect of experimental sleep loss and recovery sleep on beat-to-beat blood pressure measures.
Methods: Participants spent 6 nights/days in the Clinical Research Center. Two nights of adaptation/baseline sleep was followed by random assignment to sleep [N = 6] or sleep deprivation [N = 18] conditions. The sleep condition consisted of 9 hours of sleep/ night. The sleep deprived participants remained awake for 63 hours. In both conditions the last two days of the protocol were recovery periods. Beat to beat BP was measured (Portapres systems) continuously on the 2nd baseline, the 2nd deprivation, and the 2nd recovery days.
Results: In the sleep condition, 24-hour systolic BP was comparable across baseline, control sleep, and recovery. As expected, at night, during the sleep deprivation phase of the study, systolic BP was higher during deprivation (127±2 (SE)) than control condition (100 ± 3 (SE)), (p<0.001). There was a trend for the sleep deprived group to have higher daytime systolic BP during the deprivation phase of the study. During the recovery period, systolic BP remained higher in participants who had been sleep deprived compared with those who had 9 hours of sleep, (p<0.02). On the 2nd recovery day period, the deprivation group had a net average increase over baseline of 3 systoles, whereas the control group dropped their systolic BP by 6 when compared with their baseline values.
Conclusion: The above results show that nocturnal BP is increased at night during sleep deprivation. On the day following 2 nights of recovery sleep, BP remained elevated over control, suggesting that sleep deprivation has a lasting effect on blood pressure.
Support (If Any): NIH grants AG28324, RR025758.

0352

SLEEP CURTAILMENT IS ASSOCIATED WITH ALTERED AUTONOMIC TONUS IN EUTROPHIC INDIVIDUALS

Moraes W, Poyares D, Bittencourt LA, Tufik S, de Mello M
Psychobiology, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: Increased sympathetic tonus has been suggested as a mechanism linking short sleep duration to overweight and hypertension. The present study was proposed to assess autonomic tonus in relation to sleep duration in a representative sample of eutrophic individuals from the general adult population.
Methods: A representative sample of the city of Sao Paulo was selected (20-80 years), including 1024 individuals, from which 224 females and 193 males were eutrophic (body mass index ≤25). They underwent full polysomnography with ECG recording. Heart Rate Variability (HRV) was analyzed for the whole night using a polysomnography ECG lead (D2 modified). Time and Frequency domains variables were calculated for individuals who slept more (controls) and less than 5 hours (experimental group) per night, assessed by objective measures. One-way ANOVA was performed considering insomnia syndrome and AHI>5 as covariates.
Results: Sleep curtailment was significantly associated with reduced SDNN (p=0.02) and SDNNINDEX (p<0.01) which are related to a reduction in HRV. RMSS was also reduced (p<0.01) indicating reduction in parasympathetic tonus, and LF/HF ratio increased suggesting high sympathetic tonus.
Conclusion: Sleep shortage was associated with reduced HRV and parasympathetic tonus, and increased sympathetic tonus in eutrophic individuals. These findings support the concept that altered autonomic tonus is associated to sleep curtailment independently from the presence of obesity. This alteration could mediate the link between short sleep , obesity and cardiovascular risk. Longitudinal studies are needed to support this hypothesis.
Support (If Any): CPID/FAPESP, AFIP.

0353

SLEEP FRAGMENTATION-INDUCES EXCESSIVE SLEEPINESS IN MICE LACKING P47PHOX NADPH OXIDASE ACTIVITY

Kaushal N[1], Ramesh V[1], Christman J[2], Gozal D[1]
[1]Pediatrics, The University of Chicago, Chicago, IL, USA, [2]Medicine, University of Illinois at Chicago, Chicago, IL, USA

Introduction: Chronic sleep fragmentation (SF) induces increases in sleep propensity in mice, even in the absence of reduced sleep duration. We previously showed that SF increases oxidative stress in the CNS and that mice null for the gp91phox subunit of NADPH oxidase were protected from SF-induced cognitive deficits but not from increased SF-induced sleep propensity (Nair et al, AJRCCM 2011; 184:1305-12). Since NADPH oxidase is a complex pentameric structure, we now examined whether NOX1, which relies the p47phox for its activity was involved in SF-mediated sleepiness.
Methods: Mice lacking the p47phox-/- subunit of NADPH oxidase were chronically implanted along with wild-type (WT) littermates with telemetric transponders to assess sleep. Following surgical recovery, baseline recordings for 24h were carried out starting 7am, after which mice were subjected to chronic SF (7am to 7pm) for 15 days. 24 h recordings were carried out on day 1 (acute), day 7, and day 15. Following SF, the mice were sacrificed and markers for lipid peroxidation (malondialdehyde; MDA) and for DNA oxidation (8 hydroxy 2' deoxyguanosine; 8-OHdG) were assayed.
Results: Sleep time analysis on WT and p47phox-/-mice during light period on day 1 of SF showed no significant changes in wake (58.75 ± 2.56% and 55.61 ± 1.72 %) and SWS (39.61 ± 2.52% and 39.98 ± 1.38 %). However, p47phox-/-mice showed quicker recovery immediately following SF when compared to the WT (1.64 ±0.20 vs. 4.40 ± 0.56). Total sleep time analysis (24 h) on day 1 of SF showed increases in wake (55.22 ±1.31 vs. 59.19 ±1.61%) and REM sleep (3.71 ±0.20 vs. 4.76 ± 0.46%) and decrease in SWS (41.06 ±1.38 vs. 36.03 ±1.38%) in p47phox-/- when compared to WT mice. By day 7 and day 15, wake, SWS and REM were all comparable to baseline in both WT and p47phox-/-mice. No changes in delta power between WT and p47phox-/-mice emerged in SF. SWS latency measurement, a surrogate marker for sleep propensity showed a significant decrease in SWS latency on all days, indicating excessive sleepiness in both mouse groups. Both MDA and 8-OHdG was significantly reduced in p47phox-/- when compared to WT mice (0.788 ± 0.07 vs 1.131 ± 0.10 mg/mg tissue) and (110.35 ± 4.74 vs 131.67± 5.16 pg/ml) respectively.
Conclusion: Oxidative stress induced by excessive NADPH oxidase-mediated superoxide release in the context of SF appears to underlie pathogenic elements leading to neurocognitive dsyfunction, but is not involved in the mechanisms underlying SF-induced excessive sleepiness.
Support (If Any): NIH grant HL-086662.

0354

ROLE OF FATTY ACID SIGNALING IN INTERMITTENT HYPOXIA-INDUCED ATHEROGENESIS

Lee S, Guo S, Kim J, Gozal D, Li R
Pediatrics, Univ of Chicago, Chicago, IL, USA

Introduction: Obstructive sleep apnea (OSA) which is characterized by intermittent hypoxia (IH) during sleep has emerged as an independent risk factor for cardiovascular disease, and more specifically coronary heart disease. Recently, IH promotes atherosclerotic lesion formation in a mouse model of atherogenesis. However, the molecular mechanisms underlying IH-associated atherogenesis remain largely unknown. Fatty acid is important for many cellular functions, including cell signaling. Since fatty acid binding protein 4 (FABP4) play a critical role in the process of atherosclerosis, Fatty acid and its binding protein may also play a potential role in IH-induced atherogenesis.
Methods: Macrophage transformation, cholesterol transporters and foam cell formation were assessed in THP-1 cells. Cells were exposed to IH (alternating 21% and 5% O2 for 5 min from 7AM to 7PM each day). The mRNA and protein expression of FABP4 and cholesterol transporters were assessed by real-time PCR and western blotting. Monocyte transformation and migration were assessed by flow cytometry and immunohistochemistry. Foam cell formation was examined by oil red O staining.
Results: IH induced increased mRNA and protein expression of FABP4 in the THP-1 cell. IH was also associated with transformation of monocytes to activated macrophages, as evidenced by increased expression of CD14 and CD68. IH promoted foam cell formation in THP-1. IH also activated FABP4 translocation into nucleus. Competitive inhibitor of FABP4 not only block IH-induced FABP4 translocation, but also attenuated almost all IH-induced atherogenic events, suggesting FABP4 translation activated by fatty acid is critical to IH-induced atherogenesis.
Conclusion: Fatty acid and its binging protein play an important role in IH-induced atherogemesis and may become a viable therapeutic target aiming to prevent and potentially reverse OSA-associated atherosclerosis.
Support (If Any): AHA SDG 0930129N.

0355

ONE NIGHT OF PARTIAL SLEEP DEPRIVATION INFLUENCES GABA SIGNALLING IN THE PRECUNEUS; A 3T MAGNETIC RESONANCE SPECTROSCOPY STUDY

Cooper EA[1,3], Napolitano A[2,1], Dashdorj N[1], Auer DP[1]
[1]Division of Radiological and Imaging Sciences, University of Nottingham, Nottingham, United Kingdom, [2]Department of Occupational Health and Safety, Medical Physics, Bambino Gesù Children's Hospital, Rome, Italy, [3]Department of Psychiatry, Clinical Medicine, Brighton and Sussex Medical School, Brighton, United Kingdom

Introduction: Partial sleep deprivation (PSD) is experienced by many and causes increased sleep pressure in subsequent days leading to cognitive decline, increased sleepiness and decreased awareness of the environment. GABA is implicated in the onset and maintenance of NREM sleep and related to enhanced sleepiness. Previous MRS studies have shown changes in detectable neurotransmitter profiles following PSD, but were limited in their reliability due to the known technical challenges of separating Glutamate (Glu), Glutamine (Gln) and GABA using standard sequences. Based on animal work, we hypothesised that PSD would cause a GABA increase in the Precuneus (PrC).
Methods: Twenty-two healthy participants (15 male, 7 female) without sleep problems were recruited to an MRI study investigating the effects of PSD on GABA, Glu and Gln signalling and brain activations. Participants slept in their own home for 8-hours (Baseline) and 3-hours (PSD) in a randomised order with compliance assessed by Actigraphy. Scans were carried out on a 3T Philips Achieva between 18:30 and 22:30, separated by at least 3 days. Behavioural data was collected (Stanford Sleepiness Scale and Tiredness Symptoms Scale). In vivo Magnetic Resonance Spectroscopy (MRS) of the PrC was carried out with optimised PRESS sequences for GABA (TE1=15ms, TE=105ms) and Glu (TE=80ms) detection, acquired from a voxel size measuring 37x28x27mm^3.
Results: PSD was sufficient to cause an increase in subjective sleepiness ($p<0.001$, n=21) and tiredness symptoms ($p<0.001$, n=21). MRS results show a significant increase of GABA ($p=<0.05$, n=16) in PSD compared to Baseline; no significant changes were observed for Glu and Gln. No significant correlations were found between subjective sleepiness measures and GABA increase.
Conclusion: We found significantly increased GABA in the PrC of PSD condition compared to Baseline, with no significant changes in Glu or Gln. This increase in GABA may contribute to the feeling of sleepiness, particularly reduced awareness of one's surroundings.

0356
PROTEOMIC DETERMINATION OF CANDIDATE BIOMARKERS FOR SLEEP LOSS

Naidoo N, Sriswasdi S, Speicher D, Pack A
Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Sleep loss, a common problem in the American population, leads to wake-state instability, lapses in performance and compromises other aspects of cognitive function including executive attention and working memory. Epidemiological studies indicate an association between sleep loss and increased rates of obesity, type-2 diabetes and an increased risk of cardiovascular disease. Currently, there are no simple ways to assess the degree of sleep loss in individual subjects. It is known that there is a large difference between individuals in how affected they are by sleep loss; some individuals are relatively resistant while others are markedly affected.
Methods: In a 36 hour sleep deprivation and performance study carried out in monozygotic and dyzygotic twins we determined that the behavioral response to sleep loss has high heritability. Blood samples were obtained every 4 hours during baseline, sleep deprivation and then recovery sleep from 10 individuals who had the lowest behavioral response (low responder) to sleep deprivation, i.e., few lapses, and 10 individuals who had the highest behavioral response to sleep deprivation (high responder). We used a high throughput 3-D label free proteomic strategy to assess proteins changing expression over 36 hours of sleep deprivation in both groups. The initial discovery strategy used pooled samples at 12 hr, 24 hr and 36 hr of sleep deprivation.
Results: We have identified 50 proteins differentially expressed at 24hr and 60 peptides at 36hr of sleep deprivation in the high responder group and 87 and 99 proteins at 24 and 36 hr respectively in the low responder group. These potential biomarkers have been identified by at least 2 peptides and at least a 3-fold change. Identities and classes will be presented after validation in individual subjects is completed.
Conclusion: Our study is likely to yield one or more putative biomarkers for sleep loss.

0357
BEHAVIORAL AND GENETIC EFFECTS PROMOTED BY SLEEP DEPRIVATION IN RATS WITH EPILEPSY

Matos G[1], Ribeiro D[2], Alvarenga TA[1], Hirotsu C[1], Scorza FA[3], Le-Sueur-Maluf L[2], Cavalheiro EA[3], Tufik S[1], Andersen ML[1]
[1]Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [2]Biociencias, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [3]Neurologia Experimental, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: The interaction between sleep deprivation and epilepsy has been well described in electrophysiological studies, but the mechanisms beyond this association remain unclear. OBJECTIVE:The present study evaluated the effects of sleep deprivation on brain genetic damage and locomotor activity of rats submitted to pilocarpine-induced status epilepticus (SE).
Methods: The study was conducted in Wistar-Hannover male rats at 10 weeks of age. Fifty days after SE, rats were submitted to paradoxical sleep deprivation (PSD) for 24 h or total sleep deprivation (TSD) for 6 h. Locomotor activity was assessed by the open field test, and genetic damage was quantified with the single cell gel electrophoresis (comet) assay.
Results: Status epilepticus induced significant hyperactivity in the open field test and caused genetic damage in the brain. Acute sleep deprivation did not affect locomotor activity in epileptic or control rats, but resulted in significant DNA damage in brain cells in both groups. TSD, in turn, caused DNA damage only in epileptic rats.
Conclusion: Our results revealed that TSD and PSD induced genetic damage but not locomotor changes in rats submitted to pilocarpine induced-SE.

Support (If Any): Associação Fundo de Incentivo à Pesquisa (AFIP), Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Ministério da Ciência e Tecnologia (MCT).

0358
WAKE-DEPENDENT ACCUMULATION OF SLOW WAVES IN THE WAKING EEG OF SLEEP-DEPRIVED MICE

Ehlen C, Brager AJ, Jefferson F, Pinckney L, Paul K
Neurobiology, Morehouse School of Medicine, Atlanta, GA, USA

Introduction: Waking slow-waves have been measured in the local field potentials obtained from deep cortical layers. The regions expressing these waking slow-waves grow progressively larger as continuous wake duration increases. In the present study, we hypothesized that the prevalence of waking slow-waves in epidural EEG recordings would increase as a function of wake during periods of prolonged forced-wakefulness. Under these conditions, the number of waking slow-waves should provide a relatively simple and direct measure of sleep pressure during wake.
Methods: Male mice underwent continuous sleep deprivation (SD) for 24 hours (beginning at lights on, LD 12:12) by confinement to a slowly rotating wheel. Epidural EEG recordings were obtained (24-hours prior, during and after SD) from the fronto-parietal lead. Cortical slow-waves during wake were identified as negative deflections in filtered (0.5-4 and 2-6 Hz) EEG recordings and the largest 30% of waves were included in the analysis.
Results: The occurrence of waking slow-waves was significantly increased after the first hour of SD and reached a two-fold increase after two hours. A diurnal rhythm in the occurrence of waking slow-waves was apparent in each day of recording with more slow waves occurring in the dark phase than in the light phase. When normalized, the occurrence of waking slow-waves reached a maximum in the last six hours of SD that was three times higher than during the first 6-hours of baseline. The prevalence of waking slow-waves returned to levels observed during baseline after 2 hours of recovery sleep.
Conclusion: Slow-waves in the waking EEG were significantly elevated after only one hour of sleep loss, and continued to increase as a function of wake duration over the remaining 23 hours. These results suggest that waking EEG slow-waves can reveal complex dynamics in the accumulation of sleep pressure during extended wakefulness.
Support (If Any): NINDS award NS060659 and by the STC Program of the National Science Foundation under Agreement No. IBN-9876754.

0359
RAT SPINDLE ACTIVITY IS ACUTELY ENHANCED FOLLOWING AUTOMATED SLEEP DEPRIVATION

Albers JA, Roffler M, Anch AM
Psychology, Saint Louis University, Saint Louis, MO, USA

Introduction: Intermediate Stage Sleep (ISS) is a stage of sleep identified in the rat and the cat, characterized by spindle (7-11Hz) activity in cortical electrodes. This stage occurs primarily on the transition from High Voltage (HS) sleep to Paradoxical (REM-like) sleep. This spindle activity is thalamically generated and may play a role in the onset and maintenance of sleep and the transitions between the stages of sleep architecture. Sleep deprivation (SD) is well-documented to effect changes in post-deprivation sleep, including enhancement of slow wave activity, slow wave sleep, rebound REM sleep, and increased arousal threshold. Some of these effects may be mediated by spindle activity in the thalamus.
Methods: Ten male Sprague-Dawley rats (250-400g) underwent surgical implantation of epidural electrodes and baseline recording of sleep behavior. Rats were then deprived of sleep for the 12 hours during the light cycle using an automated rotary disc system. Recovery sleep was

recorded, scored, and compared to baseline. Epochs containing spindle activity were scored as ISS.
Results: Recovery sleep showed significant increases in HS ($t(18) = -4.71$, $p < 0.001$) and intermediate sleep ($t(18) = -2.303$, $p < 0.033$) (spindle activity) and decreases in wake ($t(18) = 4.30$, $p < 0.001$) during the dark cycle which immediately followed SD. During the next light cycle, only moderate, nonsignificant increases in high voltage sleep and decreases in wake were observed while Intermediate sleep remained entirely unchanged.
Conclusion: Rat spindle activity was acutely increased in the twelve hours of darkness immediately following SD. This effect did not carry over into the next normal sleep period despite changes in HS and wake similar to the post-SD period. Enhancement of spindle activity was paralleled by an increase in high voltage sleep. Acute enhancement of spindle activity may be responsible for increases in arousal threshold during post-SD sleep.

0360

SLEEP DEPRIVATION IS ASSOCIATED WITH MUSCLE LOSS

Dattilo M[1,4], Antunes HM[2,4], Medeiros A[2], Mônico-Neto M[1,4], Souza HS[4], Lee KS[3], Tufik S[1], Mello MT[1,4]
[1]Psicobiologia, Universidade Federal de Sao Paulo - UNIFESP, Sao Paulo, Brazil, [2]Biociências, Universidade Federal de São Paulo - UNIFESP, Santos, Brazil, [3]Bioquímica, Universidade Federal de São Paulo - UNIFESP, Sao Paulo, Brazil, [4]Centro de Estudos em Psicobiologia e Exercício, Sao Paulo, Brazil

Introduction: Sleep deprivation in rats increases blood corticosterone and reduces testosterone and insulin like growth factor (IGF)-1 levels. All these hormones regulate muscle protein synthesis and degradation, with IGF-1 being one of the most important factor involved in muscle mass regulation. Our aim was to evaluate blood corticosterone and testosterone levels, blood and muscle IGF-1 levels, and tibialis anterior muscle histomorphometry in Wistar rats submitted to paradoxical sleep deprivation (PSD).
Methods: For this study, three-month-old male Wistar rats weighing 300-350 g were distributed in 2 groups (8-9 animals per group). The first group was composed by rats submitted to PSD for 96 consecutive hours, whereas the second one was composed by control animals maintained in their home cages. The PSD procedure was conducted using a modified multiple platform method, with the animals being weighed before and after the procedure. After this, it was collected blood for corticosterone, testosterone, and IGF-1 analysis, as well tibialis anterior muscle for weight, fibre cross-sectional area, and IGF-1 analysis.
Results: As expected, the body mass loss after PSD was accompanied by increases in corticosterone and reductions in blood testosterone and IGF-1 levels. Moreover, muscle IGF-1 was also significantly reduced. Tibialis anterior showed lower weight and muscle cross-sectional area following PSD, being correlated with hormonal pattern.
Conclusion: These findings suggest that PSD induces hormonal alterations that are not restricted to blood and can possibly mediate muscle atrophy.
Support (If Any): Associação Fundo de Incentivo à Pesquisa (AFIP), Centro de Estudos em psicobiologia e Exercicio Acidentes (CEPE), Centro de Estudo Multidisciplinar em Sonolencia e Acidentes (CEMSA), CEPID/SONO-FAPESP (#98/14303-3), CNPq, CAPES, FAPESP (2009/11056-1), UNIFESP, FADA.

0361

THE EFFECT OF SLEEP LOSS ON THE REPRODUCTIVE FUNCTION OF MALE RATS

Alvarenga TA, Tufik S, Andersen ML
Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: Reduced sleep time is prevalent in modern society and can lead to various functional outcomes. These impairments significantly impact the endocrine system, and changes in sexual behavior can affect reproductive function. This study aims to evaluate the influence of selective sleep deprivation and long-term sleep restriction on sexual behavior and hormone levels as well as sperm quantity and viability in male rats.
Methods: Sexually experienced rats were subjected to paradoxical sleep deprivation (PSD) for 96 hours or sleep restriction (SR) for 21 consecutive days. The control group (CTRL) was kept in their home cages throughout the experimental protocol. Sexual behavior was evaluated following the exposure of the PSD or SR paradigm (or the equivalent time period in CTRL rats) and then the hormone and sperm variables were measured.
Results: The PSD was able to significantly decrease sexual behavior, but the SR group showed no effect compared to the CTRL group. With respect to their hormones, the PSD rats had a significantly lower testosterone levels compare to CTRL group. Sleep deprivation protocols did not change progesterone, follicle-stimulating hormone (FSH) or luteinizing hormone (LH) in relation to CTRL group. Regarding the semen analysis, both the PSD and SR groups presented a lower sperm viability compared to the CTRL group. However, the decrease in the number of live sperm was larger in the PSD group than in the SR group when compared to the CTRL rats.
Conclusion: These findings demonstrate that sleep loss can promote marked changes in the reproductive system and particularly affect sperm viability.
Support (If Any): AFIP, FAPESP 09/14206-4, 09/01030-5, 98/14303-3 and CNPq.

0362

OVARIAN HORMONES INHIBIT BASELINE SLEEP AND RECOVERY SLEEP AFTER SLEEP DEPRIVATION IN MIDDLE-AGED OVARIECTOMIZED RATS

Deurveilher S[1], Seary M[1], Semba K[1,2,3]
[1]Anatomy & Neurobiology, Dalhousie University, Halifax, NS, Canada, [2]Psychology, Dalhousie University, Halifax, NS, Canada, [3]Psychiatry, Dalhousie University, Halifax, NS, Canada

Introduction: Sleep disturbances are common among women during menopause. Hormone replacement therapy is often used to treat various menopausal symptoms, but its efficacy for improving sleep quality is controversial. To shed light on this issue, we investigated how replacement of estradiol (E) and progesterone (P) modulates baseline sleep and recovery sleep after 6 h of sleep deprivation (SD) in middle-aged, ovariectomized rats.
Methods: Female Wistar rats, 9-11 months of age, were housed under a light:dark 12:12 cycle. Rats were ovariectomized and implanted subcutaneously with Silastic capsules containing oil vehicle (Oil), 65 µg of 17β-E (E), or 65 µg of 17β-E and 66 mg of P (E+P); these doses corresponded to those commonly used for hormone replacement therapy in women. All animals were also implanted with EEG and EMG electrodes. Two weeks after surgery, EEG and EMG were recorded during a 24 h baseline period, followed by 6 h of SD (by "gentle handling") in the second half of the light phase, and a 24 h recovery period.
Results: During the 24 h baseline recording, the E and E+P groups spent more time in wakefulness and less time in non-rapid eye movement sleep (NREMS) than the Oil group, with shorter NREMS episodes during the dark phase. REMS amounts were similar among the 3 groups, but the E group had fewer REMS episodes than the Oil group during the dark phase. During the recovery dark phase immediately after SD, the E and E+P groups showed smaller NREMS and REMS rebounds than the Oil group. During the following recovery light phase, the E+P group had more REMS than the Oil group. The initial increase in NREMS EEG delta power after SD tended to be smaller in the hormonally treated rats.
Conclusion: At baseline, the hormone replacement inhibited both NREMS maintenance and REMS initiation, while promoting wakefulness, particularly during the dark (active) phase. Following SD, it

reduced both NREMS and REMS rebounds as well as sleep intensity, while lengthening REMS recovery. Compared to our previous findings in young female rats, these results with middle-aged female rats show both similarities (baseline sleep inhibition) and differences (inhibition of sleep rebound in the middle-aged vs. promotion of REMS rebound in the young). The inhibitory effects of ovarian hormones on sleep in middle-aged rodents do not provide direct support for sleep improvement by hormone replacement therapy in perimenopausal women.
Support (If Any): CIHR.

0363

SEX DIFFERENCES IN SLOW WAVE SLEEP ENHANCEMENT WITH SODIUM OXYBATE MAY MODULATE SLEEPINESS DURING SLEEP RESTRICTION

Schweitzer PK, Hall-Porter JM, Griffin KS, Walsh JK
Sleep Medicine and Research Center, St Luke's Hospital, Chesterfield, MO, USA

Introduction: Enhancement of slow wave sleep (SWS) with sodium oxybate has been shown to be associated with reduced sleepiness during sleep deprivation. Because sodium oxybate produces larger increases in slow wave activity (SWA) in females than males, we examined sex differences in sleepiness and SWA following administration of sodium oxybate during restricted sleep.
Methods: Fifty-eight healthy individuals (36F, 22M; age 27.1 (18-49)) underwent a baseline polysomnogram (2200-0700), followed by two nights without sleep, but each with a 3-hour daytime nap (0800-1100) with placebo (n=28) or 3.5mg sodium oxybate (n=30). MSLT was performed every 2-4 hours before and after naps. ANOVAs evaluated drug, sex, and their interaction on mean MSLT and SWA post drug, controlling for age and pre-drug baseline, followed by paired comparisons (Tukey).
Results: MSLT analysis revealed drug (p=.02), sex (p=.02), and drug by sex effects (p=.05). Mean MSLT score was higher for females on sodium oxybate (7.0 min) compared to females on placebo (4.3 min, p=.003), males on sodium oxybate (4.4 min, p=.014), and males on placebo (4.1 min, p = .006). Males showed no drug differences (p=.99), nor were there sex differences on placebo. SWA analysis showed drug (p<.001) and drug by sex effects (p=.009). SWA was higher for females on sodium oxybate compared to females on placebo (p < .001), males on sodium oxybate (p=.034), and males on placebo (p=.004). Males showed no drug differences (p=.88), nor were there sex differences on placebo. The change from baseline in SWA was correlated with the change in MSLT latency for males (r=.55) and females (r=.51) on placebo but only for females (r=.50) on sodium oxybate (r=.2 for males).
Conclusion: Decreased sleepiness was demonstrated only for females receiving sodium oxybate during sleep restriction. The decrease in sleepiness was related to the degree of increase in SWA.

0364

A WIRELESS SYSTEM FOR RECORDING EEG/EMG AND BIOSENSOR MEASUREMENTS FROM GROUP-HOUSED RATS

Naylor E, Johnson D, Gabbert S, Harmon H, Petillo PA
Pinnacle Technology Inc., Lawrence, KS, USA

Introduction: Existing recording systems use radio-frequency telemetry to wirelessly record electroencephalograph (EEG) and electromyograph (EMG) signals. However, current systems cannot record from multiple animals simultaneously within a group-housed environment, a condition which reduces related stress, nor can they record biosensor measurements with the EEG signal. We have developed two telemetry systems for use with rats. One is designed for long-term, wireless recording of electroencephalograph (EEG) and electromyograph (EMG) signals (EEG/EMG) while the second is capable of recording EEG, EMG and simultaneous biosensor readings (EEG/EMG/BIO).
Methods: Two rats were implanted with cortical and intramuscular recording electrodes and fitted with the EEG/EMG system. Rats were individually housed following surgery (one week) and then group housed for 24 hours. Simultaneous sleep/wake patterns were recorded from both animals. To test the EEG/EMG/BIO system, a single rat was implanted with a biosensor in the prefrontal cortex along with EEG and EMG electrodes. Following recovery, a lactate biosensor was implanted and EEG + lactate concentration was recorded for 24 continuous hours.
Results: In two rats fitted with the EEG/EMG system, the amount of time both animals were simultaneously awake increased by 121 minutes and the amount of time they were both asleep increased by 12.5 minutes compared to sleep amounts when the animals were individually housed. Recording of lactate concentration with sleep/wake state using the rat implanted with the EEG/EMG/BIO system indicated an average increase in lactate concentration of 124±18 μM during waking and an average lactate decrease of 108±8 μM during sleep.
Conclusion: When rats were recorded with the EEG/EMG system under group-housed conditions, their sleep/wake patterns show greater synchronization. Wireless recording of lactate and EEG activity demonstrated the expected lactate rise during waking and decline during sleep. These systems provide a mechanism for wireless recording of simultaneous EEG and biosensor signals from multiple, group-housed animals.
Support (If Any): This research was supported by NIH grant #5R44MH076318-03. The Defense Advanced Research Projects Agency (DARPA) and the Army Research Office (ARO) award number W911NF-10-1-006.

0365

DEVELOPMENT AND VALIDATION OF A CONTINUOUS EEG-BASED MARKER FOR SLEEP DEPTH

Marino AA[1], Carrubba S[1], McCarty DE[1], Chesson AL[1], Kim Y[1], Frilot C[2]
[1]Neurology/Sleep Medicine, LSUHSC-Shreveport, Shreveport, LA, USA, [2]School of Allied Health Professions, LSU Health Sciences Center, Shreveport, LA, USA

Introduction: Physiologically-based markers that represent sleep depth on a continuous time scale are needed. Attempts to develop such markers based on EEG amplitude/frequency properties have been unsuccessful. We developed a novel nonlinear method based on quantification of the dynamical pattern (recurrence) in the EEG. This work establishs and validates the new marker's normal phenotype, and shows that it was altered in patients with a sleep disorder.
Methods: Scored PSGs (R&K) from 8 healthy medication-free subjects and 8 subjects with OSA were obtained from the PhysioBank archive. The recurrence marker percent R (%R) was used to quantify the EEG pattern (extent to which it was governed by law rather than chance). %R is lowest during wakefulness (EEG most complex) and highest during N3 sleep. %R was calculated second-by-second and then averaged epoch-by-epoch, resulting in one %R value for each 30-sec epoch. Spectral analysis (a linear method) was used as a control.
Results: In each group, the known R&K sleep structure was directly reflected in the epoch-to-epoch changes of %R; in the normals the changes followed typical cyclic macroarchitectures (3-5 cycles) not usually present in the OSA subjects. In both groups, %R(N2) >%R(N1) and %R(N3)>%R(N2). In both REM and nonREM sleep, %R was significantly lower in OSA subjects ($P<0.05$), indicating that brain electrical activity was more complex (less sleep-like) in the OSA subjects. Significant correlations between spectral markers and R&K structure were not found.
Conclusion: %R computed over 1-sec intervals and averaged over 30-sec epochs exhibited the characteristic R&K macroarchitecture in health and OSA, indicating %R's criterion validity as a continuous marker for normal sleep. %R was decreased in OSA subjects, evidencing its association with sleep quality. %R, which emphasizes the continuous nature of sleep, may be a useful complement to sleep staging, which emphasizes sleep discontinuity.

0366

CORRESPONDENCE BETWEEN ACTIGRAPHY AND PSG MEASURES OF SLEEP ONSET LATENCY IN YOUNG CHILDREN

Craven HJ[1], Seifer R[2,3], LeBourgeois MK[1,2]
[1]Integrative Physiology, University of Colorado Boulder, Boulder, CO, USA, [2]Psychiatry and Human Behavior, The Warren Alpert Medical School of Brown University, East Providence, RI, USA, [3]Bradley/Hasbro Children's Research Center, East Providence, RI, USA

Introduction: Actigraphy is a non-invasive tool providing objective measurement of sleep onset, offset, and efficiency for extended periods of time based upon wrist-activity levels. Whether actigraphy may also provide an adequately-valid estimate of sleep-onset latency (SOL) in young children is not well-established. This study examined concordance between the gold standard of SOL, polysomnography (PSG), and actigraphy in a cohort of 2-5 year-olds studied at five different levels of prior wakefulness.
Methods: Participants were 8 healthy children (3 males) studied at three longitudinal time points (2.5-3.0y, 3.5-4.0y, 5.5-6.0y). Children followed a strict sleep schedule for at least 5 days before each of five home-based, PSG recordings in which they also wore an actigraph (AW64). Sleep assessments occurred after 4h, 7h, 10h, 13h, and 16h of prior wakefulness, reflecting different levels of sleep pressure. Visual stage scoring used 30-sec epochs from C3/A2. Lights-out time was simultaneously marked on PSG and actigraphy with event markers. Sleep-onset was the first epoch of stage 2 sleep (PSG) and the first of three consecutive epochs of scored sleep after lights-out (actigraphy).
Results: Analyses included 9-14 sleep assessments per child of SOL (concurrent PSG and ACT). Averaged SOL varied across sleep assessments and age (PSG range: 4.9+3.1 to 26.9+13.7; ACT range 4.2+3.1 to 19.3+15.9). We performed a nested correlation between PSG- and actigraphy-derived measures of SOL, covarying sleep pressure and age of assessment, nested within subject. The median partial correlation was $r=.874$ ($p<.001$), with a range of $r=.243$ to $r=.969$. Two children had very-low, non-significant correlations resulting from an outlier in which actigraphy underestimated SOL.
Conclusion: Overall, these findings suggest actigraphy has adequate validity for estimating SOL in young children when using tightly-controlled data collection and analysis procedures. Future analyses should address methods for establishing the minimum number of nights for a reliable estimate of SOL.
Support (If Any): NIH K01-MH074643, NIH R01-MH086566.

0367

CORRELATION OF A WIRELESS SLEEP MONITORING SYSTEM WITH POLYSOMNOGRAPHY SCORED TO AASM GUIDELINES

Shambroom J[1], Fabregas S[2], Johnstone J[3]
[1]Shambroom Associates, LLC, Framingham, MA, USA, [2]Sleep Research Center, Zeo, Inc., Newton, MA, USA, [3]Q-Metrix, Inc., Burbank, CA, USA

Introduction: A wireless headband system has been developed for monitoring sleep in ambulatory settings (Zeo™). The system uses no-prep dry fabric sensors which acquire a single channel from the forehead with contributions from the EEG, eye movements, and the frontalis muscle. This information is transmitted to a base station which computes a sleep stage every 30 seconds in real time. The authors have previously reported concordance of the wireless system's sleep measures with sleep measures derived from polysomnography (PSG) scored according to Rechtschaffen and Kales (R&K) guidelines. The aim of the current report was to compare sleep measures derived from PSG scored according to AASM (2007) guidelines with those from the wireless system.
Methods: Twenty-nine self-reported healthy volunteers (age 19 to 60 years, 23 female) were co-monitored in a sleep lab by the wireless system and standard PSG. Wireless system data were sampled with a 12 bit A-D converter and captured at 128 samples per second for processing. Sleep stage was assigned by the wireless system (WS) as: wakefulness, REM sleep, light sleep (combined N1 and N2), or deep sleep (N3). PSG records were visually scored by two trained technicians from different laboratories according to AASM (2007) guidelines (AASM1, AASM2). Percent agreement and Cohen's kappa of pooled epochs were computed for each paired combination.
Results: PSG and wireless system data were available for 26 subjects for a total of 19,556 epochs. Percent agreement/kappa were: WS vs. AASM1: 75.9%/0.62, WS vs. AASM2: 74.8%/0.60, AASM1 vs. AASM2: 84.2%/0.75.
Conclusion: Results for healthy adult volunteers demonstrate reasonable correlation of the wireless system with full PSG scored according to AASM guidelines. The wireless system shows promise as a portable and easy to use sleep monitoring system.
Support (If Any): Support for this study was provided by Zeo, Inc.

0368

COMPARING ESTIMATION TECHNIQUES FOR INDIVIDUAL DIFFERENCES IN PARAMETERS OF MATHEMATICAL MODELS OF FATIGUE

Kogan CJ[1], Kalachev L[1], McCauley P[2], Short RA[3], Van Dongen H[2]
[1]Department of Mathematical Sciences, University of Montana, Missoula, MT, USA, [2]Sleep and Performance Research Center, Washington State University Spokane, Spokane, WA, USA, [3]College of Nursing, Washington State University Spokane, Spokane, WA, USA

Introduction: Mathematical fatigue models make population-mean predictions of performance under conditions of sleep loss and circadian misalignment. Accurate predictions for individuals can be made using Bayesian forecasting. This relies on Bayesian priors, which reflect between-subjects variance in model parameters. Maximum likelihood estimates for Bayesian priors can be obtained by analyzing performance data from sleep deprivation studies with mixed-effects regression. For multi-process fatigue models, however, computational issues interfere with accurate estimation of Bayesian priors through maximum likelihood. We explored approximation techniques to find a balance between estimation accuracy and computational efficiency.
Methods: We compared a standard two stage (STS) approach with a linearization approach to estimate population means and between-subjects variances (Bayesian priors) for the parameters of a coupled system of ordinary differential equations (McCauley et al., 2009). STS involves estimating fatigue model parameters by maximizing each individual's likelihood function separately, and then computing the parameter means and variances. The linearization approach involves first linearizing the fatigue model, and then maximizing the combined likelihood of all individuals using a linearized version of the model. Here we allowed two model parameters to vary over subjects: a homeostatic rise constant and a homeostatic amplitude modulator. We estimated their population means and between-subjects variances using psychomotor vigilance test (PVT) data from a 14-day simulated night shift study (Van Dongen et al., 2011), and compared the estimates and computational efficiency of the two approximation techniques.
Results: The estimated between-subjects variance for the homeostatic amplitude modulator was similar for STS and linearization (0.125 and 0.126, respectively). However, the estimated between-subjects variance for the homeostatic rise constant was 0.0014 for STS and 0.0379 for linearization, indicating a substantive difference. STS estimates were computed in 13 seconds, whereas linearization estimates took 10 minutes.
Conclusion: Simulation studies have indicated that linearization produces better estimates than two stage techniques. Although linearization is less computationally efficient than STS, the considerable difference in estimates for one of the Bayesian priors suggests that linearization would nonetheless be the preferred method in order to achieve sufficient accuracy.
Support (If Any): AFOSR grant FA9550-09-1-0136 and ONR grant N00014-11-C-0592.

0369

CLINICAL APPLICATIONS FOR FUNCTIONAL DATA ANALYSIS OF ACTIGRAPHY

Ju YS[1,2], Deych E[3], Toedebusch C[2], McLeland JS[2], Gonzales C[3], Xian H[3], Duntley S[1,2], Shannon W[3]
[1]Neurology, Washington University School of Medicine, St Louis, MO, USA, [2]Multidisciplinary Sleep Medicine Center, Washington University, St Louis, MO, USA, [3]Medicine, Washington University, St Louis, MO, USA

Introduction: Fatigue, sleepiness, and depression are common symptoms in sleep medicine, however it is unknown whether symptom scales or polysomnogram findings correlate with activity levels.
Methods: Activity curves from 535 subjects who wore Actical(TM) actigraphs for one week were grouped by clinical variables, to derive activity functions over the 24-hour period using functional data analysis (FDA). Attended polysomnograms and clinical scales were obtained concurrently.
Results: Women had increased activity ~8-10am, while younger subjects had increased activity ~6-10pm. Moderate-to-severe obstructive sleep apnea was associated with decreased daytime activity levels ~9am and ~6pm-midnight. No measure of restless legs or periodic limb movements was associated with activity change. Polysomnographic measures including sleep time, sleep efficiency, and wake after sleep onset did not correlate significantly with activity. The exception was sleep latency; shorter sleep latency was associated with increased activity ~5-9am. Clinical scales including Epworth Sleepiness Scale, Brief Fatigue Index, Global Fatigue Index, Pittsburgh Sleep Quality Index, Functional Outcomes of Sleep, and Patient Health Questionnaire did not correlate with activity. The only scale with significant activity correlate was the Vitality subscore of the SF-36, which showed that higher(>65) score was correlated with increased activity through the day and decreased activity at night. Additionally, higher score on the Insomnia Severity Scale was associated with increased activity from 12-4am, reflecting increased wakefulness during the typical sleep period.
Conclusion: FDA models of activity over the 24-hour period demonstrate differences in activity predominantly during mid-morning and evening for various measures in this study. Male gender, older age, and moderate-to-severe obstructive sleep apnea are associated with decreased activity. The only subjective scale of fatigue or sleepiness with objective correlate was the Vitality subscale of SF-36. FDA may be use-

ful for stratifying patients to determine who is most likely to respond to treatment, using an inexpensive and noninvasive tool.
Support (If Any): NIH R01-HL092347, "New Data Analysis Methods for Actigraphy in Sleep Medicine" (Shannon, PI).

0370

DOSE-RELATED EFFECTS OF CAFFEINE: SENSITIVITY OF A PORTABLE SLEEP MONITORING DEVICE

Koshorek J, Roth T, Eklov S, Kluck S, Drake C
Sleep Disorders & Research Ctr, Henry Ford Hospital, Detroit, MI, USA

Introduction: A previous study, using the portable Zeo sleep monitoring device (SMD), showed that a moderate dose (400mg) of caffeine can significantly disrupt sleep, even if consumed six hours prior to bedtime. Current literature provides minimal content regarding the SMD. The present study utilized the known dose-related effects of caffeine on sleep-wake parameters to measure the sensitivity of the SMD.
Methods: Total of 16 subjects, 1.8% data loss; 3 subjects excluded: 2 due to ≥ 60min of data loss ≥ 1 night, 1 due to non-compliance. Using a double-blind crossover, Latin square design, 13 normal sleepers (6M, 7F, 47 ± 9.53 years) were given placebo or caffeine (75mg, 150mg, 300mg) 90 minutes prior to bedtime on four nights, one recovery night between treatment nights. The SMD wirelessly measured and automatically scored sleep-wake parameters (time in bed (TIB), latency to persistent sleep (LPS), stage 1 and 2 sleep (S12S), slow wave sleep (SWS), rapid eye movement (REM), wake time during sleep (WTDS), wake after sleep onset (WASO) and total sleep time (TST)) using validated algorithms. Data was analyzed using repeated-measures ANOVA.
Results: Linear dose effects were seen for TST (p=.01), WASO (p=.02) and SWS (p=.01). Compared to placebo, 150mg of caffeine significantly reduced S12S (-25.1min, p=.029), WASO (-14.3min, p=.001) and TST (-36.2min, p=.006). Compared to placebo, 300mg of caffeine significantly reduced SWS (-9.4min, p=.016) and WASO (-21.8min, p=.045). Although not statistically significant, LPS increased with higher doses of caffeine (placebo: 13.3min, 75mg: 17.0min, 150mg: 20.7min, 300mg: 19.4min). Caffeine produced no significant effect on REM sleep.
Conclusion: The SMD, used to objectively measure sleep-wake parameters at home, is sensitive to the known dose-related effects of caffeine on sleep. As in this study, dose-related effects of pharmacological interventions can be objectively detected by the SMD in the "home" environment of individuals.

0371

EEG COMPLEXITY IS ALTERED IN PATIENTS WITH CPAP-INDUCED REM REBOUND

Wang L, McCarty DE, Carrubba S, Uysal A, Chesson AL, Marino AA
Neurology, LSU shreveport, Shreveport, LA, USA

Introduction: Obstructive sleep apnea (OSA) may decrease REM sleep during diagnostic polysomnography PSG (dPSG). Some of these patients exhibit CPAP-associated REM rebound (CARR), a process that must involve changes in brain electrical activity. We hypothesized that EEG changes could be detected during REM sleep in CARR patients using a novel nonlinear method for extracting physiological information from the EEG (recurrence analysis).
Methods: Records of consecutive patients who underwent dPSG positive for OSA (AHI ≥5) and a subsequent CPAP titration PSG (cPSG) were reviewed (minimum REM, 10 min/study). CARR was identified as an increase of >10% in REM sleep, or an increase of ≥ 45 minutes in the longest continuous REM cycle. The first 5 paired studies in the CARR and non-CARR groups meeting inclusion criteria were analyzed. The recurrence variable percent R (%R) was employed to quantify the amount of determinism in the EEG during REM (F3/F4/C3/C4/O1/O2). %R is a quantitative measure of the deterministic structure in the EEG (structure governed by law rather than chance). %R is lowest during stage W (EEG most "complex") and highest in N3 sleep. Spectral analysis (a linear method) was used as a control.
Results: In the CARR group, REM % as a fraction of total sleep increased significantly in the cPSG, as expected. The complexity of brain electrical activity during REM decreased significantly, as evidenced by higher %R (which correlates with deeper sleep). The effect on %R depended on electrode derivation and was greater in the earlier part of the cPSG. Brain-activity changes were not detected using spectral analysis. In the non-CARR group, no changes in percent REM sleep or complexity of brain activity during REM were seen in the cPSG compared with the dPSG.
Conclusion: Deeper REM sleep occurs in patients exhibiting CARR, as evidenced by quantitative changes in the complexity of the EEG.

0372

LABORATORY POLYSOMNOGRAPHY VERSUS AMBULATORY POLYSOMNOGRAPHY: ARE RECORDED SLEEP PARAMETERS JEOPARDIZED OUTSIDE A LABORATORY SETTING?

Diaz-Piedra C[1], Guglielmi O[1], Olmedo AC[1], Hita E[1], Catena A[2], Buela-Casal G[1]
[1]Laboratory of Psychophysiology, University of Granada, Granada, Spain, [2]Experimental Psychology, University of Granada, Granada, Spain

Introduction: Laboratory-based polysomnography (PSG) is the gold standard for the diagnosis of several sleep pathologies. However, some pragmatic difficulties of this method have promoted the development of protocols aimed to obtain good objective measures of sleep quality. In everyday conditions, ambulatory PSG can be a choice, although it have been demonstrated that variations in sleeps patterns are linked to environmental factors, as altitude, humidity, noise, light, or temperature, that also have an impact of human health . The main aim of this study was to test whether polysomnographic values of sleep architecture are sensible to variations in natural ambient (unattended ambulatory PSG) in comparison with standard sleep laboratory setting in healthy adults.
Methods: Thirty-six healthy young adults (age: 22.6 ± 2.1 years; range: 20-28; 29 females) volunteered for overnight PSG assessment along four consecutive days. The PSG recordings were conducted in four locations: mountain (1,500 m), sea level, cave-house (a common environment in some parts of the south of Andalusia, Spain) (900 m), and laboratory (500 m). Participants did not suffer from sleep disorders or other illnesses that affect sleep, and were medication-free. MANOVA was used to take care of correlations between the dependent variables, REM sleep, non- REM sleep stages 1, 2, and slow wave sleep as percentages of total sleep time (%TST), awakenings, sleep efficiency and several sleep indexes (SpO2, ODI, AHI, and arousal index).
Results: There were no significant statistical differences between environments in the multivariate analysis (p = .637).
Conclusion: This study shows that environmental factors associated with usual human settlements do not have a significant impact on sleep architecture parameters. Ambulatory PSG might be considered a valid method for the objective evaluation of sleep characteristics in non-laboratory settings.
Support (If Any): This study was supported by a contract of research C-3511 (funded by Andalusian Government and European Union and administered by Fundación General Empresa-UGR) and by FPU AP 2007-2965 Spanish national grant (C. Diaz-Piedra).

0373

REFINING A SURVEY MEASURE OF RISK FOR NARCOLEPSY

Gaultney JF[1], Gray D[1], Daley K[2]
[1]Psychology, University of North Carolina at Charlotte, Charlotte, NC, USA, [2]Behavioral Sleep Medicine, Charlotte Eye, Ear, Nose and Throat Associates, Charlotte, NC, USA

Introduction: We previously used a validated survey to estimate risk for sleep disorders in college students, finding estimated prevalence consistent with the literature, with the exception of the narcolepsy scale. The scale overestimated prevalence, indicating 16% were at risk for narcolepsy, whereas actual prevalence is probably <1% of the general population. We hypothesized that the scale could be improved by dropping an item and adding a score from the Epworth Sleepiness Scale (ESS).
Methods: Data on 145 patients (44% male, Mage=42.71; 47 narcolepsy, 11 insomnia, 87 OSA, no dual diagnoses) were extracted from charts at a large southeastern sleep medicine practice. All narcolepsy patients who were evaluated with multiple sleep latency testing over a two-year period were included. Patients with OSA or Insomnia were limited to those who had been diagnosed around the same time as the patients with narcolepsy. Discriminant analysis determined which predictors (hypnogogic dreams, paralysis, cataplexy, daytime sleep "attacks", fall asleep in social occasions, daytime consequences) best differentiated actual diagnosis (narcolepsy/no narcolepsy).
Results: We tested a model including the original items, the hypothesized model, and the original model plus ESS, age, gender, and BMI. Although all models did an excellent job of excluding those who did not have narcolepsy (specificity; >98%), only the latter model did an acceptable job of including those with narcolepsy (sensitivity; 94%).
Conclusion: For a clinical sample of adults, narcolepsy would appear to be better predicted by adding ESS, age, gender, and BMI to the original scale items. The generalizability of these results to a younger age-group is not known, nor do we know the actual prevalence of narcolepsy among college students. Future studies of college-aged students can add ESS, age, gender and BMI to the original scale to determine if the estimated risk is more in line with the literature.

0374

UNSUPERVISED FULLY-AUTOMATED SLEEP STAGING METHOD FOR MICE

Sunagawa G, Ueda HR
Laboratory for Systems Biology, Center for Developmental Biology, Kobe, Japan

Introduction: Manual sleep staging according to EEG/EMG is an unavoidable but somewhat subjective process for sleep research in animals. Various semi-automated sleep staging methods have been developed to improve the reproducibility of sleep staging. Using manually-staged data set as training signals, however, still leaves some room for inconsistency. To remove subjectivity from sleep staging process as much as possible, we have developed a fully-automated sleep staging method for mice based on nonparametric density estimation clustering.
Methods: EEG/EMG of four C57BL6J mice were recorded. The time domain data were separated into eight-second segments and the power spectrum of each segment was calculated. The dimension of the EEG/EMG power spectrum was reduced by principal component analysis. These results were automatically staged by nonparametric density estimation clustering. Visual staging by experts was used for validation of the automatically-staged data. All analysis was done on a MacBook Air with 1.7GHz dual-core Intel Core i5 processor and 4GB memory.
Results: The full automated sleep staging method has sensitivity and specificity values of 90% and 99% among wake, NREM sleep and REM sleep states. Staging of data recorded from a single mouse over six days took 110 seconds on average.
Conclusion: We have developed a fully-automated sleep staging method for mice based on nonparametric density estimation clustering. This method has high sensitivity and specificity for wake, NREM sleep and REM sleep. We are now testing the quality of this method against circadian mutants and drug-induced alterations in sleep behavior.

0375

RECORDING OF HEART SOUND, RESPIRATION SOUND AND BODY MOVEMENT BY A PIEZOELECTRIC SENSOR AND AN IC-RECORDER AT HOME

Sato S[1,2], Kanbayashi T[2], Tokunaga J[2], Sato M[2,3], Sagawa Y[2,3], Hirai N[3], Ono K[1], Nishino S[3], Shimizu T[2]
[1]Cell Physiology, Akita University Graduate School of Medicine, Akita, Japan, [2]Neuropsychiatry, Akita University Graduate School of Medicine, Akita, Japan, [3]Sleep and Circadian Neurobiology Laboratory, Stanford University School of Medicine, Palo Alto, CA, USA

Introduction: A piezoelectric sensor that we developed can monitor cardiorespiratory and body movement signals non-invasively in contrast to overnight polysomnography, which requires uncomfortable wearing of EEG cords and many other sensors for sleep-disordered-breathing (SDB) screening. In this study, we assessed the use of an IC-recorder with the piezo-sensor for the recording of cardiorespiratory and body movement activity at individual home.
Methods: Two flat and thin piezo-sensors (30 x 180 x 1 mm) were placed under a bed sheet on a mattress on a bed at a healthy volunteer's home. Signal cords of the sensors were connected to a stereo-mini-jack input of an IC-recorder of frequency response from 20 to 23,000 Hz via a 10-fold amplifier. The piezo-sensor signal was recorded on MP3 format at 64 kb/s. After the recording, the data were transferred to a computer via an USB connector of the IC-recorder to replay with the free software, Audacity.
Results: MP3 data size was about 200MB for a 7-h recording. Either signal of the two sensors complemented the other of low-amplitude signal. Detection of breathing movement of <20Hz was mostly unsuccessful due to the frequency response of the IC-recorder. Whereas, respiration sound of higher frequency was heard at most of the recording time. Short-time Fourier transform analysis showed a repetitive increase in power spectral density in the range of 400−1000 Hz in parallel with repetitively appearing periods of inspiration-expiration sounds. Heart sounds were heard mainly as lower sounds when the signal amplitude was relatively large. Detection rate was higher in order of body movement > respiration sound > heart sound > breathing movement.
Conclusion: The recording system consists of the piezo-sensor and IC-recorder is an easy-to-use and noninvasive tool, which seems to be suitable for the use for primary screening for SDB patients in a hospital or at home.
Support (If Any): This work was supported in part by the Japan Science and Technology Agency (JST).

0376

EEG FREQUENCY-BASED SLEEP STATE DETECTIONS BY SINGLE EEG DERIVATION IN HUMAN AND RAT

Hirai N[1,2], Chiba S[1,3], Takahashi T[4], Yagi T[5], Ishimaru Y[1], Nishino S[1]
[1]Psychiatry and Behavioral Sciences, Stanford University, Palo Alto, CA, USA, [2]Psychiatry, Jichi University, Shimotsuke, Japan, [3]Otorhynolaryngology, Jikei University, Tokyo, Japan, [4]Psychology, Hosei University, Tokyo, Japan, [5]Ota Sleep Disorder Center, Kawasaki, Japan

Introduction: The current human sleep evaluation requires multiple PSG recordings in specialized sleep laboratories. If a small simple equipment can record EEG and automatically detect sleep stages, the devise can be used in the general population for monitoring their own sleep hygiene and preclinical signs of sleep disorders. However, such

simple equipment could be easily disturbed by the electrode condition, and recorded signal levels might be uneven among the recordings. To eliminate this influence, we developed a standardized-frequency-power-based sleep stage classifier by single EEG derivation and evaluated the performance in human and experimental animal.

Methods: PSGs spanning the whole night were recorded from 10 healthy subjects and rated by human scorers every 30 seconds. Discrete Fourier Transform (DFT) was performed on two-second signals starting every second, and standardized logarithmic power of 0.5-110 Hz was subjected to the following analysis. On every DFT frequency bin, probability distribution function was calculated on each stage. Using the functions of each subject as a classifier, probability of each sleep stages of other 9 subjects was calculated every second, and most probable sleep stage was used for estimation. The most frequent estimation within every 30-seconds was selected and compared to the human scorer's ratings. Although our former classifiers had been weighed statistically by the contribution function, we replaced it with 1/f function to level the effect of frequency change. The classifier without weighing was also evaluated for comparison. We applied the same procedure to the EEGs from 12 rats rated by a human scorer every 10 seconds.

Results: In the human data, the best classifiers worked at more than 85% agreement rates on all the PSG derivations. Although the sensitivity of Wake and NREM exceeded 80% on average, the rate on REM remained in a lower range (~55%). In the rat data, the sensitivity of three stages was 70-80% on average. In both human and rat, the specificity of NREM was higher (80-90%), while the rate of other two stages was lower (55-65%). The classifier without weighing worked as well as the one with 1/f-weighing.

Conclusion: Our classifiers without statistical weighing worked for the automatic sleep scoring on single EEG derivation of humans and rats. The performance on human and rat were similar, which could suggest that the EEG features among stages of human were also as different as rats' even if human scorer could hardly distinguish them.

0377

ANALYSIS OF THE SLEEP EEG WITH THE NOVEL SIGNAL ANALYSIS TECHNIQUE EMPIRICAL MODE DECOMPOSITION AS COMPARED TO SPECTRAL ANALYSIS

Chinoy ED[1], Kaslovsky DN[2], Meyer FG[3], Wright KP[1]

[1]Integrative Physiology, University of Colorado-Boulder, Boulder, CO, USA, [2]Applied Mathematics, University of Colorado-Boulder, Boulder, CO, USA, [3]Electrical Engineering, University of Colorado-Boulder, Boulder, CO, USA

Introduction: Empirical Mode Decomposition (EMD) is a novel signal analysis technique that permits the estimation of the instantaneous frequency of non-stationary signals such as the sleep EEG. Thus, unlike Power Spectral Analysis (PSA), EMD makes no assumptions (e.g. stationarity) about the signal, freeing it to measure its instantaneous frequency with greater temporal and frequency resolutions. We therefore compared EMD and PSA assessments of EEG for traditional sleep stages.

Methods: EEG data were selected from 8h sleep episodes scheduled at habitual bedtime, from 44 (21 women) healthy younger adults 21.7+3.5y (mean+SD) who maintained one week ~8h per night sleep schedules prior to study. EEG data were sampled from C3xA2 at 256Hz with a 12-bit A-D board. Artifact-free sleep stage samples of 2-5min in duration were analyzed for power in delta (0.5-4.0Hz), theta (4.0-8.0Hz), alpha (8.0-12.0Hz), sigma (12.0-15.0Hz), beta (15.0-35.0Hz), and gamma (35.0-45.0Hz) bands for sleep stages 2, 3, 4, REM, and wakefulness prior (WPSO) and after (WASO) sleep onset. Stage 2 was also examined by 1st and 2nd half of the night. Percent power was analyzed using mixed model ANOVAs and 95% confidence intervals.

Results: EMD, but not PSA, was sensitive to the following differences in EEG power: delta [Stage2-2ndvsREM], theta [Stage3vsStage4], alpha [Stage2-1stvsStage3; Stage2-2ndvsStage3; Stage2-1stvsStage4; Stage2-2ndvsStage4], sigma [Stage3vsREM], and beta [Stage2-1stvsStage4; Stage2-2ndvsStage3]. PSA, but not EMD, was sensitive to sigma [Stage2-1stvsStage2-2nd]. All differences; $p<0.05$.

Conclusion: EMD may represent a novel physiological signal analysis technique that provides precise information regarding instantaneous physiological oscillations during sleep and also addresses limitations of traditional PSA techniques.

Support (If Any): NIH R01 HL081761, T32 AG00279, M01RR00051, and NIH/NCRR Colorado CCTSI Grant Number UL1 RR025780.

0378

AUTOMATED KNOWLEDGE-BASED DETECTION OF CORTICAL SLOW WAVES IN SLEEP EEG USING MATCHING PURSUIT

Picot A[1], Whitmore H[2], Chapotot F[2]

[1]Laboratoire Plasma et Conversion de l'Energie, Universite de Toulouse, Toulouse, France, [2]Medicine, University of Chicago, Chicago, IL, USA

Introduction: The appearance of cortical slow waves (CSW) in the electro-encephalogram (EEG) is a hallmark of slow wave sleep and one of the principal criteria in visual sleep-stage scoring. Several detection methods have been proposed but none of them have been validated objectively against human expertise.

Methods: A knowledge-based pattern recognition method is proposed to automate the detection of CSW in the human EEG. This method takes advantage of a matching pursuit (MP) algorithm and exploits a minimal dictionary of limited Gabor functions modeling the target waveform characteristics. By doing so, it provides a description of EEG signals in terms of CSW properties, and a fuzzy detection threshold based on largest MP coefficients. Software plug-in implementing this new method was developed using the PRANA toolbox for bio-signal processing. It was tested on a database of overnight polysomnographic (PSG) recordings collected in 15 young healthy subjects. Recordings were visually scored for sleep-wake stages and transient slow wave events were marked by a registered PSG technologist. Measures of detection accuracy (sensibility, precision and common duration) between the different algorithms and the expert were calculated and compared to evaluate performance.

Results: Besides full automation and fast application, the results obtained from this algorithm showed excellent agreement as compared with expert marking, with 97% of correct detections, and a concordance of 67% in event time position and duration. The performance of our method was significantly and largely better to that of a generic algorithm introduced earlier, both in terms of detection sensibility and precision, with an improvement in correct and false detections of 23 % and 22 %, respectively.

Conclusion: By relying more on morphological waveform aspects than on fixed amplitude and duration thresholds, our new algorithm proves stable over time and sleep/wake states, and may well be used with virtually no human intervention.

Support (If Any): Grant PO1 AG-11412 from the National Institute of Health.

0379

DETECTING SLOW WAVE SLEEP VIA ONE OR TWO CHANNELS OF EEG/EOG SIGNALS

Yen CV[1], Hang L[2,3]

[1]Dept. of Mechanical and Electro-Mechanical Engineering, National Sun Yat-Sen University, Kaohsiung, Taiwan, [2]Sleep Medicine Center, Department of Internal Medicine, China Medical University Hospital, Taichung, Taiwan, [3]Department of Healthcare Administration, Asia University, Taichung, Taiwan

Introduction: The goal of this study is to develop and test a series of automatic slow wave sleep (SWS) detection methods that use one or two

channels of EOG/EEG signals. Based on the test results from two large datasets, this work compares the relative merits of these methods and investigates the impacts of SWS ratio and AHI (apnea-hypopnea index) value on the effectiveness of the proposed methods.
Methods: By locating the zero-crossing points of the signals, this work develops a number of new features to characterize the wave form of the EEG and EOG signals. In addition, special attention has been given to address the inter-personal differences of the EEG and EOG signals. Based on these features, neural networks are trained to detect SWS on an epoch by epoch basis.
Results: By setting the ratio of SWS to 15%, the first part of the experiments uses 265 subjects from one center as training set and 147 subjects from the other center as validation set. The validation results are Kappa coefficient 0.72-0.78, sensitivity 0.77-0.90 and positive predictive value 0.73-0.82. By using the 947 subjects as the training set, the results of the second part of the experiments show that the performances of the proposed methods decline with the reduction of SWS ratio. The proposed methods are also less effective in dealing with apnea patients.
Conclusion: For the single channel methods, it is found that EEG outperforms EOG. In contrast, the four tested two channel methods provide comparable performances. Considering the ease of use, the two channels EOG methods seems to be the method of choice. Finally, it is concluded that, to optimize the SWS detection performances, quality of the training set is of great importance.

0380

INTEGRATION OF ARTIFACT REJECTION ALGORITHMS FOR SPECTRAL ANALYSIS OF REM SLEEP

Cashmere D, Seres R, Pietrone R, Begley A, Miewald J, Buysse DJ, Germain A
Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: REM sleep phasic events can affect power spectral analysis outcomes. However, the effort and time involved in REM sleep artifact detection and rejection have hampered REM-focused investigations. This study aimed to evaluate and compare the effects of automated algorithms with and without visual epoch exclusions.
Methods: Eleven whole-night records from military veterans were used to compare the effects of three artifact rejection methods on spectral power bands. The 3 methods were: 1) validated EMG-based artifact rejection algorithm with visual inspection (A+V); 2) method A plus a validated REM detection algorithm (A+R); and 3) A+R combined with epoch-by-epoch visual inspection and rejection (A+R+V). Visual inspection used a program called Spec Edit developed at the University of Pittsburgh. Spec Edit was used to exclude 4 second EEG epochs having artifact and missed by above rejection algorithms. The number of epochs left for visual inspection and spectral analysis across the three techniques was considered as a measure of time-cost analyses.
Results: The percentage of REM epochs removed using the 3 methods were 18.7 + 6.7, 26.2 + 8.4 and 30.4 + 7.9, respectively. And average whole night REM power values for 0.5 to 32 Hz. were .85 + .33, .93 + .34 and .86 +33 [$F(2,20) = 8.96$, $p<0.002$]. Average whole night REM theta power values (4 to 8 Hz) were 1.70 + .88, 1.73 + .90 and 1.70 + .89 33 [$F(2,20)=15.22$, $p<0.0001$].
Conclusion: The 3 rejection methods excluded a significant number of epochs. Final EEG power values were similar on all bands for method A+R and A+R+V, despite the additional time required for visual inspection time in method 3. Automated algorithms focused on EMG and REMs appear to provide reliable spectral estimates, while optimizing efficiency.
Support (If Any): National Institute of Health (MH083035; Germain; ULRR-024153; Reis) and the US Department of Defense Congressionally Directed Medical Research Program (PT073961; Germain).

0381

VALID, SENSITIVE, INTERPRETABLE: A NOVEL APPROACH TO EEG ANALYSIS

Mensen A[1,2], Khatami R[1,2]
[1]Sleep, Clinic Barmelwedi, Barmelweid, Switzerland, [2]Neurology, University Hospital Zurich, Zurich, Switzerland

Introduction: Recent advances in the capabilities of EEG recordings have made the issue of how to statistically tackle the large datasets unavoidable. Several attempts have been made to reduce the data's complexity however we argue that this inevitably introduces user-biases and unjustified assumptions. Threshold-free cluster enhancement (TFCE) has recently been shown to be a superior technique in the analysis of fMRI datasets. Combined with non-parametric permutation based statistics, we show that TFCE can also be applied to analyse EEG datasets.
Methods: TFCE essentially finds clusters in the data over multiple thresholds and combines the information with the strength of the signals in that cluster, enhancing weak but clustered signals to a level directly comparable to strong focal signals. We show that the method is both statistically valid, sensitive to the wide range of signal types commonly found in EEG, and results in an openly interpretable result structure, while only requiring the data and the electrode coordinates as inputs. We compare the method to previously used permutation approaches using the maximum-statistic, cluster size and cluster mass, as well as the parametric approach used in SPM.
Results: For single subject time-channel analyses over different SNR, frequency analysis or multi-subject data, the TFCE approach outperformed the other approaches in terms of sensitivity and false-alarm rate and was able to provide specific information about the localisation and statistical strength unavailable in the contrasting methods.
Conclusion: Using only the original ERP waveforms and information about electrode location as input parameters we show that TFCE approach combined with non-parametric statistics is not only a statistically valid method of analysis with little room for user-biases or tweaking options, but also a highly sensitive method for the variety of signal differences and experimental manipulation possible in EEG experimentation.

0382

INFLUENCE OF SLOW OSCILLATING TRANSCRANIAL DIRECT CURRENT STIMULATION (SO- TDCS) ON NIGHT SLEEP

Garcia CI, Nadi N, Weise R, Schoebel C, von Mengden I, Blau A, Glos M, Fietze I, Penzel T
Sleep Medicine, Charité, Berlin, Germany

Introduction: Transcranial stimulation has an impact on EEG oscillation characteristics (e. g. power), memory performance as well as sleep architecture. Preliminary experiments with tDCS have shown that depending on the characteristics of the stimulation sleepiness or alertness may be induced. So- tDCS increased slow oscillation (0.4-1.2Hz) power as well as theta (4-8 Hz) and beta (15-25Hz) power. Enhancing the excitability of the prefrontal cortex (PFC), by means of anodal tDCS, is proposed to result in improved working memory function.
Methods: In previous studies we used daytime stimulation with one sequence and with three sequences of 0.75 Hz on frontolateral position on 20 healthy subjects. For sleepiness evaluation we peformed the alpha attenuation test, PVT, DSST, and KSS. According to the results changes to the protocol have been made. In this randomized, sham-controlled, double-blind cross over trial 10 healthy individuals are stimulated during evening time with anodal so- tDCS (550µA) at EEG position C3/C4. Subjects stay for 3 nights in the sleep lab. First night is an adaption night. Due to randomization, subjects will receive sham or active stimulation 30 min before sleep. One stimulation period lasts 30 min with 5x5 min of stimulation and 1 min off in between. In addition subjects have to complete several cognitive tests (PVT, DSST) and a subjective sleepiness questionnaire (KSS).

Results: In previous studies with daytime stimulation on frontolateral position we could see no significant effect of anodal so-tDCS on cognitive performance, reaction time or alertness. Experiments with nighttime stimulation will be finished by January 2012. Data analysis will be blinded to the rater concerning active or sham condition. Visual scoring of the polysomnographic nights will be done by different independent raters. Primary endpoint is an increase in spindle activity during night sleep after active stimulation. Secondary, it is hypothesized that stimulation in the evening time enhances cortical excitability resulting in increased cognitive performance (indicated in improved DSST and PVT test results).
Conclusion: Success in this objective will mean that effects on sleep and maintaining sleep are demonstrated and that the corresponding stimulation paradigm is determined providing us with valuable clues for modeling stimulation and guiding us in the potential applications of multisite brain stimulation.
Support (If Any): This study is funded by European project HIVE within the 7th framework program.

0383

USING THE RANDOM-EFFECTS ZERO-INFLATED POISSON MODEL TO ANALYZE ACTIVITY COUNT DATA

Wang W, Klerman EB
Division of Sleep Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA

Introduction: Actigraphy is commonly used as a non-invasive method to study sleep/wake patterns. Several studies have concluded that wrist actigraphy can usefully categorize sleep/wake state and produce common summary measures of sleep quality including sleep latency, sleep efficiency, and number of wake bouts. Understanding the underlying statistical distribution and correlation structure of the activity data is required for performing appropriate statistics. Since activity data contain many zeros, a classical Poisson or Negative Binomial regression model may not be appropriate since they both underestimate zero counts. A Random-Effects Zero-Inflated Poisson (REZIP) regression model (Hur, 1998; Hall, 2000) would be able to handle count data with extra zeros and account for correlated data from the same individual.
Methods: Thirty-nine subjects studied during inpatient protocols are included in this analysis. Subjects were instructed to wear the actiwatch on their non-dominant wrist at all times except when it might be exposed to water. For each subject, any intact 90-minute or longer blocks with all zeros were removed before conducting further analyses, since these blocks were likely to be when the actiwatch was not being worn properly. Polysomnography on scheduled sleep episodes was conducted and scored for sleep stages. REZIP models were fitted to the actigraphy data to examine (i) whether there are differences in activity counts between sleep and wake, and between NREM and REM sleep stages, and (ii) whether there is individual variability in actigraphy patterns.
Results: The distribution of activity counts is not statistically normal or Poisson. However, a zero-Inflated Poisson model is a good fit to the activity data. As expected, there is significant difference in the mean activity count between Wake and Sleep ($P<0.0001$). Though there is no significant difference ($P=0.24$) in the mean activity count between NREM and REM sleep stages, the probability of having a zero count is different between NREM and REM sleep stages ($P<0.0001$). In addition, there is significant individual variability across all sleep stages ($P<0.0001$).
Conclusion: Results from REZIP models suggest that the distribution of activity counts is zero-inflated. Appropriate models need to be considered when using these data for studying sleep/wake patterns. Future use of actigraphy could incorporate these statistical differences in actigraphy during different sleep stages or for other analyses.
Support (If Any): RC2-HL101340 and K24-HL105664 (EBK) and NSBRI HFP01603 through NASA NCC 9-58, AFOSR FA9550-06-0080/ O5NL132.

0384

SLEEP AND HEALTH-RELATED FUNCTION IN A CLINICAL SAMPLE AS MEASURED BY PROMIS (PATIENT-REPORTED OUTCOMES MEASUREMENT INFORMATION SYSTEM)

Buysse DJ[1], Krystal AD[2], Johnston K[1], Dodds N[1], Yu L[1], Giang R[1], Pilkonis P[1]
[1]Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA, [2]Psychiatry, Duke University, Durham, NC, USA

Introduction: PROMIS is an NIH Roadmap initiative to develop self-report item pools and questionnaires that measure key health outcome domains manifested in various chronic diseases. PROMIS provides an electronic Web-based resource for administering computerized adaptive tests, collecting self-report data, and reporting health assessments. We have previously published validation data for PROMIS Sleep Disturbance (SD) and Sleep-Related Impairment (SRI) scales. The current study compares a broader set of PROMIS health outcome measures in clinical samples of chronic insomnia (CI, n=93), obstructive sleep apnea (OSA, n=105) and good sleepers (GS, n=132).
Methods: Participants were recruited from clinics, clinical research studies, and community advertising. Diagnoses were verified by medical and research records and self-report data. Participants completed computer-based self-report assessments for 11 PROMIS item banks: Anger, anxiety, depression, fatigue, physical function, pain interference, pain behavior, SD, SRI, and 2 social satisfaction scales. All questions were administered using adaptive testing, in which a computer algorithm chooses questions based on the individual's previous responses until a specified level of precision in the estimated score is achieved. Previous calibration studies in representative samples determined the measurement characteristics of each item, so that its contribution to overall severity was known.
Results: ANOVAS showed significant group differences ($p<.001$) on all scales. GS differed from both patient groups ($p<.001$) on all scales. CI scored higher than OSA ($p<.05$) on anxiety, depression, and SD scales. OSA scored higher than CI on pain behavior and pain interference scales. The mean number of questions across all 11 PROMIS scales was 77.4 per participant, or about 7 per scale.
Conclusion: PROMIS self-report measures identify significant impairments in CI and OSA on a range of health-related outcomes beyond sleep and fatigue. PROMIS provides efficient and precise measurements of a health profile that may identify treatment targets and measure treatment effects.
Support (If Any): AR052155.

0385

ASSESSING CIRCADIAN PHASE IN HUMAN SUBJECTS USING LIMITED PERIPHERAL BLOOD MEASUREMENTS

Anafi R[1,6], Nikonova EV[4], Arnardottir ES[2], Shockley KR[3], McDonald TP[4], Podtelezhnikov AA[4], Winrow CJ[4], Hogenesch JB[5], Renger JJ[4], Pack A[1,6]
[1]Division of Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Department of Respiratory Medicine and Sleep, Landspitali University Hospital, Reykjavik, Iceland, [3]Biostatistics Branch, National Institute of Environmental Health Science, National Institutes of Health, Research Triangle Park, NC, USA, [4]Neuroscience Department, Merck Research Laboratories, West Point, PA, USA, [5]Department of Pharmacology, University of Pennsylvania, Philadelphia, PA, USA, [6]Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Measuring the entrained circadian phase of human subjects is laborious and costly. As part of a study on the effects of diurnal rhythms and sleep deprivation on leukocyte transcription, we identified transcripts that have a strong circadian pattern and are unaffected by recent sleep history. We tested our ability to estimate the circadian phase of human subjects using a limited panel of these transcripts.

Methods: Fourteen subjects (ages 19 to 44) were instructed to follow a regular sleep/wake schedule for two weeks prior to their admission to the clinical research center. Blood samples were collected every 4 hours during an uninterrupted sleep/wake cycle and during a voluntary 38-hour period of acute sleep deprivation. Total RNA was extracted and transcript levels were measured using a custom human GeneChip® microarray. We identified diurnally regulated transcripts using both COSINOR analysis and the JTK_CYCLE algorithm with a false discovery rate (FDR) cutoff of 1%. We then developed a support vector machine (SVM) model (libsvm, R programming environment) to predict the time of sample collection given a panel of transcript levels. The accuracy of these predictions was assessed through cross-validation.
Results: Nearly 5000 transcripts were identified as cycling, with a greater than 80% overlap in the transcripts identified by the two methods. The vast majority of these continued to cycle, unaffected, despite acute sleep deprivation. However, inter-subject variation of mean transcript levels limited the utility of a single blood draw for phase assessment. Using a panel of 50 transcripts and two blood draws separated by 8 hours, the SVM model was able to correctly classify the phase of a subject with an accuracy of 92%.
Conclusion: This study indicates that measurement of transcript levels from peripheral blood samples at two time points may be a promising and cost effective means of assessing circadian phase.
Support (If Any): NIH grant HL094307. ASMF Physician Scientist Training Award. Support provided by Merck & Co., Inc.

0386

A DATA-DRIVEN BAYESIAN ALGORITHM FOR SLEEP SPINDLE DETECTION

Babadi B[1,2], McKinney S[3], Tarokh V[4], Ellenbogen JM[5,6]
[1]Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital, Boston, MA, USA, [2]Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, MA, USA, [3]Institute for Computational and Mathematical Engineering, Stanford University, Stanford, CA, USA, [4]School of Engineering and Applied Sciences, Harvard University, Cambridge, MA, USA, [5]Department of Neurology, Massachusetts General Hospital, Boston, MA, USA, [6]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: The sleep spindle is an important brain rhythm that appears as a transient pulse of activity on the EEG during sleep. Quantifying its presence and character might provide an objective measure that can be employed to evaluate numerous hypotheses concerning the function of this signature rhythm in sleep. Most of the existing methods for automatic spindle detection do not take into account the 'Gestaltic' EEG features captured by the human eye, and suffer from high computational complexity. We developed a Data-driven Bayesian (DiBa) algorithm for sleep spindle detection, which represents the EEG waveforms in terms of an empirically tailored basis that captures essential features of the spindle rhythm. This fast and low complexity algorithm displays detection performance superior to many existing methods.
Methods: The EEG recordings of 8 healthy sleeping subjects were visually scored by a technician, providing a large set of exemplary spindles. By applying the Karhunen-Loève decomposition to this set, we obtained an empirically tailored basis for representing sleep spindles. The DiBa algorithm projects the streaming EEG data onto this empirical basis, and employs a Bayesian framework in order to localize the sleep spindles.
Results: Based on a total of 1550 minutes of test data recorded from the 8 subjects and the gold standard judgment of a human expert, we computed the performance curves of the DiBa algorithm which demonstrate the trade-off between sensitivity and specificity of the algorithm. In particular, the DiBa algorithm achieves a sensitivity of 96.0% and a specificity of 92.9%. Our results reveal that the DiBa algorithm outperforms several existing methods for spindle detection.
Conclusion: Our approach, employing the Karhunen-Loève decomposition and Bayesian inference, represents a significant advance in the analysis of sleep data. Our proposed algorithm extracts data-driven features to generate an intuitive probabilistic output using a low complexity procedure.

0387

ACCOUNTING FOR DYNAMIC CHANGES IN NEUROBEHAVIORAL PERFORMANCE WITHIN WAKING PERIODS IN A BIOMATHEMATICAL FATIGUE MODEL

McCauley P, Van Dongen H
Sleep and Performance Research Center, Washington State University Spokane, Spokane, WA, USA

Introduction: Investigation of the biomathematical model of fatigue of McCauley et al. (2009) showed that temporal changes in neurobehavioral performance across days of total or partial sleep loss are well captured by a two-component homeostatic process, the dynamics of which can be formally examined independent of the temporal changes within days. This research uncovered qualitatively different neurobehavioral responses after sleep restriction to less than ~4h per day; suggested that baseline performance depends critically on habitual sleep duration (experimentally confirmed by Rupp et al., 2009); and captured nonlinear interaction between homeostatic and circadian influences on performance. We pursued a more detailed examination of the temporal changes within days, using data from a recent simulated night shift study (Van Dongen et al., 2011).
Methods: N=27 healthy subjects (ages 22-39y; 14f) participated in a 14-day in-laboratory study, which included a 5-day shift period with performance testing, a 34h rest period without performance testing, and another 5-day shift period with performance testing. 14 subjects were randomized to a day shift condition, involving daily nocturnal sleep (TIB 22:00-08:00). 13 subjects were randomized to a night shift condition, involving daily diurnal sleep (TIB 10:00-20:00) during the two shift periods, and nocturnal sleep and diurnal naps during the rest period. Performance testing during the two shift periods in each condition included the 10min PVT, for which lapses (RTs>500ms) were assessed.
Results: The nonhomogeneity of the differential equations for the fatigue model, which governs the dynamics within days, was refined with a sigmoidal increase of the amplitude of the circadian influence on performance during wake and an exponential decline during sleep. This caused the circadian influence on performance to be small when well-rested and approach a supremum with increasing fatigue, and resulted in 74.4% improvement in root mean square error for predicting the PVT data from the study. As the number of model parameters was furthermore reduced by one, this constituted a significant improvement in model adequacy (ΔAIC=-255.43, $P<0.001$).
Conclusion: Simulated night shifts with 10h daytime TIB produce moderate fatigue, and the circadian influence on neurobehavioral performance is prominent. Our refined biomathematical model of fatigue (originally developed to improve modeling of the homeostatic influence) predicts these dynamics parsimoniously and accurately.
Support (If Any): AFOSR grant FA9550-09-1-0136 and ONR grant N00014-11-C-0592.

0388

OBSTRUCTIVE SLEEP APNEA PREDICTS INCIDENT STROKE RISK: 17 YEAR FOLLOW-UP OF THE BUSSELTON SLEEP COHORT

Marshall NS[1], Wong KK[1,4], Cullen SR[2], Knuiman MW[3], Grunstein RR[1]
[1]Centre for Integrated Research and Understanding of Sleep (CIRUS), University of Sydney, Sydney, NSW, Australia, [2]Western Australian Sleep Disorders Research Institute, Perth, WA, Australia, [3]School of Population Health,, University of Western Australia, Perth, WA, Australia, [4]Sleep and Respiratory Failure, Royal Prince Alfred Hospital, Sydney, NSW, Australia

Introduction: Obstructive sleep apnea (OSA) is a risk factor for premature mortality probably through its effects on the cardiovascular system. Because OSA causes large blood pressure changes through the night in conjunction with milder perturbations in systematic blood pressure it is thought that probably elevates the risk of stroke in particular.
Methods: In a community-based cohort of 400 residents of the Western Australian town of Busselton we quantified OSA via the respiratory disturbance index (RDI) as measured by a single night recording in November-December 1990 by the MESAM IV device, along with a range of cardiovascular disease risk factors. Follow-up for stroke related death and hospitalisations was ascertained via record linkage to the end of 2007. Sleep apnea was classified as absent (AHI<5), mild (AHI5-15) or moderate-to-severe (AHI>15).
Results: There were 24 stroke events (4 fatalities) in the 380 participants without stroke or heart attack history at baseline. People with moderate-to-severe OSA were at increased risk for stroke at both a univariate (HR=5.7; 95% CI 1.9, 17.8) and multivariate level (HR=5.2; 95% CI 1.5, 18.2) after control for leading stroke risk factors. Tests for linear trends across the categories of severity were positive ($p<0.05$) and treating AHI as a continuous variable indicated that each unit increase was associated with about a 5.7% increase in risk ($p=0.01$).
Conclusion: Moderate-severe obstructive sleep apnea is an independent risk factor for stroke in the Busselton Health study. This replicates previous observations from the Sleep heart Health Study and the Vitoria sleep project.
Support (If Any): National Health and Medical Research Council (NHMRC) of Australia.

0389

PROSPECTIVE STUDY ON THE EFFECT OF SNORING ON CAROTID ATHEROSCLEROSIS: 4-YEAR FOLLOW-UP

Kim J[1,3], Pack A[2,3], Jackson NJ[3], Lee S[4], Shin C[4,5]
[1]School of Nursing, University of Pennsylvania, Philadelphia, PA, USA, [2]School of Medicine, University of Pennsylvania, Philadelphia, PA, USA, [3]Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [4]Institute of Human Genomic Study, Korea University Ansan Hospital, Ansan, Republic of Korea, [5]School of Medicine, Korea University, Ansan, Republic of Korea

Introduction: Recent animal studies suggest a potential effect of snoring on increased local inflammatory responses and adjunct vessel damage in carotid arteries by transmission of vibration energy. A few human studies have reported supportive evidence that intima-media thickness (IMT), an indicator of subclinical atherosclerosis on carotid arteries, is elevated in snorers compared with non-snorers. However, there is no prospective observation on the effect of snoring on carotid atherosclerosis. The present study examined whether snoring is related to carotid IMT over 4 years.
Methods: A subset analysis on a cohort of Korean adults (The Korean Genome Epidemiology Study) was conducted on 1,623 subjects (ages 43-73) without cardiovascular disease ,obesity (body mass index (BMI) $\leq$ 27.5 kg/m2), or on medications for hypertension, diabetes, or dyslipidemia. Individuals were grouped into habitual snorers (snoring $\geq$ 4 days/week), occasional snorers (<4 days/ week), and non-snorers, based on self-reported frequency of snoring. IMT at the far and near wall of common carotid arteries was measured by B-mode ultrasonogram on both sides at baseline examination and biennially over 4 years. Mixed Effects Linear and Logistic regression models analyzed averaged mean and maximal values of IMT, with "Time" and "Snoring" interactions examined to assess snoring relationships with change in IMT.
Results: After adjusting for age, BMI, blood pressure, glucose and lipids levels, and life-style factors, habitual snorers had significantly ($p=0.016$) higher mean and maximal values of carotid IMT over 4 years (mean: 0.719±0.005, maximum: 0.918±0.006) than non-snorers (mean: 0.704±0.003, maximum: 0.899±0.004) in women, but not in men. Odds ratios (95% confidence interval) of maximal carotid IMT greater than 1.0 mm were 1.80 (1.11-2.90) for habitual snorers ($p=0.016$), compared with non-snorers. The effect of snoring on change in IMT over time showed a borderline significance ($p=0.075$).
Conclusion: The findings from this 4-yr follow-up indicate that habitual snoring could be longitudinally associated with the early process of atherosclerosis on carotid arteries in non-obese women. Longer prospective observations which are in progress will confirm the independent effect of snoring on the early change in IMT on carotid arteries as well as the gender difference.
Support (If Any): This study was supported by a grant of the Korea Centers for Disease Control and Prevention [budgets 2005-347-2400-2440-215, 2006-347-2400-2440-215, 2007-090-091-4854-300, and 2008-E00169-00] from the Korean Centers for Disease Control and Prevention and partially by 1K99NR013177 - 01 from NIH/NINR.

0390

REQUIRING 4% OXYGEN DESATURATION TO SCORE HYPOPNEAS MISSES OSA PATHOLOGY AND LEAVES MANY PATIENTS UNTREATED. AN OUTCOME STUDY, TREATING OSA PATIENTS WHO DO NOT DEMONSTRATE 4% DESATURATIONS

Simmons JH[1,2,3], Barlow S[1,2]
[1]Comprehensive Sleep Medicine Associates, Houston, TX, USA, [2]Neurology, Sadler Clinic, The Woodlands, TX, USA, [3]Sleep Education Consortium, Houston, TX, USA

Introduction: Debate of what criteria best defines obstructive respirations has been met with various opinions. We sought to retrospectively assess outcome in symptomatic patients in whom NPSG studies demonstrated hypopneas in every aspect (decreased flow, arousal's etc..) other than meeting the desaturation criteria of 4% to determine if treating such patients is a worthy endeavor.
Methods: Review of patients who presented to our sleep centers in whom the AHI using a minimum of 4% desaturation (Ox- AHI) was less than 5 / hour sleep but in whom the AHI independent of assessing the SaO2 (NonOx-AHI) was greater than 5 / hour sleep. Follow up attempts were made on qualifying patients, tabulating Epworth Sleepiness Scale (ESS) and Patient Global Impression (PGI) scores were obtained pre and post treatment as well as body weight.
Results: 240 patient records meeting criteria of DeOx-AHI <5/hr with NonOx-AHI >5/hr were identified. 69 patients could not be contacted. 18 never started treatment and 37 were non-compliant with treatment. The remaining 116 patients complied with treatment for six months or more. Average age was 51 y/o (21 to 83), 35 Males, 81 Females. Follow up assessment ranged from 6 to 65 months (average 20 months). 88 patients (76%) demonstrated improved ESS scores, average from 12.7 down to 8.0, and 101 improved PGI scares (87%). Significant improvement with treatment was characterized by an ANOVA assessing ESS, PGI and Weight between groups that was significant with a $p<0.01$. T-Tests of the ESS and PGI scores were significant both with $p < 0.001$. Weight did not demonstrate significant change with T-Test of $p > 0.05$.
Conclusion: Our results correspond with our long history of clinical experience, in that treatment is warranted in symptomatic patients who demonstrate fragmented sleep from hypopniec events without desatura-

tion. Unfortunately many cling to the dogma that tabulating and treating respiratory events without desaturation is unwarranted, and as a result many insurance providers have taken a similar position. Our data clearly demonstrates that such reluctance to diagnose OSA in the absence of desaturating events would leave many of our affected patients inappropriately untreated. We encourage those laboratories who hold strictly to only tabulating hyponeas with desturations to take a closer look and consider extending the diagnosis of OSA to patients who demonstrate obstruction with reduced airflow in the absence of desaturation.

0391

NON-EXERCISE ACTIVITY THERMOGENESIS (NEAT) IN OBSTRUCTIVE SLEEP APNEA: A PILOT STUDY

Mansukhani MP[1], McCrady-Spitzer S[2], Levine J[2], Somers VK[3], Caples SM[1,4]

[1]Center for Sleep Medicine, Mayo Clinic, Rochester, MN, USA, [2]Endocrinology, Mayo Clinic, Rochester, MN, USA, [3]Cardiovascular Diseases, Mayo Clinic, Rochester, MN, USA, [4]Pulmonary and Critical Care Medicine, Mayo Clinic, Rochester, MN, USA

Introduction: Obesity is the strongest risk factor for obstructive sleep apnea (OSA). Obesity and OSA share a bidirectional relationship. Mechanisms underlying obesity in untreated and treated OSA are largely unexplored. The main aim of this study was to examine the effects of OSA and continuous positive airway pressure (CPAP) treatment on non-exercise activity thermogenesis (NEAT), the major non-basal metabolic rate contributor to energy expenditure.
Methods: Three middle-aged (mean age 44 ± 7 years) obese (mean BMI 35 ± 5 kg/m2) CPAP naive male subjects with moderate OSA (mean AHI 16 ± 9 per hour) diagnosed by polysomnography (PSG) were recruited. Body position and movement were calculated every half-second using the novel PAMS system on each of the subjects. This was performed for seven days prior to initiation of CPAP (n=3), and for seven days following a four week period of CPAP treatment, after the effectiveness of CPAP was confirmed on repeat PSG (n=3). Patients continued to utilize CPAP throughout the second phase of the study period.
Results: Preliminary findings suggest that after CPAP treatment, there was a trend toward an overall increase in NEAT measured in accelerometer units (AU) (p=0.08), with a decrease in time spent sitting (p=0.12), and increased motion whilst in the upright position (p=0.07). There were indications that subjects walked more and at faster velocity after receiving CPAP therapy (p=0.3).
Conclusion: This study suggests a trend toward increased physical activity in obese sleep apneics treated with CPAP, with an increase in time spent upright and decrease in sitting time. The findings also suggest that after CPAP treatment, subjects showed a trend toward walking longer and faster than previously. Results of this pilot study will need to be confirmed in larger studies.

0392

SLEEP MRI EVALUATION OF THE UPPER AIRWAY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA WITH EEG CORRELATION

Shin LK[1,2], Holbrook A[1], Powell N[3,4], Kushida C[3], Fischbein NJ[1], Capasso R[4]

[1]Radiology, Stanford University, Stanford, CA, USA, [2]Radiology, VA Palo Alto Veterans Health Care System, Palo Alto, CA, USA, [3]Sleep Medicine, Stanford University, Stanford, CA, USA, [4]Otolaryngology, Stanford University, Stanford, CA, USA

Introduction: Surgical failures for treating obstructive sleep apnea (OSA) have been attributed to inaccurate preoperative evaluation in the awake or drug-induced sleep state that may not accurately reflect airway collapse during normal physiologic sleep. We describe our initial experience and the clinical utility of a pre-operative real-time, sleep MRI examination of the upper airway in OSA patients with synchronous EEG correlation.
Methods: Three male patients (mean - 45.7 yrs; BMI 29.1) with polysomnography-proven OSA referred by an OSA otolaryngologist underwent real-time, dynamic sleep MRI at 3Tesla with EEG correlation in addition to routine pre-operative evaluation. Cine, multi-planar MR images were acquired for up to 4 hours during natural, physiologic sleep. Up to 3 independent imaging planes (e.g. midsagittal, and 2 axial slices) can be obtained at a temporal resolution of 3 images every 2 seconds. Sleep onset and apnea events were confirmed by synchronous EEG, measurement of airflow (oral and nasal), respiratory effort, and pulse-oximetry. Otolaryngologist assessment of airway collapse was evaluated by questionnaire before and after sleep MRI imaging review. Clinical usefulness of sleep MRI imaging (5 point scale) and assessment of anatomic location of airway collapse (soft palate, tongue) with respect to degree of collapse (4 point scale), extent of planned surgery for each location (none, minor major), and degree of expected correction (none, minimal, moderate, complete) were recorded.
Results: Sleep MRI was rated "very helpful" (4 of 5 points) in 2 patients and "critical to proper management" (5 of 5 points) in 1 patient. Post sleep MRI assessment of airway collapse changed at least one degree in each patient: In patient 1, tongue collapse was upgraded; In patient 2, collapse at the palate was upgraded but downgraded at the tongue; In patient 3, collapse was upgraded at the palate and tongue. Planned surgery was upstaged in patients 1&3 at a total of 5 sites and downgraded in patient 2 at one site. Surgeon's expectation for operative correction improved in 2 patients at 7 different sites after evaluation with sleep MRI.
Conclusion: Initial experience with pre-operative upper airway evaluation with sleep MRI with EEG correlation appears clinically useful in OSA patients. Sleep MRI can increase sleep surgeon's confidence in airway collapse localization and can significantly alter surgical management in patients with OSA.
Support (If Any): Hitachi Medical Systems RSNA Research Seed Grant.

0393

DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA BASED ON SPECTRAL FEATURES OF TRACHEAL BREATH SOUNDS DURING WAKEFULNESS

Karimi D[1,2], Moussavi Z[1,2]

[1]Electrical & computer Engineering, University of Manitoba, Winnipeg, MB, Canada, [2]eHealth, TRLabs, Winnipeg, MB, Canada

Introduction: Currently, the standard diagnostic method for obstructive sleep apnea (OSA) is overnight polysomnography, which is a time-consuming and expensive test. The goal of this study was to develop an OSA diagnosis technique based on short recordings of tracheal breath sounds during wakefulness.
Methods: Tracheal breath sounds were recorded from 105 subjects during nose and mouth breathing at their maximum flow rate in supine and upright postures. The apnea-hypopnea index (AHI) for the subjects was determined through the full-night polysomnography. Several features were computed from the power spectrum density of the sound signals in different frequency bands: 150-450 Hz, 450-600 Hz, 600-1200 Hz, and 150-1200 Hz. The differences of these features between supine and upright breathing and between nose and mouth breathing were also calculated. Data from approximately 60% of non-OSA (AHI<5) and moderate or severe OSA subjects (AHI≥15) were used for selecting the most characteristic features. The rest of the data was used for classification. Classification was performed using an ad hoc method based on voting from the individual features.
Results: For discriminating severe OSA (AHI≥30) from healthy subjects (OSA<5), accuracy, sensitivity, and specificity were 88%, 82%, and 93%, respectively. When classifying into 4 classes of non-OSA (AHI<5), mild (15>AHI≥5), moderate (30>AHI≥15) and severe OSA (AHI≥30), the classification accuracy decreases but the results are still

promising. Using the best combination of four features, approximately 80% of moderate and severe-OSA patients were diagnosed to belong to these two classes, while only 11% of non-OSA and mild-OSA subjects were misclassified as moderate or severe OSA patients.
Conclusion: Spectral features of breath sounds recorded during wakefulness have the potential for OSA diagnosis. The classification accuracy may improve by matching for anthropometric parameters such as age, BMI, and gender.
Support (If Any): This study was funded by Natural Sciences and Engineering Research Council (NSERC) of Canada and Telecommunications Research Lab of Manitoba.

0394

DRUG-INDUCED SLEEP ENDOSCOPY IN SLEEP-DISORDERED BREATHING: REPORT ON 1249 CASES

Vroegop AV[1,2], Hamans E[1,2], Boudewyns AN[1,2], Scholman J[2], Wouters K[3], Braem MJ[2,4], Van de Heyning PH[1,2], Vanderveken OM[1,2]
[1]ENT, Head and Neck Surgery, Antwerp University Hospital, Edegem, Belgium, [2]Faculty of Medicine and Health Sciences, Antwerp University, Antwerp, Belgium, [3]Department of Scientific Coordination and Biostatistics, Antwerp University Hospital, Edegem, Belgium, [4]Special Care Dentistry, Antwerp University Hospital, Edegem, Belgium

Introduction: During a drug-induced sleep endoscopy (DISE), a flexible nasopharyngoscope is used to visualize the upper airway (UA) during artificial sleep. The aim of this study was to describe UA flutter and collapse patterns in a large cohort of patients with sleep-disordered breathing and to look for associations with polysomnographic characteristics.
Methods: Between June 2007 and September 2011, 1249 patients underwent polysomnography (PSG) and DISE [age 47 ± 10 y; apnea hypopnea index (AHI) 18.9 ± 15.3/h; body mass index (BMI) 27.2 ± 3.7 kg/m^2], to assess eligibility for UA surgery or oral appliance therapy. DISE findings were categorized to the following UA levels: palate, oropharynx, tongue base and hypopharynx/epiglottis. The degree of collapse was reported as complete, partial or none and the pattern of the obstruction was described as concentric, anteroposterior or laterolateral. Associations between PSG and DISE findings were analyzed.
Results: A multi-level collapse was associated with both higher BMI and higher AHI values. Complete palatal collapse was associated with higher BMI and higher AHI, while circular palatal collapse was associated with higher BMI values only. Oropharyngeal collapse was associated with higher BMI. Hypopharyngeal collapse was associated with higher AHI values. A complete tongue base collapse was associated with higher AHI and lower BMI values. Palatal or oropharyngeal flutter was associated with higher BMI; palatal or hypopharyngeal flutter with higher AHI. Epiglottis flutter was associated with lower BMI and lower AHI values.
Conclusion: DISE provides a description of UA collapse patterns in patients with sleep-disordered breathing. More severe obstructive sleep apnea was associated with multilevel collapse comprising of a complete palatal collapse, a complete tongue base collapse and hypopharyngeal collapse. Obesity was associated with oropharyngeal but not with tongue base collapse. These findings provide more insight in the pathophysiological mechanisms of UA collapse during sleep and might help to guide treatment decisions.

0395

RESPIRATORY INDUCTANCE PLETHYSMOGRAPHY COMPARED WITH THERMISTER AND PRESSURE AIRFLOW TRANSDUCTION TO IDENTIFY OBSTRUCTIVE SLEEP DISORDERED BREATHING

Williams SG, Holley A, Lesage S, Dombrowsky J, Lettieri C
Walter Reed National Military Medical Center, Bethesda, MD, USA

Introduction: The American Academy of Sleep Medicine (AASM) recommends oronasal thermister and pressure transduction to detect changes in breathing during overnight polysomnography (PSG). Because there is considerable variability in the accuracy of this technology, we sought to determine whether volume changes measured via calibrated respiratory inductance plethysmography (RIP) were correlated with the AASM-recommended respiratory measures for apneas and hypopneas.
Methods: 10 consecutive patients suspected of having OSA received PSG monitoring using the standard montage. For each patient, the PSG was reviewed for respiratory events consisting of a minimum 4% oxygen desaturation and an arousal. Two separate scorers calculated the change in the derivative of the tidal volume (dVt) for each event. All arousals not associated with a desaturation were used for specificity analysis. Receiver operating characteristic (ROC) curves were constructed to evaluate the accuracy of calibrated RIP.
Results: We analyzed a total of 955 events which included 404 events with a PTAF drop ≥ 30%, 64 events with a thermistor drop ≥ 90%, and 211 events that were associated with both a 4% desat and an arousal. Using the RIP belts, the tidal volume dropped by -50.0±24.3% when the PTAF decreased by ≥ 30%, and increased by 0.28±28.4% when the PTAF decreased by < 30% (-50.3% (95% CI: -53.8 to -46.9); p<0.001). For thermistor drops <90% versus ≥ 90%, the volume changes measured via the RIP belts were -62.7±20.1 versus -17.9±35.7 respectively (-44.8% (95% CI: -53.6 to -35.9); p<0.001). For patients with both a 4% desat and an arousal versus those who did not have both, volume changes in the RIP belts were -51.5±25.6 versus -12.3±34.5 respectively (-39.1 (95% CI: -44.2 to -34.1); p<0.001). The areas under the ROC curve for volume changes via RIP belts predicting a PTAF drop ≥ 30%, a thermistor drop ≥ 90%, and a 4% desat coupled with an arousal were 0.92 (95% CI: 0.90 to 0.94; p<0.001), 0.86 (95% CI: 0.82 to 0.90; p<0.001), and 0.83 (95% CI: 0.80 to 0.86; p<0.001).
Conclusion: Calibrated RIP belts provide a useful alternative to the standard airflow measures and can be used to diagnose respiratory events.

0396

THE PSYCHOMOTOR VIGILANCE TASK AS A SCREENING TOOL FOR OBSTRUCTIVE SLEEP APNEA

Batool-Anwar S[1,2], DeYoung P[1], Varvarigou V[3], Zhang C[1,3], Kales S[3,2], Malhotra A[1,2]
[1]Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]Environmental and Occupational Medicine, Harvard School of Public Health, Boston, MA, USA

Introduction: The psychomotor vigilance task (PVT) is widely used to assess the degree of cognitive deterioration in clinical and experimental settings. However, the use of PVT in screening for OSA has not been established. We examined how reaction time, and lapses as measured by psychomotor vigilance task could predict the severity of OSA.
Methods: This is a cross-sectional study of participants with suspected OSA, who attended a local sleep clinic. A 1- minute mock PVT demonstration was done prior to each test. The participants were asked to maintain the fastest possible reaction times (RT's) to a simple visual stimulus. Each test lasted 10 minutes, and from each trial RT's parameters were extracted using the devices' software program.
Results: The complete data on PVT, the outcome variable, were available for 67 participants (men 60%). Mean age was 46 years. Independent variables used in the analysis included apnea-hypopnea index

(AHI), arousal index, and oxygen desaturation index. Other covariates used were age, gender, BMI, Epworth sleepiness score (ESS), and neck circumference. Using simple linear regression AHI was a predictor of mean RT (p 0.03), mean reciprocal RT (p 0.02), and fastest 10% mean (p 0.03). However, the results for lapses >500 ms did not reach statistical significance (p 0.14). Similarly the results were not significant for arousal index and oxygen desaturation index. The multiple regression models suggested that gender was a significant predictor for only mean reciprocal RT (Beta -0.47, p 0.02). Limitations of the study include small sample size and the possibility of residual confounding.
Conclusion: Psychomotor vigilance task can be used as a screening tool to predict severity of obstructive sleep apnea.

0397

BODY MASS INDEX IS AN EFFECTIVE MEASURE FOR OCCUPATIONAL SCREENING OF EMPLOYEES AT HIGH RISK FOR MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA: IMPLICATIONS FOR DOT COMMERCIAL DRIVER MEDICAL EXAMINATIONS

Czeisler CA[1,2], Shea SA[1,2,3], Lockley SW[1,2], Barger L[1,2], O'Brien C[1], Qadri S[1], Epstein LJ[1,2,3], White D[1,2], Rajaratnam S[1,2,4]
[1]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]Sleep HealthCenters, Boston, MA, USA, [4]School of Psychology and Psychiatry, Monash University, Clayton, VIC, Australia

Introduction: In 2007, an FMCSA Medical Expert Panel recommended that commercial motor vehicle drivers with a BMI greater than 33 kg/m2 be denied medical certification without objective testing, and where indicated, effective treatment for OSA. In 2008, the Medical Review Board of the FMCSA recommended a BMI threshold of 30. In 2011, the FMCSA Medical Review Board and the Motor Carrier Safety Advisory Committee jointly recommended that the FMCSA immediately issue a Guidance with a BMI threshold 35, pending final ruling. We examined the association between BMI and objectively diagnosed OSA.
Methods: State troopers (n=605) completed the Berlin questionnaire and provided self-reported BMI. Polysomnographic studies were performed on 114 participants; 60 screened positive on the Berlin and 54 screened negative. OSA severity was classified by a sleep specialist using both RDI and SaO2. Those with RDI >10/hour or RDI>5/hour with SaO2<85%, were classified as Mild-to-Moderate, Moderate-to-Severe, or Severe-OSA (MMS-OSA); those with RDI >25/hour were classified as Moderate-to-Severe, or Severe-OSA (MS-OSA).
Results: We found that BMI >25 had a positive predictive value (PPV) of 67% for MMS-OSA, PPV of 31% for MS-OSA; BMI >30 had PPV of 80% for MMS-OSA, PPV of 36% for MS-OSA; BMI >33 had PPV of 81% for MMS-OSA, and PPV of 52% for MS-OSA; BMI >35 had a PPV of 92% for MMS-OSA, PPV of 75% for MS-OSA among state troopers. We found that BMI >25 had negative predictive value (NPV) of 67% for MMS-OSA, NPV of 87% for MS-OSA; BMI >30 had NPV of 48% for MMS-OSA, NPV of 76% for MS-OSA; BMI >33 or >35 had NPV of 41% for MMS-OSA, NPV of 77% for MS-OSA.
Conclusion: Elevated BMI conveys a very high risk of moderate-to-severe/severe-OSA. These results can be used to inform public policy regarding occupational screening of commercial vehicle drivers and others in safety sensitive occupations.
Support (If Any): The study was supported by Grant No. 2004-FS-BX-001 from the National Institute of Justice, Office of Justice Programs, US Department of Justice; Grant No. R01 OH008496 from the Centers for Disease Control and Prevention; and grants from the ResMed Foundation. Points of view in this document are those of the authors and do not necessarily represent the official position or policies of the US Department of Justice.

0398

FACTORS ASSOCIATED WITH ELEVATED APNEA HYPOPNEA INDEX IN A SAMPLE WITH A LOW SCREENING PROBABILITY OF APNEA

Carnethon M[1], Knutson KL[2], Kim K[1], de Chavez PJ[1], Liu K[1], Goldberger JJ[3], Ng J[3], Zee P[3]
[1]Preventive Medicine, Northwestern University, Chicago, IL, USA, [2]Medicine, University of Chicago, Chicago, IL, USA, [3]Medicine, Northwestern University, Chicago, IL, USA

Introduction: Sleep disordered breathing (SDB) may confound the association between sleep duration and cardiovascular disease (CVD) risk factors. We attempted to assemble a cohort of adults with a low probability of SDB, but observed that some participants had high apnea hypopnea index (AHI) scores. Our objective was to compare the characteristics of participants who had high AHI scores vs. low AHI scores despite screening negative for SDB.
Methods: Men and women ages 35-64 from the Chicago, IL area were randomly sampled and invited to participate in the Chicago Area Sleep Study. Eligible adults had body mass index [BMI] <35 kg/m2 and a low probability of SDB based on the Berlin Questionnaire and a modified STOP-BANG questionnaire. In total, 505 adults had valid data based on 1 night of apnea screening using in-home detection equipment (ApneaLinkTM), 7 days of wrist actigraphy (ActiwatchTM) and a clinical examination for CVD risk factors.
Results: The mean age of the sample was 48 years, 54% were female and 11% (n=55) had AHI>15. Age (50.8 y [SE=1.1] vs. 47.7 [SE=0.4]), BMI (28.3 kg/m2 [SE=0.6] vs. 26.3 [SE=0.2]), waist circumference (96.2 cm [SE=1.7] vs. 87.4 [SE=0.6]) and the proportion of men (73% vs. 42%) was significantly ($p<0.05$) higher among those with AHI>15 vs. AHI<15. Hypertension, obesity and diabetes were also more common in participants with AHI>15 vs. <15, but not significantly so. A (higher proportion of women with AHI>15 were obese and had hypertension ($p<0.01$); there were no differences among men. Among men, Asian ethnicity was associated with more false negatives. There were no differences in measured sleep duration, self-reported daytime sleepiness and sleep quality.
Conclusion: Questionnaire screening for SDB in a population sample yielded more false negatives among men, older, and heavier participants. Misclassification may be attributed to the absence of differences in self-reported sleep duration or quality between groups.
Support (If Any): Support was provided by NIH 4 R01 HL092140-03.

0399

PREVALENCE AND EFFECTS OF BMI AND SLEEP POSITION ON SEVERITY OF OSA IN CHINESE AND NON-CHINESE PATIENTS

Ng R
Sleep Medicine, Woodbine Medical Centre, Markham, ON, Canada

Introduction: Obstructive sleep apnea (OSA) is a common sleep disorder affecting both men and women in all ethnicities. However, past and current studies are primarily based on Caucasian populations. Large scale prevalence studies with a more in-depth consideration of parameters affecting OSA in other ethnic groups such as Chinese are still lacking. As such, little is known regarding the major role that ethnicity plays in OSA, both as a risk factor in itself, as well as its influence on other risk factors. The main purpose of this study was to establish the prevalence and effects of sleep position and body mass index (BMI) on obstructive sleep apnea (OSA) severity in the Chinese and non-Chinese ethnicities.
Methods: A large scale, retrospective study analyzing key differences in AHI, and its relationship with BMI, and sleep position amongst Chinese (n=857) and non-Chinese (n=839) ethnic groups was performed. Subgroup analyses after matching for: (1) OSA severity and (2) body mass index and (3) gender and (4) sleep position was analyzed between the two groups.

Results: Chinese have much higher prevalence of OSA across all severity classes as compared to the non-Chinese counterpart ($\chi 2 = 51.2$, $p<.005$). Although increasing body weight is correlated positively with OSA severity in both ethnic groups, Chinese are much more sensitive to increasing BMI (linear regression, B=2.87 vs. B=1.89, $p<.01$). Obesity alone significantly and severely increases the risk and severity of OSA in Chinese patients to a much greater degree than non-Chinese with each successive BMI increase. The Chinese ethnic group was also shown to have a more severe degree of OSA in the supine ($\chi 2=91.51$, $p<.005$) and non-supine positions ($\chi 2=20.73$, $p<.005$). Although changing to non-spine position significantly lowered the severity of OSA in both ethnic groups, the improvement was much more pronounced in the Chinese group (AHI change of 21.7 vs. 14.5, $p<.005$).
Conclusion: The data from this study confirms that Chinese has higher prevalence of OSA compare to non-Chinese and obesity has a much more profound additive effect on OSA severity in this ethnic group. More stringent or modification of risk assessment criteria for OSA, such as the effect of BMI, in this ethnic group is likely indicated. Additionally, this study highlights the possibility of factors in addition to obesity (i.e. narrow upper airway anatomy) that could play a more dominant etiologic role in the pathogenesis of OSA in Chinese.

0400

CPAP TREATMENT OF OSA IMPROVES DAYTIME SLEEPINESS ON MSLT IN PARKINSON'S DISEASE

Ancoli-Israel S[1,2,3], Neikrug AB[1,2], Avanzino JA[1], Liu L[1], Faierman M[1], Carbungco A[1], Natarajan L[4], Loredo JS[3], Maglione JE[1], Corey-Bloom J[2,5]
[1]Department of Psychiatry, University of California San Diego, La Jolla, CA, USA, [2]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, , La Jolla, CA, USA, [3]Medicine, UCSD, La Jolla, CA, USA, [4]Preventive and Family Medicine, UCSD, La Jolla, CA, USA, [5]Neurosciences, UCSD, La Jolla, CA, USA

Introduction: OSA is a common sleep abnormality seen in patients with Parkinson's disease (PD). The consequences in PD include the same consequences seen in other OSA patients, including excessive daytime sleepiness (EDS). There has been controversy in the literature however as to whether the EDS seen in patients with PD and OSA is secondary to OSA or to PD medications. As part of a larger study, this analysis examined the effect of treating OSA on EDS in PD patients.
Methods: 76 PD patients (mean age=67.5y) were screened with PSG for OSA defined as AHI>10 followed by an MSLT (baseline; BL). Those meeting criteria were randomized to 3-weeks of either therapeutic CPAP (tCPAP; n=15; mean age=67.9y, 4 females) or sham CPAP (sCPAP; n=15; mean age=70.8y, 3 females). A second PSG with MSLT was repeated at 3-weeks (P1). After 3-weeks all patients received tCPAP for an additional 3-weeks and PSG with MSLT were repeated (P2). Overall treatment effects for the entire sample between baseline and P2 was assessed.
Results: There was no difference in MSLT sleep onset times between the two groups at BL ((mean±SE): tCPAP=8.8±1.06, sCPAP=10.6±1.19). Repeated measures analysis showed a significant phase-by-treatment interaction at P1 ($F=4.559$; $p=0.042$) suggesting significantly different change scores between treatment arms (mean change±SE): sCPAP: -1.64±0.93; tCPAP: 1.83±1.33 with the sCPAP being sleepier on each MSLT nap and the tCPAP group being less sleepy on all but one nap. There was an overall improvement for the entire sample at P2 from a mean of 9.04±0.56min at BL to 11.31±0.97min at P2 ($p=0.029$; i.e., when all were receiving tCPAP).
Conclusion: Some of the daytime sleepiness seen in patients with PD plus OSA may be secondary to the nighttime disruption and oxygen desaturation as treating OSA improves EDS in these patients.
Support (If Any): NIA AG08415, UL1RR031980 (CTRI), the UCSD Stein Institute for Research on Aging and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

0401

CARDIOVASCULAR REGULATION EFFECTS OF CPAP THERAPY IN OBSTRUCTIVE SLEEP APNEA DURING DAYTIME

Penzel T[1], Riedl M[2], Gapelyuk A[2], Schoebel C[1], Glos M[1], Garcia C[1], Fietze I[1], Kurths J[2], Wessel N[2]
[1]Sleep Medicine Center, Charite Universitätsmedizin Berlin, Berlin, Germany, [2]Department of Physics, Humboldt Universität, Berlin, Germany

Introduction: Obstructive sleep apnea can be the cause for changes in cardiovascular regulation during the night but also during daytime. Altered regulation may not be visible in absolute values but also in a changed coupling between the heart beat and the respiration. In a controlled randomized study we investigated effects of CPAP therapy on daytime cardiovascular regulation.
Methods: Twenty-eight patients with OSA in total, thereof 18 with arterial hypertension and 10 with normal blood pressure, were studied at baseline and at a follow up date with three months of CPAP. Ten age and sex matched healthy control subjects were investigated using the same protocol. All subjects underwent cardiorespiratory polysomnography. In addition we recorded 20 minutes quiet breathing at rest and a bicycle ergometry with ECG and blood pressure (Portapres). Cardiorespiratory coupling was investigated using symbolic coupling traces, a new developed technique which can reveal causality between signals.
Results: The stress test showed a significant reduction of the diastolic blood pressure at a work load of 50W and 100W ($p<0.05$ and $p<0.01$, respectively) and a decrease of the heart rate recovery time after the stress test ($p<0.05$).
Conclusion: The results indicate a reduction of vascular resistance and sympathetic activity during daytime. The coupling analysis of the resting periods by means of symbolic coupling traces approach indicated an effect of the CPAP therapy on the baroreflex reaction in hypertensive patients where influences of the systolic blood pressure on the heart rate changed from pathological patterns to adaptive mechanisms of the normotensive patients ($p<0.05$).
Support (If Any): Deutsche Forschungsgemeinschaft DFG project PE 628/4-1, BR 1303/10-1, KU-837/23-1.

0402

CARDIOMETABOLIC AND NEUROBEHAVIOURAL CHANGES AFTER CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) TREATMENT FOR OBSTRUCTIVE SLEEP APNEA (OSA)

Hoyos CM[1,2], Yee BJ[1,2,3], Phillips CL[1,2,4], Grunstein RR[1,2,3], Liu P[1,2,3]
[1]Woolcock Institute of Medical Research, Sydney, NSW, Australia, [2]University of Sydney, Sydney, NSW, Australia, [3]Royal Prince Alfred Hospital, Sydney, NSW, Australia, [4]Royal North Shore Hospital, Sydney, NSW, Australia

Introduction: Visceral abdominal fat (VAF), insulin resistance (IR) and OSA often co-exist. Whether CPAP can improve these metabolic parameters is unclear because there are no randomised sham-controlled trials investigating the effect on VAF, and the data on CPAP and IR are inconsistent. We assessed the effect of CPAP on important intermediate markers of cardio-metabolic health and neurobehavioural function in men with OSA without type II diabetes (DM).
Methods: Sixty-five CPAP-naïve men with moderate to severe OSA (age=49±12y, apnea hypopnea index (AHI)=39.9±17.7 events/h, body mass index=31.3±5.2 kg/m2, ESS=10±4.4) were randomised in a 12-week double blind sham-controlled parallel group study, to receive either active (n=34) or sham (n=31) CPAP, followed by 12-weeks of open-label therapeutic CPAP for all participants. The primary outcome was VAF change (CT scan) from baseline to week 12. Secondary outcomes were IR and disposition index (minimal model), liver fat, total fat and lean muscle (DEXA), arterial stiffness, objective and subjective

sleepiness (modified MWT and ESS) and driving ability (AusEd). Tertiary outcomes were changes from baseline to 24 weeks.
Results: CPAP, compared to placebo, significantly decreased AHI by 33 events/h (mean difference -33.0 events/h; 95%CI, -43.9 to -22.2, p<0.0001) There were no between group differences in the change in VAF (-13.0cm3; -42.4 to 16.2, p=0.37) or IR (-0.13 [min-1][μU/mL])-1; -0.40 to 0.14, p=0.33) after 12 weeks. Objective and subjective sleepiness improved in both groups (both p<0.05). The changes in all other secondary outcomes were not significantly different between groups. Adjustment for CPAP use, OSA severity, BMI or sleepiness did not alter findings. IR improved at week 24 (p=0.02), but not VAF.
Conclusion: Twelve weeks of therapeutic CPAP did not significantly improve VAF or IR in men with moderate to severe OSA without DM. Longer-term CPAP may improve IR.
Support (If Any): The National Health and Medical Research Council of Australia (NHMRC) through a project grant (512498). Sham machines were provided by Phillips Respironics.

0403

DEPRESSIVE SYMPTOMS IMPROVE IN PATIENTS WITH SLEEP APNEA WHO USE POSITIVE AIRWAY PRESSURE (PAP)

Bae C[1], Thompson N[2], Katzan I[1], Moul DE[1]
[1]Neurological Institute, Cleveland Clinic, Cleveland, OH, USA, [2]Quantitative Health Sciences, Cleveland Clinic, Cleveland, OH, USA

Introduction: Patients with obstructive sleep apnea (OSA) often have depressive symptoms. No large studies have been conducted in this patient population using the Patient Health Questionnaire 9 (PHQ-9) to measure change in depressive symptoms after using positive air pressure (PAP) therapy for OSA.
Methods: The main hypothesis was that adherent (>4 hours per night) PAP users will have a greater decrease in PHQ-9 scores compared to non-adherent PAP users. Inclusion criteria: at least 2 outpatient visits with a pre-PAP PHQ-9 score ≥ 5. A multiple regression model was examined with the following covariates : age, gender, race, marital status and total sleep time.
Results: 779 OSA patients seen at the Cleveland Clinic Sleep Disorders Center between 1/2008-7/2011 were included for analysis. The average age was 52.9±13 years, with 47.6% male, 77.5% Caucasian, and 61.8% married. There were 662 adherent PAP users (85%) and 117 non-adherent PAP users (15%). In the PAP adherent group, 479 patients (61.5%) had an Epworth Sleepiness Scale (ESS) score ≥ 10. Baseline PHQ-9 scores for adherent vs. non-adherent PAP users were 11.2±5.3 and 11.8±5.1, respectively. The PHQ-9 score decrease for adherent PAP users was 3.8±5.2 compared to 2.0±5.2 for non-adherent PAP users (p=0.0002). Within the PAP adherent group, baseline PHQ-9 scores for sleepy (ESS ≥ 10) versus non-sleepy patients were 12.1±5.3 and 9.9±4.7, respectively (p=0.0015). Among adherent PAP users, the PHQ-9 score decrease for sleepy patients was 4.3±5.4 compared to 3.1±4.0 for non-sleepy patients (p=0.0041).
Conclusion: All OSA patients who used PAP showed a significant decrease in depressive symptoms as measured by PHQ-9 scores. Adherent PAP users had greater PHQ-9 score decreases compared to non-adherent PAP users. The sleepy PAP-adherent group showed the biggest improvement, but even the non-adherent PAP group also had improved PHQ-9 scores.

0404

SUBJECTIVE SLEEP DURATION AND SLEEP LATENCY PREDICT CPAP ADHERENCE AND PARTIALLY EXPLAIN RACIAL DISPARITIES IN CPAP USE

Billings ME[1], Rosen CL[2,3], Auckley D[2], Benca R[4], Foldvary-Schaefer N[2,3], Iber C[5], Zee P[6], Redline S[7], Kapur VK[1]
[1]Pulmonary Medicine, University of Washington, Seattle, WA, USA, [2]Case Western Reserve, Cleveland, OH, USA, [3]Cleveland Clinic, Cleveland, OH, USA, [4]Psychiatry, University of Wisconsin, Madison, WI, USA, [5]University of Minnesota, Minneapolis, MN, USA, [6]Northwestern University, Chicago, IL, USA, [7]Harvard Medical School, Boston, MA, USA

Introduction: Prolonged sleep latency, short sleep duration, and frequent difficulty falling asleep may decrease CPAP adherence as these factors decrease sleep opportunity and may worsen tolerability of CPAP. Blacks are reported to have lower CPAP adherence than Whites. We prospectively evaluated whether self-reported sleep measures predicted CPAP adherence. Further, we explored whether racial differences in self-reported sleep habits contribute to observed racial disparities in CPAP adherence.
Methods: We performed a secondary analysis of data from the HomePAP study, a randomized trial of home vs. lab based diagnosis and treatment of OSA. Subjects (n=191) had moderate OSA (AHI≥15) and sleepiness (ESS≥12). We used multivariate regression to assess if baseline subjective sleep measures and symptoms predicted CPAP use at 3 months. In addition we explored whether these factors mediated the association of race with CPAP adherence.
Results: Baseline sleep latency and duration were associated with 3-month CPAP adherence. In analyses adjusting for AHI and study-arm, subjects reporting > 30 minute sleep latency (SL) used CPAP for 70 minutes less than subjects with shorter SL. Each additional hour of sleep duration (SD) predicted 30 minutes greater CPAP use with the same adjustments. Difficulty falling asleep was not associated with CPAP adherence. Blacks reported longer SL and shorter SD at baseline than Whites but did not report more frequent trouble falling asleep. Adjusting for SL and SD at baseline reduced the magnitude of the association of CPAP with black race.
Conclusion: Among subjects with moderate to severe OSA and sleepiness, self-reported prolonged SL and shorter SD at baseline were associated with worse CPAP adherence at 3 months. Prolonged SL and shorter SD are more frequently reported by Blacks and these differences partially explain the racial disparity in CPAP adherence. SL and SD should be considered when evaluating patients with poor CPAP adherence. Future research is needed to assess the role of SL/SD interventions to improve CPAP adherence, especially in groups such as racial minorities who have a high prevalence of short sleep.
Support (If Any): American Sleep Medicine Foundation 38-PM-07 Grant: Portable Monitoring for the Diagnosis and Management of OSA.

0405

THE IMPACT OF CPAP FOR ONE NIGHT ON OBJECTIVE AND SUBJECTIVE NEUROCOGNITIVE FUNCTION IN SLEEP APNEA

Guo M[1,2,3], Carusona A[1,3], Matteis P[1,2,3], Stickgold R[2,3], Malhotra A[1,3], Djonlagic I[1,2,3]
[1]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Center for Sleep and Cognition, Beth Israel Deaconess Medical Center, Boston, MA, USA, [3]Harvard Medical School, Boston, MA, USA

Introduction: Cognitive deficits are commonly recognized in obstructive sleep apnea (OSA). Currently, the gold standard for treatment is CPAP therapy. This study examined the effect of CPAP therapy for one night on memory consolidation, attention and vigilance and subjective experience.

Methods: 62 participants (19-58 years; mean=37.6) completed the Psychomotor Vigilance Test (PVT) and motor sequence learning task (MST) in the evening and the morning after overnight polysomnography. Participants also completed subjective evaluations of sleep quality. Results were compared between healthy sleepers (n=15; AHI=3.7±0.3/h) and OSA participants who received CPAP all night (n=10; AHI=4.4±1.1/h), part of the night (n=14; all-night-AHI=26±4.6/h), and no treatment (n=23; AHI=22.3±3.1/h). OSA was defined by an AHI≥10.
Results: Independent of how much CPAP therapy they received, all OSA participants showed significantly less percent overnight improvement on the MST compared to healthy sleepers (OSA 10.9%±1.6%, Controls 24%±5.3%; p=0.0065 [ANOVA]). Within the OSA group, only those participants who received a full night on CPAP exhibited faster reaction times on the PVT in the morning (p=0.04). Compared to untreated OSA patients, full night CPAP participants also felt subjectively more rested (66.7% vs. 18.2%, p=0.009) and reported better sleep (44.4% vs. 18.2%; p=n.s.).
Conclusion: Our results demonstrated an immediate improvement in vigilance and subjective experience after one night of CPAP, but showed no effect on sleep-dependent motor memory consolidation. This dissociation points to different underlying brain structures for these processes, some of which might require continued adherence to CPAP for improvements. Thus, the immediate cognitive benefit of CPAP may be over-stated.
Support (If Any): NIH-NHLBI National Heart, Lung, and Blood Institute - K23 HL103850-01 American Sleep Medicine Foundation - #54-JF-10.

0406

USE OF THE PAP-NAP PROCEDURE IN CPAP RESISTANT PATIENTS TO IMPROVE OUTCOME OF CPAP THERAPY

Simmons JH[1,2,3], Monova P[1,2], Weir S[1]
[1]Comprehensive Sleep Medicine Associates, Houston, TX, USA, [2]Sadler Clinic Sleep Disorders Ceneter, The Woodlands, TX, USA, [3]Sleep Education Consortium, Houston, TX, USA

Introduction: Outcome studies of CPAP compliance have historically demonstrated success rates as low as 50%. Improved methods of CPAP adaptation have been utilized, but tabulation of outcome is limited. A procedure known as the PAP-NAP has been relatively recently implemented in some sleep centers, consisting of a daytime session up to two hours with a technologist / therapist working one on one with the patient, addressing their specific needs to enhance CPAP comfort and tolerability. This study was to retrospectively assess if the PAP-NAP improved CPAP success.
Methods: We retrospectively reviewed 76 consecutive cases in which PAP-NAPs were performed and conducted assessment to determine the frequency of the following parameters: success rate of tolerating CPAP by the end of the PAP-NAP procedure, the degree of compliance at the time we of follow up assessments, the time interval from the PAP-NAP procedure and the follow up assessment for this study. We defined Adequate-CPAP compliance as utilizing CPAP greater than 4 hours per night on eighty percent of nights. Instances in which patients were still actively attempting to utilize CPAP nightly, but unsuccessfully achieving the Adequate-CPAP compliance criteria were tabulated as Partial-CPAP compliance. All other patients who did not utilize CPAP were tabulated as CPAP-Failures.
Results: Of the 76 patients who underwent PAP-NAPs in our sleep centers, of which 35 were males and 41 females, with an average age of 56 years (9-88). 95 % of the patients were able to tolerated CPAP by the end of the PAP-NAP session. Follow assessments occurred at 18.5 weeks (range of 2 to 84 weeks with a median of 13 weeks). Adequate-CPAP compliance was present in 29 patients (38 %), Partial-CPAP compliance was present in 26 patients (34 %), and CPAP-Failure was present in 21 patients (28%).
Conclusion: Although 95% of patients successfully adapted to CPAP during the PAP-NAP procedure, the rate dropped significantly over the first few weeks. Nonetheless, our results demonstrated that the PAP-NAP was able to salvage 38% of patient reluctant to proceed with therapy, demonstrating Adequate-CPAP compliance more than 4 months later. We anticipate that over longer follow-up intervals some of our Partial-CPAP compliance group may improve to meet Adequate-CPAP compliance levels. With CPAP historically having a low long term compliance rate, utilization of the PAP-NAP procedure is clearly necessary and beneficial to improve overall CPAP success.

0407

CORRELATION BETWEEN CRANIOFACIAL CHARACTERISTICS AND PRESSURE TITRATION OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) IN PATIENTS WITH OF OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS)

Cunha TC, Dal-Fabbro C, Haddad FM, Tufik S, Bittencourt L
Psychobiology, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: The influence of craniofacial characteristics on the pressure of CPAP titration in patients with OSAS has not been sufficiently discussed in the literature. The aim of this study was to evaluate this issue.
Methods: 40 men (42.8 ± 14.7 years old, BMI: 26.4 ± 3.8 kg/m2 and AHI: 16.1 ± 7.4) with mild-moderate OSA underwent cephalometric, ENT assessment and polysomnography for CPAP tritation. Cephalometric variables analyzed were: SNA, SNB, ANB, SN-GoMe, FMA, S-Go, ANS-Me, the anterior cranial base, maxillary and mandibular length, upper and middle pharyngeal space, trailing space mid palate, soft palate length , PES, LAS and distances vértedra third-hyoid, mandibular plane-hyoid, hyoid-mental and atlas-jaw. ENT changes were named: 1) Craniofacial (one of three changes: high-arched palate, retrognathia or occlusion in Class II facial profile) 2) Pharyngeal (3 of the following: web soft palate, thick or a posterior pillars gutters, long or thick uvula , tonsils grade III or IV), 3) Nose: (1 of the following: septal deviation grade II or III, septal deviation + grade I complained of nasal obstruction or rhinitis frequent or hypertrophy of the inferior turbinate + complaining of nasal obstruction or rhinitis often), and 4) Mallampati class III and IV. Linear regression was done.
Results: The higher maxillary length (p=0,0020), the higher upper pharyngeal space (p=0,002), the higher hyoid-mental distance (p=0,031), the lower mandibular length (p=0,029), the lower midlle pharyngeal space (p=0,005) and the lower mandibular plane-hyoid distance (p=0,007) correlated with a higher CPAP pressure. Correlation between CPAP pressure and pharyngeal changes was also observed (p = 0.021).
Conclusion: Correlation was observed between CPAP pressure and cephalometric and ENTcharacteristics.
Support (If Any): FAPESP, CEPID, AFIP and CNPq.

0408

LONG-TERM OBJECTIVE COMPLIANCE MEASUREMENT DURING ORAL APPLIANCE THERAPY IN PATIENTS WITH SLEEP-DISORDERED BREATHING: 1 YEAR FOLLOW-UP

Dieltjens M[1,2,5], Braem MJ[1,5], Vroegop AV[2,5], Wouters K[3], De Backer WA[4,5], Van de Heyning PH[2,5], Vanderveken OM[2,5]
[1]Special Care Dentistry, Antwerp University Hospital, Edegem, Belgium, [2]ENT Department and Head and Neck Surgery, Antwerp University Hosptial, Edegem, Belgium, [3]Department of Scientific Coordination and Biostatistics, Antwerp University Hosptial, Edegem, Belgium, [4]Pulmonary Medicine, Antwerp University Hosptial, Edegem, Belgium, [5]Faculty of medicine and health sciences, University of Antwerp, Wilrijk, Belgium

Introduction: Oral appliances (OA) are a non-invasive treatment for sleep-disordered breathing (SDB). Adequate follow-up of OA therapy

can only be achieved through objective compliance measurements. This is the first report on the long-term results of objective compliance measurement during OA therapy.
Methods: In 20 patients with a polysomnographic established diagnosis of SDB (AHI: 16 ± 10/h; age: 50 ± 10 y; men/women: 9/11), compliance was objectively measured during OA therapy using a microsensor thermometer (TheraMon®, Handelsagentur Gschladt, Austria). Measurement of OA use was based on the assumption that the OA has been used when a temperature > 35 °C was recorded, expressed as the 'Mean Daily Use' (MDU). The microsensor recorded at a sampling rate of 1 measurement/15 minutes, allowing data acquisition for a consecutive 100 day period. The data were read out at 1, 3 and 12 month after start of study. Patients with a MDU of ≥ 4 hours/night on 70% of days monitored were considered as 'regular users'. Data are presented as median (quartiles Q1;Q3).
Results: The objective MDU was 7.24 (6.03; 8.00) h/night at 1 month. No statistical difference was found at 3 month follow-up: MDU was 6.95 (5.79; 7.66) h/night. One year after OA therapy initiation, one patient discontinued treatment. In the 19 other patients, the MDU after 1 year was 6.50 (4.80; 7.74) h/night and was statistically lower than the MDU at1 month follow up (p=0.006), but not different from 3 month follow up. At 1 year follow-up, 79% could be considered 'regular user'.
Conclusion: In this study, 79% of patients are 'regular users' at 1 year follow up with a MDU of 6.50 h/night. This is relatively high compared with CPAP where literature indicates that 58 to 78% of the patients are 'regular users' at 1 year follow up.

0409

ADHERENCE AND EFFECTIVENESS OF POSITIONAL THERAPY FOR OBSTRUCTIVE SLEEP APNEA SYNDROME

Fridel KW[1,4,2], Mosti C[2], Lennon T[3], Bootzin RR[4]
[1]Behavioral sleep Medicine, Center for Sleep Medicine, Grayslake, IL, USA, [2]Department of Psychology, University of Florida, Gainesville, FL, USA, [3]Clinical Sleep, Comprehensive Sleep Solutions, Tucson, AZ, USA, [4]Department of Psychology, University of Arizona, Tucson, AZ, USA

Introduction: The purpose of this investigation was to explore how adherence to a positional therapy intervention affected therapeutic outcome in participants with positional-related obstructive sleep apnea syndrome.
Methods: Eighteen adult participants identified as having positional-related obstructive sleep apnea by an initial overnight polysomnography study were recruited. Participants were instructed to use a "tennis ball technique" positional device for three weeks at home and record their sleep habits and adherence before a final post-treatment polysomnography evaluation.
Results: A repeated measures MANOVA found significant effects of treatment between pre- and post-test on the objective polysomnography variables of Total Recording Time [$F(1,17) = 5.21$, $p<.05$, $\eta2=.24$], Total Sleep Time [$F(1,17) = 8.59$, $p<.01$, $\eta2=.34$], Sleep Efficiency [$F(1,17) = 5.42$, $p<.05$, $\eta2=.24$], Total REM sleep time [$F(1,17) = 9.91$, $p<.01$, $\eta2=.37$], and the Apnea-Hypopnea Index [$F(1,17) = 14.28$, $p<.001$, $\eta2=.46$]. Sleep onset latency was not statistically significant. There were significant effects of treatment on the subjective measures of the Functional Outcome of Sleep Quality [$F(1,17) = 8.92$, $p<.01$, $\eta2=.35$], Pittsburgh Sleep Quality Index [$F(1,17) = 11.2$, $p<.01$, $\eta2=.39$], Epworth Sleepiness Scale [$F(1,17) = 6.69$, $p<.05$, $\eta2=.28$], and the Brief Symptom Inventory [$F(1,17) = 5.14$, $p<.05$, $\eta2=.23$]. In summary, the results of this study indicated that the positional device was efficacious for significantly improving both objective polysomnography variables and subjective variables of sleep and daytime functioning. Even partially adherent participants reported significant improvements in nighttime sleep quality and quality of life. Mixed Linear Modeling demonstrated that significant improvements in sleep quality, time to sleep onset, and total sleep time were not seen until the last weeks of treatment.
Conclusion: This study found very acceptable adherence rates with this positional device design; all participants were able to utilize the therapeutic device on at least a portion of every night during the three-week intervention.

0410

LONG-TERM RESPONSE OF UPPER AIRWAY STIMULATION IN OBSTRUCTIVE SLEEP APNEA

Badr M[1], Strohl KP[2], Oliven A[3], Maurer JT[4], Woodson B[5], de Vries N[6], Knaack L[7], Verbraecken J[8], De Backer WA[8]
[1]Pulmonary, Allergy, Critical Care and Sleep Medicine, Wayne State University, Detroit, MI, USA, [2]Pulmonary, Critical Care and Sleep Medicine, Case Western Reserve University, Cleveland, OH, USA, [3]Department of Medicine B, Technion - Israel Institute of Technology, Haifa, Israel, [4]Department of Otorhinolaryngology, Sleep Disorders Center, University Medicine Mannheim, Mannheim, Germany, [5]Department of Otolaryngology and Communication Sciences, Medical College of Wisconsin, Milwaukee, WI, USA, [6]Department of Otorhinolaryngology, Head and Neck Surgery, Sint Lucas Andreas Hospital, Amsterdam, Netherlands, [7]Somnolab, Somnolab - Dortmund Sleep Disorders Clinic and Research Center, Dortmund, Germany, [8]Department of Respiratory Medicine, Antwerp University Hospital, Antwerp, Belgium

Introduction: Previous studies identified patient selection criteria for therapy success in Upper Airway Stimulation (Inspire Medical Systems, USA) for treatment of moderate-to-severe OSA in patients intolerant to continuous positive airway pressure. The current study reported therapy response at 12-months post-implant in subjects who met selection criteria.
Methods: Among 34 implanted subjects, 18 met selection criteria and 16 did not. AHI (Level 1 monitoring) were measured at 12 months. All patients were monitored for device-related adverse events and patients met selection criteria were examined for therapy response during overnight PSG.
Results: There were no device malfunctions or un-anticipated device-related adverse events from 6-12 months. Among patients who met selection criteria and for which data are available, the AHI reduced significantly from 33.9±6.2 at baseline to 17.0±18.5 ($p<0.01$) at 6-month, and 11.0±10.8 ($p<0.01$) at 12-month. Quality of Life measures were also improved in these subjects from baseline to 6-month, 10.7 ± 5.4 to 7.5 ± 4.1 ($p=0.03$) for ESS, and 88.8 ± 22.1 to 104.6 ± 13.7 ($p=0.01$) for FOSQ. AHI for patients did not meet selection criteria remained unchanged from baseline of 50.4±17.4 to 51.3±27.6 at 6-month and 46.2±25.6 at 12-month.
Conclusion: The current study has demonstrated that Upper Airway Stimulation to treat OSA has a sustained therapy efficacy at 12-month post-implant in a selected group of moderate-to-severe OSA subjects.
Support (If Any): Inspire Medical Systems, Inc.

0411

LONG-TERM EFFECTIVENESS OF HYPOGLOSSAL NERVE STIMULATION FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

Kezirian EJ[1], Eastwood PR[2], Hillman DR[2], Malhotra A[3], Wheatley JR[4], Iber C[5], Huntley T[6], Zammit G[7], Catcheside P[8], Barnes M[9]
[1]University of California, San Francisco, San Francisco, CA, USA, [2]Sir Charles Gairdner Hospital, Perth, WA, Australia, [3]Brigham and Women's Hospital, Boston, MA, USA, [4]Westmead Hospital, Sydney, NSW, Australia, [5]University of Minnesota, Minneapolis, MN, USA, [6]Center for Ear, Nose & Throat & Allergy, Carmel, IN, USA, [7]Clinilabs, New York, NY, USA, [8]Adelaide Institute for Sleep Health, Adelaide, SA, Australia, [9]Austin Hospital, Melbourne, VIC, Australia

Introduction: This study examined the safety and effectiveness at twelve months of a novel hypoglossal nerve stimulation (HGNS® ; Ap-

nex Medical, Inc.) system for the treatment of obstructive sleep apnea (OSA) in patients who do not tolerate CPAP therapy.

Methods: Thirty-two subjects (66% male, mean age 52.8±9.6) with moderate to severe OSA and unable to tolerate positive airway pressure participated. Each subject underwent surgical implantation of the HGNS system, which unilaterally stimulates the hypoglossal nerve with synchronous inspiration during sleep. Stimulation is timed to coincide with respiratory inspiration using a sensor that detects changes in thoracic impedance. Apnea-hypopnea index (AHI) was measured during in-laboratory polysomnography (PSG) to assess OSA severity at baseline and on stimulation at 6 and 12 months post-implant. Symptomatic response was assessed using Epworth Sleepiness Scale (ESS) and the Functional Outcomes of Sleep Questionnaire (FOSQ). Nightly use was defined as mean hours of use over all patient-nights.

Results: HGNS was used a mean of 5.0±1.8 hours/night of use. With HGNS therapy, there was a significant ($p<0.001$) AHI improvement from baseline (44.7±17.7/h; mean±SD) to 21.3±18.0/h and 20.8±16.3/h at 6 and 12 months, respectively. Subjects reported significant ($p<0.001$) improvement in symptoms as assessed by ESS (12.0±4.6 at baseline to 8.5±3.8 and 7.5±3.7, at 6 and 12 months, respectively), and FOSQ (14.3±2.0 at baseline to 16.6±2.4 and 17.4±2.0, at 6 and 12 months, respectively). Subjects with a BMI ≤35 kg/m^2. were more likely to have an improvement in AHI (50% or greater reduction in AHI) when compared to higher BMI subjects - 80% and 75% of lower BMI subjects compared to 22% and 33% of higher BMI subjects at 6 and 12 months, respectively.

Conclusion: HGNS therapy demonstrated a favorable efficacy profile in terms of lower AHI scores and improved patient symptoms, with a sustained patient response through 12 months of follow up. Subjects with BMI ≤35 kg/m^2 had a significantly better response to HGNS therapy than more obese participants, suggesting that less obese subjects have more favorable response characteristics. Use/adherence to HGNS therapy was high. A randomized, controlled trial is now underway to evaluate the HGNS system in subjects with BMI≤35 kg/m^2.

Support (If Any): Apnex Medical, Inc.

0412

VENTILATORY VARIATIONS IN REM AND NREM STATES IN SLEEP INDUCED ALVEOLAR HYPOVENTILATION

Turner J[1], Bogan R[1,2]

[1]SleepMed, Columbia, SC, USA, [2]School of Medicine, University of South Carolina, Columbia, SC, USA

Introduction: Previous database review of 36444 subjects presenting to SleepMed at multiple sites across the United States identified a group with low RDI but prolonged sleep hypoxemia. Other research studies have documented reductions in ventilatory response to hypoxemia that are profound during rapid eye movement (REM) sleep but more modest in non-REM (NREM) sleep. The purpose of this study is to assess the distribution of respiratory and hypoxic events in both REM and Non-REM(NREM) sleep states in subjects with sleep induced hypoventilation (SHV).

Methods: Records of subjects identified with SHV presenting to SleepMed of SC from 2009-2011 for evaluation of a sleep complaint, were reviewed to assess differences in REM/NREM AHI. Subjects were identified from database analysis and selected for RDI<10 but substantial nocturnal hypoxemia with low oxygen desaturation index (ODI). ODI was measured at equal to or greater than the 4% change during TST as well as saturation index time less than 90%. ESS scores were collected as a measure of daytime sleepiness.

Results: 50 subject records were identified with SHV with 43 (50) achieving a minimum of 15 minutes of REM sleep. Means and standard deviations for the 43 patients were: 32 females and 11 males: age= 59 years (13) range 26-81 years; BMI 32 (9); ESS 8 (6); RDI 6.7 (2); low O2= 82 (4); SAO2<90%= 72 min (95); ODI 5 (2). Sleep parameters results includes: AHI= 5 (2); TST 349 min (61); REM (min) = 54 (33); REM AHI= 18 (14); REM AI =7(8); NREM (min) = 294 (64); NREM AHI= 3 (3); NREM AI= 1 (1). 22/43 subjects (51%) reported a history of tobacco usage. T-tests comparing REM AHI to NREM AHI $p<0.0001$.

Conclusion: The majority of oxygen desaturation continues to be a REM phenomenon. The variables of partial upper airway obstruction, changes in CO2 responsiveness during REM sleep and the effects of BMI and weight distribution support worsening during REM sleep. However, the desaturation is not entirely explained on the basis of a REM related phenomenon. There was a female predominance in our population identified with SHV. As a group daytime sleepiness was not present as measured by the ESS.

0413

VARIATION IN OBSERVER AGREEMENT IN DRUG-INDUCED SLEEP ENDOSCOPY

Vroegop AV[1,2], Vanderveken OM[1,2], Wouters K[3], Hamans E[1,2], Hohenhorst W[4], Kezirian EJ[5], Kotecha B[6], de Vries N[7], Braem MJ[8,2], Van de Heyning PH[1,2]

[1]ENT, Head and Neck Surgery, Antwerp University Hospital, Edegem, Belgium, [2]Faculty of Medicine and Health Sciences, Antwerp University, Antwerp, Belgium, [3]Department of Scientific Coordination and Biostatistics, Antwerp University Hospital, Edegem, Belgium, [4]ENT, Facial Plastic and Interventional Sleep Medicine, St. Antonius Clinic, Wuppertal, Germany, [5]Otolaryngology--Head and Neck Surgery, University of California, San Francisco, San Francisco, CA, USA, [6]ENT, Head and Neck Surgery, The Royal National Throat, Nose and Ear Hospital, London, United Kingdom, [7]ENT, Head and Neck Surgery, St. Lucas Andreas Hospital, Amsterdam, Netherlands, [8]Special Care Dentistry, Antwerp University Hospital, Edegem, Belgium

Introduction: During drug-induced sleep endoscopy (DISE), the upper airway (UA) is visualized using a flexible nasopharyngoscope under sedation, providing evaluation of the localization of flutter and collapse in patients with sleep disordered breathing. The aim of this study was to determine inter-observer agreement in a cohort of ENT surgeons.

Methods: In this prospective study, 77 ENT surgeons observed 6 different DISE videos and were asked to score the level (palate, oropharynx, tongue base, hypopharynx, epiglottis), direction (anteroposterior, concentric, lateral) and degree of collapse (none, partial or complete collapse). Additionally, these videos were assessed by 7 observers experienced with DISE. Findings were collected and analyzed, determining Fleiss kappa (κ) and overall observer agreement (OA) per UA level.

Results: In the complete cohort, there was a high agreement on palatal and on epiglottis collapse (OA=0.9403; κ=0.5540 and OA=0.7125; κ=0.4710, respectively). Agreement on presence or absence of oropharynx and tongue base collapse was lower (OA=0.6697; κ=0.2240 and OA=0.7394; κ=0.3372, respectively). Agreement on presence or absence of collapse was lowest for hypopharyngeal collapse (OA=0.5098; κ=0.1786). Amongst the experienced observers, there was greater agreement on the oropharynx as well as the tongue base (OA=0.8133; κ=0.6207 and OA=0.9259; κ=0.751, respectively).

Conclusion: DISE can assess UA collapse patterns when alternatives to CPAP are considered. Standardization and optimization will enhance the role of DISE in therapeutic decision-making. This study indicates that inter-observer agreement was higher in experienced versus non-experienced ENT surgeons, suggesting that training may be beneficial for those new to this evaluation technique.

0414

AUTOMATED ANALYSIS OF PLETHYSMOGRAPHIC AND SATURATION SIGNALS FROM SIMPLE OXIMETRY IN THE DIAGNOSIS OF SLEEP DISORDERED BREATHING

Barak-Shinar D[1], Amos Y[1], Bogan RK[2]
[1]WideMed Ltd., Herzliya, Israel, [2]SleepMed Inc., Columbia, SC, USA

Introduction: Sleep Apnea and Apnea Hypopnea Index (AHI) are usually measured in sleep laboratories using a high number of electrodes connected to the patient body. In this study, we examined the use of a standarad pulse oximeter system with an automated analysis based on the photoplethysmograph(PPG) signal for the diagnosis of sleep disordered breathing. Using a standard and simple device might provide a convenient screening and potentially a diagnostic solution for patient evaluation at home or in an ambulatory setting.
Methods: The study included 135 patients that were referred routinely to sleep laboratory [SleepMed Inc.] for the diagnosis of sleep disordered breathing. Each patient underwent an overnight PSG study according to AASM guidelines in the sleep laboratry. The Apnea Hypopnea Index (AHI) obtained from the PPG analysis is compared to the AHI obained from the manual scoring of gold standarad full Polysomnography (PSG). The automatic analysis is based on photoplethysmographic and saturation signals only. Those two signals were recorded for the entire night as part of the full overnight PSG sleep study.
Results: The AHI and respiratory events measured by the pulse oximeter analysis are correlated very well with the corresponding results obtained by the gold standarad full PSG. The sensitivity and specificity of AHI 15 cutoff-level measurement by the analysis are both above 90%. The sensitivity and specificity for the detection of respiratory event are both above 85%.
Conclusion: The tested system in this study yielded an acceptable results of sleep disorded breathing compared to the gold standard PSG. Accordingly, and given the convenience and simplicity of the standarad pulse oximeter device , the new system can be considered suitable for home and ambulatory screening and potential diagnosis of sleep disordered breathing patients.

0415

THE EVALUATION OF DRUG-INDUCED SLEEP ENDOSCOPY AS A PATIENT SELECTION TOOL FOR IMPLANTED UPPER AIRWAY STIMULATION FOR OBSTRUCTIVE SLEEP APNEA

Vanderveken OM[1,2], Maurer JT[3], Hohenhorst W[4], Hamans E[1,2], Lin H[5], Vroegop AV[1,2], Anders CF[3], de Vries N[6], Van de Heyning PH[1,2]
[1]Department of ENT, Head and Neck Surgery, Antwerp University Hospital, Edegem, Belgium, [2]Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium, [3]Department of Otorhinolaryngology, Head & Neck Surgery, Sleep Disorders Center, University Hospital Mannheim, Mannheim, Germany, [4]ENT Department, Facial Plastic and Interventional Sleep Medicine, Kliniken St. Antonius, Wuppertal, Germany, [5]Department of Otolaryngology-Head and Neck Surgery, Wayne State University School of Medicine, Detroit, MI, USA, [6]Department of ENT, Head and Neck Surgery, Sint Lucas Andreas Hospital, Amsterdam, Netherlands

Introduction: To study the predictive value of drug-induced sleep endoscopy (DISE) in assessing therapeutic response to implanted upper airway stimulation (UAS) for obstructive sleep apnea (OSA).
Methods: During DISE artificial sleep is induced by midazolam and propofol or propofol only, and the pharyngeal collapse patterns are visualized using a flexible fiberoptic nasopharyngoscope. The level (palate, oropharynx, tongue base, hypopharynx, epiglottis), the direction (anteroposterior, concentric, lateral) and the type of collapse (no, partial or complete collapse) were scored in a standard fashion.
Results: We report on the correlation between DISE results and therapy response in 19 OSA patients (apnea/hypopnea-index (AHI) 36.7 ± 10.9 /h; body mass index (BMI) 28.4 ± 2.0 kg/m^2, age 53 ± 11 y, 18 male/1 female) that underwent a DISE procedure before UAS device implantation (Inspire II, Inspire Medical system, Minneapolis, USA). In the evaluation of a first group of seven OSA patients a significantly better outcome with UAS was discovered in the 3 patients without palatal complete circular collapse (CCC) that were all responders at the 6-month visit, with an AHI reduction from baseline 24.9 ± 5.6 to 5.8 ± 4.8/h with UAS. No predictive value was found according to the other DISE collapse patterns. In a second group of 12 OSA patients we prospectively excluded patients with palatal CCC before UAS implantation. In this group a significant decrease was noted in AHI from 38.7 ± 9.0 at baseline to 16.7 ± 18.8 /h with UAS ($p < 0.001$).
Conclusion: The absence of palatal CCC during DISE may predict therapeutic success with implanted UAS therapy. DISE can be recommended as a patient selection tool for implanted upper airway stimulation for obstructive sleep apnea.
Support (If Any): This study is sponsored by Inspire Medical Systems, Inc.

0416

PERFORMANCE CHARACTERISTICS OF TWO QUESTIONNAIRES IN DETERMINING HIGH PRE-TEST PROBABILITY FOR OBSTRUCTIVE SLEEP APNEA

Luyster F[1], Firat H[2], Yüceege M[2], Sever O[2], Demir A[3], Ardic S[2], Terhorst L[1], Strollo PJ[4]
[1]School of Nursing, University of Pittsburgh, Pittsburgh, PA, USA, [2]Pulmonary Division, Diskapi Yildirim Beyazit Training and Research Hospital, Ankara, Turkey, [3]Pulmonary Division, School of Medicine, Hacettepe University, Ankara, Turkey, [4]Division of Pulmonary, Allergy, and Critical Care Medicine, Department of Medicine, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: There is currently no consensus regarding a standard instrument to identify high pre-test probability for OSA in sleep clinic populations. The aim of this study was to determine the performance characteristics of a new, easily deployed questionnaire, the OSA50, compared to the Berlin Questionnaire (BQ) in a sleep clinic.
Methods: Data were collected on 285 consecutive participants (191 males, 94 females) referred to a sleep clinic for suspected OSA. A high risk for OSA was calculated for the BQ and the OSA50 using previously published scoring algorithms. All participants underwent attended in-lab polysomnography. Sensitivity, specificity, positive and negative predictive values of the BQ and OSA50 were calculated for the whole sample, as well as for males and females and those with and without co-morbidities, using an AHI of ≥ 5, ≥ 15, and ≥ 30 as cutoffs. Logistic regression models and receiver operating characteristic (ROC) curves were used to assess the predictive accuracy of the BQ and the OSA50.
Results: The OSA50 identified 252 patients (88%) as being at high-risk of having OSA. Similarly, 234 (82%) were in an OSA high-risk group according to the BQ. The OSA50 performed with sensitivities of 93%, 98%, and 99% and specificities of 36%, 26%, and 17% at AHI cutoffs of ≥ 5, ≥ 15, and ≥ 30, respectively. The BQ resulted in similar sensitivities and specificities at the above AHI cutoffs. Both the OSA50 and BQ were able to detect high risk of OSA in females and those with co-morbidities.
Conclusion: The OSA50 is a convenient instrument for identifying high risk of OSA in patients referred to a sleep clinic. It has sensitivity and specificity that is comparable to the BQ. The use of the OSA50 to identify high risk patients may augment decision making for home cardiopulmonary sleep testing.

0417

UTILITY OF THE BERLIN QUESTIONNAIRE IN IDENTIFYING OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITH TYPE 2 DIABETES

Aurora R[1], Shaw J[2], Fulcher G[3], Naughton M[4], Cistulli P[3], Bergenstal RM[5], Zimmet P[2], Punjabi NM[1]
[1]Pulmonary and Critical Care Medicine, Johns Hopkins School of Medicine, Baltimore, MD, USA, [2]Baker IDI, Heart and Diabetes Institute, Melbourne, VIC, Australia, [3]Respiratory Medicine, Royal North Shore Hospital, Sydney, NSW, Australia, [4]Respiratory Medicine, Alfred Hospital and Monash University, Melbourne, VIC, Australia, [5]International Diabetes Center, Park Nicollet, Minneapolis, MN, USA

Introduction: Obstructive sleep apnea (OSA) is common in patients with type 2 diabetes mellitus (T2DM). Given that OSA may alter glycemic control, simple validated methods are needed for OSA case-identification in these patients. Using baseline data from an ongoing international, multi-center study, the current analysis examined the utility of the Berlin questionnaire for identifying OSA in T2DM patients.
Methods: The analyses are based on the GlyCOSA study, a multicenter study evaluating the effects of positive airway pressure for OSA in non-insulin treated patients with T2DM. Patients without a previous diagnosis of OSA completed the Berlin and Epworth Sleepiness Scale (ESS) questionnaires. The ApneaLinkTM(ResMed) was used to diagnose OSA. To determine whether data from the Berlin and ESS data were associated with OSA in T2DM patients, logistic regression models were used.
Results: There were 1,106 participants with complete data on the Berlin questionnaire and ApneaLink-derived oxygen desaturation index (ODI). The sample was predominantly male (63.7%) with a mean age of 60.9 years and BMI of 31.7 kg/m2. The median ODI was 10.0 events/hr (interquartile range: 5.0-19.0 events/hr). OSA prevalence using an ODI threshold of >5, >10, and >15 was 76.8%, 52.7%, and 36.1%, respectively. A high risk Berlin score was noted in 76.4% of the sample. After adjusting for age, sex, and ethnicity, a high risk Berlin score was associated with OSA. The adjusted odds ratios for an ODI of >5, >10, and >15 were 2.24 (95%CI: 1.64-3.06), 2.23 (95%CI: 1.67-2.98), and 2.13 (95%CI: 1.55-2.93). The sensitivities of a higher risk Berlin score for predicting an ODI of >5, >10, and >15 was 80.0%, 82.7%, and 84.0%, respectively, with corresponding specificities of 35.4%, 20.5%, and 27.9%.
Conclusion: In patients with T2DM, a high risk Berlin score is predictive of OSA but with moderate sensitivity and poor specificity.
Support (If Any): Funding for the GlyCOSA study was provided by ResMed.

0418

RISK OF OBSTRUCTIVE SLEEP APNEA IN THE TURKISH ADULT POPULATION

Ardic S[1], Demir A[2], Ucar Z[3], FIRAT H[1], Itil O[4], Karadeniz D[5], Aksu M[6], Sevim S[7], Yilmaz H[8], Oktay B[9]
[1]Chest Diseases, Diskapi Training and Research Hospital, Ministery of Health, Ankara, Turkey, [2]Chest Diseases, Hacettepe University, Ankara, Turkey, [3]Chest Diseases, Dr Suat Seren Chest Diseases and Surgery Training and Research Hospital, Izmir, Turkey, [4]Chest Diseases, Dokuz Eylül University, Izmir, Turkey, [5]Neurology, Cerrahpasa University, Istanbul, Turkey, [6]Neurology, Erciyes University, Kayseri, Turkey, [7]Neurology, Mersin University, Mersin, Turkey, [8]Neurology, Celal Bayar University, Manisa, Turkey, [9]Chest Diseases, General Hospital Ministery of Health, Mardin, Turkey

Introduction: Obstructive sleep apnea (OSA) represents a major public health problem. We have investigated the risk of OSA in the Turkish adult population.
Methods: An interviewer administered questionnaire was used to collect data in a nationwide representative sample of adult population of 5021 adults (2598 women, 2423 men) with a mean age of 40.7 year. High risk of OSA was defined as the positive response to two of the three categories in the Berlin questionnaire.
Results: High risk of OSA was found in 13.7% (men: 11.1%, women: 20.2%), habitual snoring in 9.6% (men: 11.6%, women: 7.7%). After the adjustment for age and gender, high risk of OSA was associated with age, lower socioeconomic status, lower level of educational status, time spent before television, history of hospitalization, and cardiovascular disease.
Conclusion: Prevalence rates were close to the lower end of the estimates from previous studies. Women predominance of high risk of OSA despite lower prevalence of habitual snoring in women could be due to higher prevalence of obesity in women and social undesirability of reporting symptoms like snoring in men. Further investigation of the confounding factors and second stage of the study with polysomnography, would help to delineate our findings.
Support (If Any): Cephalon and Gen Medicine.

0419

SCREENING FOR OBSTRUCTIVE SLEEP APNEA: ARE THE EPWORTH SLEEPINESS SCALE AND MUELLER MANOEUVRE REALLY WORTHWHILE?

Fanous A, Forest V, Payne RJ
Otolaryngology Head and Neck Surgery, McGill University, Montreal, QC, Canada

Introduction: Our objectives are to assess the ability of three commonly used clinical screening modalities at predicting obstructive sleep apnea (OSA). These modalities are: The Epworth Sleepiness Scale (ESS), Mueller Manoeuvre (MM), and specific signs/symptomatology of OSA.
Methods: This is a retrospective case series study of 180 patients undergoing polysomnography to assess for OSA between 2007 and 2010. Prior to polysomnography testing, each patient underwent OSA screening with the ESS, digitally recorded MM, as well as a sleep apnea focussed history and physical exam.
Results: The severity of obstructive sleep apnea, as established by the AHI, correlated significantly with both the MM examination of the base of the tongue ($r = 0.86$ with $p < 0.03$) and with the ESS ($r = 0.72$ with $p < 0.05$). The velopharyngeal and hypopharyngeal MM examinations, although correlating with the AHI ($r = 0.62$ and $r = 0.53$ respectively), were not statistically significant. Finally an unrefreshing sleep on history correlated weakly ($r = 0.54$) with OSA, but this was not statistically significant.
Conclusion: To our knowledge, this is the first study to examine the correlation between OSA severity and commonly used clinical screening tools available to clinicians. The MM examination of the base of the tongue showed an excellent correlation with AHI. ESS showed statistically significant correlation as well.

0420

FEASIBILITY OF A SYSTEM FOR IDENTIFICATION AND PERIOPERATIVE MANAGEMENT OF SLEEP APNEA PATIENTS IN A COMMUNITY HOSPITAL

Nicholson DH, Christensen JM
Internal Medicine, Pomona Valley Hospital Medical Center, Claremont, CA, USA

Introduction: Increasing recognition of, and concerns for the safety of Sleep Apnea patients undergoing surgery prompted us to develop a system for management of these patients. We describe the system and report findings. Our goal was to decrease intra and post-operative airway complications for this known high risk group and to disseminate information to caregivers in a timely manner.
Methods: A previously validated tool, the Berlin Questionnaire was utilized. Data was collected in pre-op admitting. The risk score was calculated and a simple report generated with suggestions for patient man-

agement. The reports are exported to the hospital information system for review by the medical and nursing staff. Reports are electronically faxed to the primary care physician and to the surgeon if positive.
Results: From 4/1/2010 to 12/31/2010 3482 consecutive patients were screened for Sleep Apnea. Of the patients screened, 2657 were outpatients and 825 were inpatients. Hospital Length of stay for PAP, screen negative and screen positive were 4.06, 3.16 and 2.96. Length of ICU stay was 1.09, 0.45 and 0.21, step down monitoring unit were 1.35, 0.64 and 0.75 and medical/surgical floor was 1.62, 2.07 and 1.99. Thirty four percent of patients screened were identified as at risk for sleep apnea by the Berlin Questionnaire. Five percent of screened patients were identified as using PAP.
Conclusion: A system for rapid identification and management of patients at risk or under treatment for Sleep Apnea is feasible in a community hospital. Concerns about potential increase of cost and length of stay raised during the initial start- up period do not appear to be valid.

0421

ELEVATED HYPOPNEA-APNEA RATIO IN OBESITY HYPOVENTILATION SYNDROME

Majid R, Tallavajhula S, Gupta A, Allen E, Castriotta RJ
Pulmonary, Critical Care and Sleep Medicine, University of Texas, Houston., Houston, TX, USA

Introduction: In the United States the prevalence of obesity is increasing rapidly with an expected increase in the prevalence of 'Obesity Hypoventilation Syndrome' (OHS). A retrospective study reported that 46% of patients who refused long-term noninvasive positive airway pressure (PAP) therapy died during an average 50-month follow-up period. The timely diagnosis and treatment of OHS is hence of upmost importance. Our prior study showed that very obese patients (BMI ≥ 45 kg/m2) with obstructive sleep apnea (OSA) have predominantly hypopneas with a higher hypopnea apnea ratio (HAR) than those with BMI < 35 kg/m2. In this study we evaluated whether patients with OHS also have a high HAR.
Methods: We performed a retrospective chart review of patients evaluated with a nocturnal polysomnogram. We compared patients with a diagnosis of OHS (Group 1) to patients diagnosed with severe OSA (an apnea hypopnea index of >30) without hypoventilation (Group 2). The diagnosis of OHS was made by the following criteria (i) BMI >30 kg/m2 (ii) awake daytime pCO2 > 45 torr and (iii) sleep-disordered breathing. We used a two-tailed student's t test to compare the HARs between the groups.
Results: We reviewed 27 cases in Group 1 and 33 cases in Group 2 (mean age of 46, ±12.4 [SD] years, p = 0.25). We found a significant difference in the mean BMI (50.5 kg/m2 ±11 [SD] vs. 42 kg/m2 ±9.5 [SD], p = 0.002). The mean apnea hypopnea index (AHI) between the two groups was similar (mean 73.5 ± 33 [SD], p = 0.9). The male to female ratio in both groups was also similar (3.7:1) with over three fold more males in each group. We found the OHS patients had a higher Epworth Sleepiness Score (13 vs 9.6, p = 0.01).We then compared the HAR and found a significantly higher proportion of hypopneas in the OHS group (mean HAR = 46.9 vs 7.4, p value = 0.001). When we matched for BMI the difference in HAR persisted (50.4 vs 9.3, p value =0.003).
Conclusion: Patients with OHS have a significantly higher hypopnea to apnea ratio (HAR) than patients with a similar level of severity of OSA without hypoventilation. They also appear to have higher ESS which we hypothesize may be related to hypercapnia. A high HAR may be polysomnographic marker of OHS for those not routinely performing capnography. These findings may also lead to insights as to other pathophysiologic pathways that lead to the development of OHS (differences in airway control) and potentially more effective treatment options.

0422

DEVELOPMENT AND VALIDATION OF UTILITY SCORING FOR THE SNORE-25 AND FOSQ QUALITY OF LIFE INSTRUMENTS

Skirko JR[1,2], James KT[1,2], Weaver T[3], Weaver EM[1,2]
[1]Comparative Effectiveness, Cost & Outcomes Research Center, University of Washington, Seattle, WA, USA, [2]Department of Otolaryngology, University of Washington, Seattle, WA, USA, [3]College of Nursing, University of Illinois at Chicago, Chicago, IL, USA

Introduction: Utility measures are needed to perform cost-effectiveness studies for obstructive sleep apnea (OSA) treatments. The goal of this study was to develop and validate a utility scoring algorithm for an OSA-specific quality of life instrument (Symptoms of Nocturnal Obstruction & Related Events, or SNORE-25) and for a sleep-specific functional status instrument (Functional Outcomes of Sleep Questionnaire, or FOSQ).
Methods: Development and validation of the SNORE-25 utility scoring algorithm was conducted in newly diagnosed untreated OSA patients from the Seattle Sleep Cohort study and from the TURBO trial. Baseline participants were randomly divided into a model development set (60%) and cross-validation set (40%). Utility scoring of the SNORE-25 was derived from the SF-6D utility index through multiple linear regression in the development sample with Akaike information criterion (AIC) determining the best model. The association of SNORE and SF-6D was confirmed in the cross-validation group. The FOSQ utility scoring algorithm development and validation is planned in random subsets of the CATNAP trial and other observational and trial datasets.
Results: For the SNORE-25, we enrolled 500 patients (development n=300, validation n=200). The mean (standard deviation) SF-6D utility index score was 0.61 (0.08) with a range of 0.40 - 0.85. SF-6D utility index scores were similar across OSA severity subgroups. The best-fit model (the SNORE Utility Index) was the natural log conversion of the instrument subscales, with r2=0.32 and AIC=-727 (excellent fit) in the development sample. The SNORE Utility Index retained this relationship within the validation sample (r2=0.33). Similar FOSQ analyses are planned.
Conclusion: The SNORE Utility Index provides a validated disease-specific, preference-weighted utility instrument that can be utilized in future studies of OSA patients. The FOSQ Utility Index development and validation are planned.
Support (If Any): K23 HL068849 (EM Weaver), R01 HL084139 (EM Weaver), UL1 RR025014 (Disis), R01 HL076101 (TE Weaver).

0423

DOES REM PREDOMINANT SLEEP APNEA PRESENT AS A DISTINCT PHENOTYPE? - A CASE-CONTROL STUDY FROM NORTHERN INDIA

Shukla G, Gupta A, Goyal V, Srivastava A, Mohammed A, Behari M
Neurology, All India Institute of Medical Sciences, New Delhi, India

Introduction: Few large studies, among which two published very recently have elaborated characteristics of REM predominant obstructive sleep apnea (REM OSA), and found no significant differences in its presentation from non stage dependent sleep apnea (OSAS). These observations are different from the features observed by us in our population. This case controlled study aims at describing phenotypic and polysomnographic (PSG) differences between REM OSA and OSAS.
Methods: Consecutive patients with REM OSA (REMAHI/NREMAHI>2), were compared with double the number of consecutive patients with OSAS for assessment of various clinical manifestations and PSG findings, over a 1 year period. These details were prospectively obtained and were compared for statistical differences.
Results: Nineteen patients with REM OSA (15 males)(mean age 46.6 + 13.5) were diagnosed, hence compared with 38 consecutive patients

with OSAS. Patients with REM OSA significantly differed from the comparison group in the presenting features of insomnia seen in 8 patients (42%) versus 3 (8.1%); snoring in 4 (21%) versus 26 (72%); headaches in 5 patients (26%) compared to none and daytime somnolence in 7 patients (36.8%) with 25 (69/4%) in the OSAS group. REM OSA patients also had significantly lower Mallampati scores. Median total AHI was 17 (range 5-43) and 63.5 (range 8-142), while median REM AHI were comparable (43.6 and 51) in the two groups respectively. Arousal and desaturation indices were significantly lower in the REM OSA. No significant differences were observed in BMI, overall cognitive performance and sleep latencies.
Conclusion: REM OSA among Indian patients may represent a distinct phenotype, mainly in the way these patients present to the clinic with atypical features like insomnia and headache and less frequently with the classical features of snoring and excessive daytime somnolence.

0424

PHOTOPLETHISMOGRAPH DERIVED RESPIRATORY SIGNAL - APPLICATION IN SLEEP STUDIES

Amos Y[1], Pinhas I[1], Barak-Shinar D[1], Smart F[2], Lewis B[3], Amir O[3]
[1]WideMed Ltd., Herzliya, Israel, [2]Department of Cardiology, Morristown memorial hospital, Morristown, NJ, USA, [3]Division of Cardiology, Lady Davis Carmel Medical Center, Haifa, Israel

Introduction: Photoplethysmograph (PPG) devices, known commonly as pulse oximeters, provide instantaneous and continuous in vivo measurements of arterial oxygenation. The purpose of this study is to demonstrate that the PPG signal can be used by clinicians beyond its traditional use of the oxygen saturation. By analyzing the baseline variations, envelope and rate of the PPG signal, a new respiration waveform with clinical relevancy is extracted.
Methods: 50 subjects hospitalized either in the cardiology department of Morristown Memorial Hospital; Morristown, NJ, USA or in Heart Failure Center at Lady Davis Carmel Medical Center/Lin Medical Center in Haifa, Israel. Each subject went through a complete night sleep study. The sleep study included standard Polysomnography (PSG) signals with the PPG signal. The PSG data set was scored manually for achieving the gold standarad analysis. Respiratory rate and signal were extracted from the PPG and compared to standard respiration signal using two independent measures: respiratory rate and envelope modulation. The envelope modulation was investigated by manually marking of respiratory events based on PPG derived respiratory (PDR) signal and SpO2 and compares them to the gold standarad respiratory events.
Results: The PDR shows accurate calculation of respiratory rate with maximum standard deviation below 1.5CPM per investigated respiration rate. A sensitivity of more than 82% for the detection of respiratory event using PDR- SpO2 system against gold standard human scorer was achieved.
Conclusion: The results confirm that the PDR contributes to the detection of respiratory events and that it can be used clinically for the diagnosis of sleep disordered breathing. Using a reduced number of signals for sleep apnea diagnosis will make this test available at home or at ambulatory enviroment to currently undiagnosed populations as heart failure patients that find it difficult to spend the entire night in the sleep lab.

0425

THE APNEA AND HYPOPNEA INDEX OF A CLINICAL REFERRED SAMPLE AND A POPULATION-BASED COHORT

Castro LS, Bittencourt LA, Lucchesi LM, Tufik S
Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: The profile of patients with sleep breathing disorder may differ in light of where they come.To investigate the differences between patients referred to polysomnography (PSG) in the Sleep Institute and volunteers from a population-based cohort (EPISONO), considering the apnea and hypopnea index.
Methods: A total of 5,819 patients aged between 20-80 yrs. had been referred to basal PSG in the laboratory and given consent to scientific research. A sample of 1,042 individuals was selected to represent the adult population of São Paulo city according to gender, age (20-80) and socioeconomic status. All of them underwent a full-night PSG between July and December of 2007. Those with an apnea and hypopnea index (AHI) above 5 were compared for sociodemographic, anthropometric and sleep characteristics.
Results: Patients were predominantly men (63% versus 44%), obese (33% versus 22%), older (46±13 versus 42±14yrs old) and graduated (51% versus 23%). The prevalence of an AHI>5 was indeed twice as higher among them (76% versus 38%). After selecting patients and volunteers with an AHI above 5, the proportion of men increased significantly, especially in the clinical sample (71% versus 56%). The difference in obesity disappeared (39% versus 37%), with a substantial increase of its prevalence in the cohort. Similar increase was observed for age (48±13 versus 51±14). As for the PSG variables, patients were found with higher sleep latency (27±31 versus 18±23), total sleep time (342±63 versus 331±74) and AHI (30±25 versus 19±16), while with a slightly decrease in the slow wave sleep (18±9 versus 21±9). Complaints of non-restorative sleep (54% versus 42%) and sleepiness (56% versus 38%) were as well most common among them.
Conclusion: The profile of referred patients mostly includes well educated men around their fifties. Our findings suggest that in the population, the elderly and the younger women are perhaps less symptomatic and probably misdiagnosed.
Support (If Any): AFIP, FAPESP, CEPID, CNPq.

0426

WHERE DID YOU SNORE LAST NIGHT? - A PROSPECTIVE STUDY IN SNORERS AND THEIR BED PARTNERS

Klösch G, Seidel S, Wöber C, Bauer T, Scheibel N, Oberhofer P, Pacher J, Albert F, Casjens T, Zeitlhofer J
Department of Neurology, Medical University of Vienna, VIenna, Austria

Introduction: It is a common clinical experience that partners of patients with obstructive sleep apnea syndrome (OSAS) complain of disturbed sleep and relationship difficulties because of the patient's symptoms. Subjective complaints are not only related to snoring, but also to apneas and restlessness. Nevertheless, up to now most studies in snorers and bed partners were carried out only over a few nights/days.
Methods: We set out to simultaneously record both, subjective and objective sleep parameters over 14 days in snorers and their bed partners. Quality of sleep, daytime sleepiness and psychiatric comorbidities were assessed using the Pittsburgh Sleep Quality Index, the Epworth Sleepiness Scale, the Self-rating Anxiety Scale and the Self-rating Depression Scale. The sleep-wake-cycles in patients and partners was documented by actigraphy ("ActiwatchTM") and sleep diaries for 14 days and all patients were screened for an Obstructive Sleep Apnea Syndrome. To detect differences between snorers and their bed partners data were compared using unpaired two-sided t-tests ($p<0.05$).
Results: Fifty-three patients (14 females) and 47 bed partners (36 females) with a mean age of 49.9±11.1 and 44.5±11.9 years, respectively, were included in this study. Data of 20 couples who spent at least one night together and one night alone were analyzed. During nights spent together patients and bed partners did not differ regarding their objective sleep parameters. During nights spent alone bed partners showed a significantly longer time in bed (482±81 vs. 426±70 min, p=.03) and longer total sleep time (414±81 vs. 357±56 min, p=.02) than patients. Fragmentation indices were significantly higher in bed partners and patients during nights spent together than during nights spent alone (35±16 vs. 35±13, p=.029 and 34±16 vs. 29±14, p=.029). The subjective sleep latency was significantly longer in bed partners than in patients (22±21 vs. 15±24 min, p=.005).

Conclusion: Patients and bed partners showed a more fragmented sleep when spending the night together. During nights spent alone bed partners slept significantly longer than patients.

0427

HIGHER STOP-BANG CUT-OFF VALUES IMPROVES DIAGNOSTIC ACCURACY IN BARIATRIC SURGERY PATIENTS

Endara-Bravo AS, Bellows CF, Thammasitboon S
Pulmonary, Critical Care and Sleep Medicine, Tulane University Health Sciences Center, New Orleans, LA, USA

Introduction: The STOP-bang questionnaire has been well validated as a screening tool for obstructive sleep apnea (OSA) in general surgery patients, but not in bariatric surgery (BS) patients. In our previous study, the STOP-bang score of ≥ 3 showed a high sensitivity (96%), but low specificity (20%) in BS patients. We hypothesize that a higher score is needed to diagnose OSA in BS patients.
Methods: This is a retrospective study of consecutive subjects who had a sleep study prior to BS. All subjects answered the STOP-bang questionnaire prior to their sleep study. Subjects currently treated with positive airway pressure therapy were excluded. The sensitivity, specificity, and likelihood ratio for STOP-bang scores of 4 to 7 were calculated.
Results: A total of 59 patients were included in the study. The prevalence of OSA in the BS population was 84%. The sensitivity/specificity for STOP-bang scores of ≥4 along with AHI>5, AHI>15 and AHI>30 was 82/60%, 85/40%, and 90/34%, respectively. The sensitivity/specificity of STOP-bang score of ≥5 for AHI>5, AHI>15 and AHI>30 was 59/90%, 68/72%, and 76/63%, respectively. The sensitivity/specificity of STOP-bang score of ≥6 for AHI>5, AHI>15 and AHI>30 was 33/100%, 41/92%, and 52/87%, respectively. The sensitivity of STOP-bang score of ≥7 for AHI>5, AHI>15 and AHI>30 was 14/100%, 21/100%, and 33/100%, respectively. The OSA likelihood ratio (LR) for STOP-bang scores of 4 or 5 with an AHI>5 were 2.05 and 5.9, respectively, whereas for scores ≥6 the LRs were infinite. All patients with a STOP-bang score ≥6 had OSA, and all patients with STOP-bang scores ≥7 had severe OSA.
Conclusion: Higher STOP-Bang score cut-off values progressively improved their predictive power of detecting OSA in BS patients. A STOP-bang score ≥5 in BS patients is associated with OSA with a post-test probability of 97%.

0428

INSPIRATORY FLOW LIMITATION IN A NORMAL POPULATION OF ADULTS IN SAO PAULO

Palombini LO[1], Tufik S[1], Rapoport DM[2], Santos-Silva R[1], Godoy L[1], Ayappa I[2], Bittencourt L[1]
[1]Departamento de Psicobiologia, Universidade Federal de São Paulo, Sao Paulo, Brazil, [2]Division of Pulmonary, Critical Care and Sleep Medicine, Department of Medicine, New York University School of Medicine, New York, NY, USA

Introduction: Inspiratory Flow Limitation (IFL) is indicated by the flattening appearance of the flow curve detected by nasal cannula pressure during sleep. The main purpose of the present study was to evaluate the distribution of IFL during sleep in the general population and to provide reference data for this respiratory pattern.
Methods: Subjects were derived from the representative sample of the Sao Paulo Epidemiologic Sleep. Flow limitation was manually scored and the % of TST (total sleep time) with IFL was analyzed. Subjects for the "normal" group were asymptomatic (no excessive daytime sleepiness, fatigue or witnessed apneas); had no OSAS (obstructive sleep apnea syndrome) (ICSD-2 criteria) and no significant primary lung disease. IFL was described by mean, SD (standard deviation) and percentiles. Correlation analysis and linear regression analysis were also used for analysis.
Results: 163 individuals met the criteria for the "normal" group. The mean age was 38 ± 12.8 years old, BMI was 25.3 ± 4.5 kg/m2, 62.4% and were woman. The 95% percentile of the % of time with IFL was 30%. Women presented 10.3 ± 12.8 % and men11.6 ± 14% of TST with IFL. Obese individuals have clearly more IFL than normal weight subjects (14± 15.3% versus 7.9± 11.2, p <0.05). There was a modest significant positive correlation between IFL and BMI (r=0.208, p< 0.01). There was no correlation of IFL with age and gender.
Conclusion: Flow limitation was present in 30% of the TST in non symptomatic individuals. Weight affects IFL depending of the age group, while gender and age did not show a significant effect. The demonstration of IFL in normal individuals is important and can be helpful to define IFL parameters in the diagnosis of sleep breathing disorders.
Support (If Any): Supported by: AFIP, FAPESP and CNPq.

0429

RACIAL DISPARITIES IN SLEEP APNEA EVALUATION

Kraus DM, Seiger AN, Weng J, Patel SR
Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA

Introduction: African-Americans (AAs) have a greater burden of many diseases including stroke, hypertension, and diabetes in comparison to European-Americans (EAs). However, health care utilization for these conditions is less in AAs. Whether racial disparities exist in the care of sleep disorders is unknown. In this study, we sought to examine whether there are racial differences in the severity of obstructive sleep apnea (OSA) at the time of clinical diagnosis.
Methods: Data from 841 patients with OSA seen in a tertiary care sleep disorders center from February 2007 to December 2010 agreeing to participate in a research protocol were analyzed. OSA was defined as an apnea hypopnea index (AHI) ≥ 5 on overnight polysomnography. Race was based on self-report. Body mass index (BMI) was calculated by height and weight measured in clinic. AHI was log transformed to approach normality.
Results: The cohort was evenly split between AAs (N=419, 49.8%) and EAs (N=422, 50.2%). Males made up only 33% of AAs vs. 56% of EAs (p<0.0001). AA females were younger (47.7 vs. 54.6 years, p<0.0001) and more obese (BMI 41.7 vs. 35.8 kg/m2, p<0.0001) than EA females but had similar AHI (21.8 vs. 19.7, p=0.20). Similar to females, AA males were younger (48.6 vs. 53.8 years, p=0.0004) and more obese (38.0 vs. 33.8 kg/m2, p<0.0001) than EA males. In addition, AA males had more severe OSA (mean AHI 37.8 vs. 28.6, p=0.003) than EA males.
Conclusion: Despite having the most severe OSA, there is underrepresentation of AA males to a sleep referral center. These data suggest there may be barriers to sleep apnea care among AA males. Further research to identify and remove such barriers is warranted.

0430

THE STRUCTURE OF SLEEP-RELATED BREATHING DISORDERS IN PATIENTS WITH HEART FAILURE III-IV FUNCTIONAL CLASS (ACCORDING TO NYHA CLASSIFICATION)

Korostovtseva LS[1], Sviryaev YV[1], Kozlova SN[3], Sazonova YV[1], Kozlenok AV[2], Malikov KN[2], Konradi AO[1]
[1]Hypertension, Almazov Federal Heart, Blood and Endocrinology Centre, St Petersburg, Russian Federation, [2]Functional Diagnostics, Almazov Federal Heart, Blood and Endocrinology Centre, St Petersburg, Russian Federation, [3]Pavlov St Petersburg State Medical University, St Petersburg, Russian Federation

Introduction: Objective - to study the structure of sleep-related breathing disorders in patients with heart failure (HF) III-IV functional class (according to NYHA classification).
Methods: 57 subjects were enrolled in the study: 50 males and 7 females, mean age - 57.9±10.5 years. HF resulted from coronary artery

disease in 55 cases, and from cardiomyopathy - in 2 subjects. HF resulted from coronary artery disease in 55 cases, and from cardiomyopathy - in 2 subjects. All patients underwent full polysomnography (Embla N7000, MedCare Flaga, Iceland), and echocardiography (GE Vivid 7, Norway). Blood tests for N-terminal-pro-brain natriuretic peptide (NT-proBNP) were taken. Statistical analysis was performed using SPSS 16.0, non-parametric methods were used.

Results: All patients had HF with decreased systolic function: Simpson ejection fraction EF% 32(24; 40)%, NT-proBNP was 1527 (654; 2436) pg/ml. According to polysomnography data 3 patients had no sleep-breathing disorders (apnea-hypopnea index, AHI, less than 5 episodes/h), while 19 subjects had mild sleep apnea, 16 - moderate, and 20 - severe sleep apnea ($\chi 2$= 8.08; p=0.044). 20 patients (35.1%) demonstrated obstructive sleep apnea [AHI 13.5 (95% CI 9.8-27.1) episodes/h]; 4 patients had central apnea [AHI 36.3 (95% CI 10.2-54.3) episodes/h], and mixed apnea was the predominant type (52.6%, 30 subjects), AHI - 22.6 (95% CI 19.6-33.2) episodes/h (Kruskall-Wallis test, $\chi 2$= 5.13; p=0.07). Central apnea index, but neither obstructive nor total apnea index, was associated with EF (r=-0.50, p=0.01), however, no correlation with the level of NT-proBNP was found (p>0.05).

Conclusion: Sleep-related breathing disorders are common in patients with severe HF. We found a relatively low prevalence of central sleep apnea in HF patients, and mixed apnea was the predominant type. Only central sleep-breathing disorders are related to the severity of left ventricular systolic dysfunction.

Support (If Any): The research leading to these results has received funding from the European Union Seventh Framework Programme [FP7/2007-2013] under grant agreement N 241558 (SICA-HF). The research leading to these results has received funding from the Russian Ministry of Science and Education within the FTP "R&D in priority fields of the S&T complex of Russia 2007-2012" under state contract N 02.527.11.0007.

0431

DIFFERENCES IN SLEEP APNEA SYMPTOMS BETWEEN AFRICAN-AMERICAN AND EUROPEAN-AMERICAN PATIENTS

Seiger AN, Kraus DM, Weng J, Patel SR
Sleep Medicine, Brigham and Womens Hospital, Boston, MA, USA

Introduction: Racial differences exist in the reporting of sleep complaints in a general population. Whether this reflects differences in disease susceptibility or how the disease is experienced is not known. In this study, we sought to compare the clinical manifestation of obstructive sleep apnea (OSA) in African-Americans (AAs) and European-Americans (EAs) with similar disease severity.

Methods: Data from 945 patients with OSA seen in a tertiary care sleep disorders center from February 2007 to December 2010 agreeing to participate in a research protocol were analyzed. Patients completed a sleep questionnaire regarding sleep-related symptoms. OSA was defined as an apnea hypopnea index (AHI) ≥ 5 on overnight polysomnography. Race was based on self-report.

Results: The cohort was split evenly between AAs (N=475, 50.3%) and EAs (N=470, 49.7%) with 44% men, a mean age of 51.6 years and mean AHI 36.5. OSA severity did not differ by race (mean AHI 39.0 in AAs vs. 34.0 in EAs, p=0.32).No differences were found between AAs and EAs in frequency or loudness of snoring. However, AAs were less likely to report their snoring bothered others (75% vs. 82%, p=0.01). AAs were more likely to report headache on awakening (24% vs. 16%, p=0.003), had more severe daytime sleepiness (mean Epworth score 11.5 vs. 9.7, p<0.0001) and more drowsy driving (12% vs. 4%, p=0.004). All differences remained significant after adjusting for AHI. In addition, AAs remained less likely to report bothersome snoring after also adjusting for presence of a bed partner.

Conclusion: AA and EA OSA patients differ in the symptoms reported at the time of diagnosis. Independent of OSA severity, AA patients are less likely to report bothersome snoring but more likely to report a morning headache, daytime sleepiness, and drowsy driving. Incorporating knowledge of these differences may help clinicians more accurately screen for OSA in African-American populations.

0432

CLINICAL AND POLYSOMNOGRAPHIC CHARACTERISTICS OF PATIENTS FROM AN OTORHINOLARYNGOLOGIC RESEARCH SERVICE

Fomin D[1], Perla S[1], Lorenzi-Filho G[2], Dias IS[3], Aguiar I[3], Hirata RP[3], Santos IR[3], Oliveira LF[3]
[1]1MBOI Mirim Hospital, Santo Amaro University, Sao Paulo, Brazil, [2]2Sleep Laboratory, Pulmonary Division, Heart Institute (InCor) Sao Paulo University Medicine School, Sao Paulo, Brazil, [3]Nove de Julho University - UNINOVE, Sao Paulo, Brazil

Introduction: Obstructive sleep apnea (OSA) is a respiratory disorder characterized by collapse of the upper airway during sleep. OSA is an independent risk factor for cardiovascular disease, which includes hypertension, atrial fibrillation, coronary artery disease, and stroke, and has important social implications with reduction in quality of life. Our objective is to describe the demographic, clinical and polysomnographic variables of patients from an otorhinolaryngologic service.

Methods: This is a descriptive clinical study conducted with patients from an otorhinolaryngologic research service. Patients were evaluated regarding to anthropometric measurements, full overnight polysomnography, Epworth Sleepiness Scale (ESS) and Berlin Questionnaire.

Results: Ninety subjects were consecutively evaluated, consisting of 46 men and 44 women, with a mean age of 45.3±15.6 years and a mean BMI of 29.4±5.1kg/m2. Among the main complaints, snoring was the most reported (89%) followed by apnea (40%). Regarding to sleep disorders, the median the score in ESS was 13 (0-25) and 55 (61,1%) subjects were considered high risk to develop OSA by the Berlin Questionnaire. Twenty-two (24.4%) subjects were considered normal (AHI<5), 22 (24.4%) had mild OSA, 20 (22.2%) had moderate OSA and 26 (28%) were considered severe OSA. The mean AHI was 26.3±27.4, the mean arousal index was 18.8±14.2 and the mean oxyhemoglobin saturation was 93.9±4.7%.

Conclusion: This population is characterized as young adults and overweight. There was an important prevalence of OSA, being half of them moderate to severe OSA, which could lead to cardiovascular disorders, diurnal excessive sleepiness and consequently reduction in quality of life.

Support (If Any): The authors thank Fundação de Amparo a Pesquisa do estado de Sao Paulo (Fapesp, acronym in Portuguese) and Conselho Nacional de Desenvolvimento Cientifico e tecnologico (CNPq acronym in Portuguese) for suporting this research.

0433

THE IMPLICATION OF METABOLIC SYNDROME FOR SLEEP APNEA DIAGNOSIS

Rizzo D[1], Bailes S[1,2], Baltzan M[2,3], Grad R[1,2,4], Pavilanis A[2,5], Fichten CS[1,6], Libman E[1,2]
[1]Jewish General Hospital, Montreal, QC, Canada, [2]McGill University, Montreal, QC, Canada, [3]OSR Medical, Montreal, QC, Canada, [4]Herzl Family Practice Centre, Montreal, QC, Canada, [5]St-Mary's Hospital, Montreal, QC, Canada, [6]Dawson College, Montreal, QC, Canada

Introduction: As part of a large, prospective study, we are investigating the association between obstructive sleep apnea (OSA) and metabolic syndrome in middle age and older family medicine patients. Since OSA sufferers often present with non-traditional signs and symptoms of the condition, this sleep disorder is under-recognised in general medical practice,. Recent research has shown an association between OSA and metabolic syndrome, which includes obesity, diabetes, hypertension and dyslipidemia. Both OSA and metabolic syndrome are recognised

risk factors for cardiovascular disease. We present preliminary findings about the presence of metabolic syndrome components and of OSA in a sample of older adults, none of whom had ever been referred for a sleep study.
Methods: 19 middle-aged and older patients were recruited from two family medicine clinics (11 men, 8 women; mean age 57). Participants had no prior diagnosis of OSA. They underwent overnight polysomnography (PSG) and we collected information from their charts about their health status, including the presence of metabolic syndrome components.
Results: 16 of the 19 participants were found to have OSA following PSG; 3 did not. Among those with OSA, 11 of the 16 (69%) had at least one metabolic syndrome component. This was true only of 1 of the 3 non-OSA participants (33%). Among those with OSA, the mean apnea/hypopnea indices were in the severe range (> 30), regardless of whether they had metabolic syndrome components.
Conclusion: - A very large number (85%) of this previously undiagnosed older sample had significant OSA, supporting our previous findings. - More than half (58%) of the sample were found to have both OSA and at least one metabolic syndrome component. - This suggests that the presence of even one metabolic syndrome component, in the context of other sleep disorder signs, should prompt further evaluation of OSA in middle-age and older primary care patients.
Support (If Any): Canadian Institutes for Health Research.

0434

POLYSOMNOGRAPHIC AND GENERAL CHARACTERISTICS OF INTERSTATE PROFESSIONAL BUS DRIVERS: PRELIMINARY RESULTS

Hirata RP[1], Aguiar I[1], Nacif SR[1], Giannasi L[2], Studart Leitão Filho FS[3], Santos IR[1], Romano S[4], Salvaggio A[4], Insalaco G[4], Oliveira LF[1]
[1]Nove de Julho University - UNINOVE, Sao Paulo, Brazil, [2]Dentistry, Julio Mesquita Filho State University, Sao Jose dos Campos, Brazil, [3]Medicine, Fortaleza University, Fortaleza, Brazil, [4]4National Research Council of Italy, Institute of Biomedicine and Molecular Immunology "A. Monroy", Palermo, Italy

Introduction: Obstructive sleep apnea (OSA) is a respiratory disorder characterized by collapse of the upper airway and has a significant contribution on traffic accidents. Our objectives were to describe the clinical and anthropometric characteristics of professional interstate bus drivers and to identify the presence of sleep disorders in a sample of this population.
Methods: This is an observational cross-sectional study. Firstly, 710 bus drivers were enrolled in this study, which clinical and anthropometric characteristics were gathered from the patient records retrospectively. Thirty five drivers were consecutively invited to participate in this study protocol, involving medical examination, full night polysomnography, Epworth Sleepiness Scale (ESS), and Berlim Questionnaire.
Results: With regard to the 710 drivers, all of them were male, with a mean age of 41.7±6.9 years, weight of 81.4±3.3kg and BMI of 27.2±3.3Kg/m2, the mean abdominal and neck circumference were respectively 94.4±8.6cm and 38.9±2.2cm and 38.2% of the sample was considered hypertensive. A sample of 34 bus drivers underwent PSG, being 23 (67.6%) reporting snore and 12 (35.3%) reporting diurnal excessive sleepiness during the work shift, this occurring mostly at the early morning. The prevalence of OSA was 76% (AHI>5), being 44% considered moderate-severe OSA patients with a mean AHI value of 36.9±2.3. The median observed at the ESS was 7.5 (IC95%1-13) and 7 (20,6%) drivers were considered high risk to develop OSA. Time spent with SpO2<90% (min) was greater in severe OSA when compared with mild and no OSA (p=0.039 and p=0.036, respectively) and the snore time (%TTS) were also greater in the subjects with severe OSA when compared to moderate, mild and no OSA (p=0.007, p=0.006 and p=0.001, respectively).
Conclusion: This population is characterized as young adults with a high prevalence of OSA and cardiovascular risk factors. Trial registration: Registro Brasileiro de Ensaios Clínicos - RBEC. Identifier RBR-7dq5xx.
Support (If Any): The authors thank Fundação de Amparo a Pesquisa do estado de Sao Paulo (Fapesp, acronym in Portuguese) and Conselho Nacional de Desenvolvimento Cientifico e tecnologico (CNPq, acronym in Portuguese) for supporting this research.

0435

APNEA DURATION IN OBSTRUCTIVE AND CENTRAL APNEA

Mansour A, Koo BB
Sleep Medicine, University Hospital Case Western Reserve, Cleveland, OH, USA

Introduction: The study of apnea duration is restricted to obstructive disease. We investigated the relation of apnea duration in both obstructive and central disease to various demographic and polysomnographic factors.
Methods: Data from 680 patients undergoing polysomnography (PSG) between January 2002 and January 2003 at a university sleep laboratory were analyzed. Apnea, hypopnea and sleep were scored according to AASM guidelines and demographic information including age, body mass index (BMI), Epworth score (ESS), gender, race and medical history was collected. Apnea duration was stratified into short and long around the median value for duration, being 17 seconds for obstructive apnea and 14 seconds for central apnea. Those with long apnea were compared to persons with short apnea for both obstructive and central apnea. Comparisons included age, sex, BMI, ESS, race, apnea-hypopnea index (AHI) and medical history.
Results: For persons with obstructive apnea of long compared to short duration, AHI (39.6±26.9 vs. 28.3±28.1; p<0.001) and age (56.9±14.9 vs. 49.3±15.5; p<0.001) were significantly higher; minimum oxygen saturation (79.1±8.3 vs. 82.9±7.6; p<0.001) and BMI (33.0±8.6 vs. 35.9±9.7; p<0.001) were significantly lower. The long duration obstructive apnea group was more likely to be male (56.7% vs. 38.3%; p<0.001) and white (53.5% vs. 42.0%; p=0.01). There was no significant association with ESS or heart disease. For persons with central apnea of long compared to short duration, AHI (34.0±28.9 vs. 21.2±23.9; p<0.001) and age (54.5±15.4 vs. 46.1±14.8; p<0.001) were significantly higher; minimum oxygen saturation (82.0±8.2 vs. 83.6±7.8; p=0.04) was significantly lower. This long duration central apnea group was more likely to be male (60.4% vs. 40.2%; p<0.001) and have coronary artery disease (12.9% vs. 5.2%; p=0.01).
Conclusion: Long duration apnea for both obstructive and central disease is associated with greater severity apnea, older age, male gender and more severe oxygen desaturation.
Support (If Any): Dr Brian Koo, MD.

0436

ACOUSTIC PHARYNGOMETRY MEASUREMENT OF MINIMAL CROSS-SECTIONAL AIRWAY AREA IS A SIGNIFICANT INDEPENDENT PREDICTOR OF OBSTRUCTIVE SLEEP APNEA SEVERITY

DeYoung P[1,2], Bakker JP[1,2], Batool-Anwar S[1,2], Zhang C[1,2], Malhotra A[1,2]
[1]Sleep Medicine, Brigham and Womens Hospital, Boston, MA, USA, [2]Medicine, Harvard Medical School, Boston, MA, USA

Introduction: The current gold-standard method of diagnosing obstructive sleep apnea (OSA) is polysomnography which can be cumbersome and expensive. We therefore sought to determine a method to triage patients with OSA. We hypothesized that acoustic pharyngometry in combination with clinical characteristics (body mass index; BMI, and Epworth Sleepiness Scale, ESS) would predict severity of OSA.

Methods: Untreated subjects with suspected OSA were recruited at a local sleep clinic and underwent either laboratory- or home-based polysomnography. While seated in an upright position and breathing through the mouth, an acoustic pharyngometer was used to measure the minimum cross-sectional area (MCA) of the mouth at end-exhalation.
Results: Fifty subjects were recruited (29 males, mean age 47.8 range 21 to 81 years; mean±SD apnea-hypopnea index 37.8±32.1 events/hour, ESS 10.7±5.8 /24, BMI 34.9±7.7 kg/m2). Using univariate linear regression, the MCA and BMI were both significant independent predictors of AHI (p=0.01 and p=0.02 respectively). In a multivariate linear regression model including ESS, BMI, and MCA, only MCA was a significant independent predictor of AHI (standardized beta=-0.36, p=0.03; overall model R2=0.27, p=0.02).
Conclusion: These data suggest that independent of obesity and sleepiness, MCA determined by acoustic pharyngometry can significantly predict OSA severity. This measurement, which is easily obtained in upright and awake patients, offers potential utility in OSA diagnostic protocols.
Support (If Any): Sleep Group Solutions.

0437

DETERMINANTS OF NOCTURNAL PULSE OXIMETRY NADIR DURING SLEEP IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Castro A[1,4], Schwartz SW[2,4], Rosas JA[4], Anderson M[1,4], Foulis P[3,5]
[1]Division of Pulmonary, Critical Care and Sleep Medicine, University of South Florida, Tampa, FL, USA, [2]Department of Epidemiology and Biostatistics, University of South Florida, Tampa, FL, USA, [3]Department of Pathology and Cell Biology, University of South Florida, Tampa, FL, USA, [4]Medical Service, James A. Haley VA Hospital, Tampa, FL, USA, [5]Laboratory Service, James A. Haley VA Hospital, Tampa, FL, USA

Introduction: In the diagnosis of sleep apnea (OSA) during polysomnography, the nocturnal pulse oximetry nadir (n-SpO2) is routinely captured, and believed to be associated with severity of OSA, determined by A+HI. We questioned whether other factors were associated with such n-SpO2.
Methods: We used baseline data from a 5-year longitudinal study. 2379 veterans undergoing sleep study from 2001-2006 had a measure of n-SpO2. We examined three outcome variables: (1) dichotomizing n-SpO2 as =<74% versus >74%; (2) dichotomizing n-SpO2 as =<85% versus >85%; (3) comparing =<74% versus >90%, excluding patients with values in between. Independent variables included age, gender, race, BMI, tobacco dependence, A+HI, and combinations of co-morbidities, including COPD, CHF and pulmonary hypertension. Logistic regression was used for all modeling.
Results: Average age and BMI was 58.9 +/- 11.6 years and 34.0 +/-7.1 kg/m2, respectively. Five percent were women and 74% were white. We found that A+HI and BMI were independent determinants of n-SpO2 (p<0.0001 for each). In a model containing only A+HI and BMI as independent variables, the odds ratios (OR) per standard deviation A+HI and BMI were 1.46 and 1.38 for Outcome 1 (see methods), 1.64 and 1.35 for Outcome 2, and 3.00 and 2.09 for outcome 3, respectively. The model area under the receiver operator curve (AROC) was 0.68, 0.66 and 0.81 for Outcome 1, Outcome 2, and Outcome 3, respectively. When A+HI and BMI were both included in the model, none of the other covariates were significant except age and gender for Outcome 2. Inclusion of all other covariates in the model did not noticeably change the ORs for BMI and A+HI or the AROC.
Conclusion: In patients with OSA, low SpO2 recording during polysomnography is largely and independently determined by BMI and A+HI.

0438

CHRONIC PAIN AND REM-RELATED RESPIRATORY EVENTS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Goodpaster RL
Sleep Research Core and Reading Center, Vanderbilt University, Nashville, TN, USA

Introduction: Poor sleep quality is a common complaint of chronic pain suffers. Disruption of rapid eye movement (REM) sleep has been associated with a lower pain threshold. CPAP use has also been linked to a possible reduction in pain sensitivity. To investigate further, we examined REM vs. non-REM apnea-hypopnea indexes in subjects with chronic pain.
Methods: De-identified archival data were reviewed to assess differences between 283 subjects who underwent a polysomnographic sleep study at The Sleep Wellness Institute in West Allis, Wisconsin. All polysomnographic data was collected and interpreted using AASM guidelines. The alternative hypopnea rule was used. The subjects were grouped into those who self-reported experiencing fibromyalgia, migraines, chronic back pain, or arthritis (n=149) and a control group (n= 134) that did not report any symptoms of pain. Subjects who did not experience REM sleep were excluded from analysis. Each control was selected by range-matching the apnea hypopnea index (AHI) within 0.5 events per hour, using random numbers generation.
Results: Subjects that reported chronic pain showed a greater mean REM AHI (30.3 per hour) when compared to the controls (19.8 per hour) (p<.001; independent samples t-test); significance was maintained even after adjusting for body mass index and gender in multivariate model s(p = 0.005). Total mean AHI for the chronic pain group was 15.9 per hour and the control group's total mean AHI was 15.5 events per hour (p > 0.8).
Conclusion: The data suggests that chronic pain suffers may experience an increased level of sleep disordered breathing during REM sleep when compared to those that do not report pain.

0439

CALIBRATION MODEL FOR APNEA-HYPOPNEAS INDICES FOR AASM CRITERIA FOR HYPOPNEAS

Ho VU[1], Gottlieb DJ[2,1]
[1]Pulmonary & Critical Care Medine, Boston University, Boston, MA, USA, [2]Pulmonary, Critical Care, & Sleep Medicine, VA Boston Healthcare System, Boston, MA, USA

Introduction: Diagnosis and severity of obstructive sleep apnea (OSA) are based on the apnea-hypopnea index (AHI). The American Academy of Sleep Medicine Manual for Scoring of Sleep and Associated Events provides two alternative hypopnea definitions: the recommended definition requiring reduction in airflow accompanied by ≥4% desaturation; the alternative requiring reduction in airflow accompanied by either ≥3% desaturation or arousal. Previous clinic-based studies have shown higher values of AHI using the alternative (AHI-3%A) rather than the recommended (AHI-4%) hypopnea definition, but did not explore the shape of this relationship across the range of OSA severity. This study explores the relationship of AHI-3%A to AHI-4% in a large, general population sample.
Methods: AHI-4% and AHI-3%A values were available from 6265 in-home polysomnograms performed at the baseline examination of the Sleep Heart Health Study. Subjects included 3314 women and 2951 men, mean (SD) age 62.8 (10.8) years. Linear spline regression was performed to assess the relationship of AHI-4% to AHI-3%A, with knots at AHI-4% values of 5, 15, and 30 events per hour.
Results: AHI-3%A values were substantially higher than AHI-4% values at all severity levels; however, the slope of the relationship decreased with increasing AHI. For AHI-4% values of 5, 15 and 30, the corresponding estimated values for AHI-3%A were 14.9, 28.3, and 45.1. Using these values of AHI-4% and AHI-3%A as thresholds defining

mild, moderate and severe OSA, the two measures had very good agreement (weighted kappa 0.79).
Conclusion: Identification and severity classification of OSA are substantially affected by the hypopnea criteria used to calculate AHI and by the thresholds used to define disease severity. This analysis suggests that when using the AASM alternative hypopnea definition, threshold AHI values of approximately 15, 30, and 45 events per hour may be appropriate thresholds for defining mild, moderate, and severe OSA.
Support (If Any): NHLBI/NIH.

0440

CLINICAL CHARACTERISTICS IN MALE AND FEMALE PATIENTS WHIT RAPID EYE MOVEMENT-RELATED SLEEP DISORDERED BREATHING

Okur H[1], Pelin Z[2]
[1]Sleep Disorders Unit, Sureyyapasa Chest Diseases and Thoracic Surgery Teaching Hospital, Istanbul, Turkey, [2]Vocational School of Health Related Professions, Gazikent University, Gaziantep, Turkey

Introduction: Rapid eye movement (REM)-related sleep apnea is becoming a recognized pattern of sleep disordered breathing (SDB) , the significance of which is not well understood. Web investigated clinical characteristics in male and female patients whit REM SDB.
Methods: Patients age >18 undergoing routine 16 channel polysomnography (PSG) for presumed SDB were included. Included were 25 REM SDB patients who met these criteria: AHI≤15, REM AHI:≥10, NREM AHI≤10, REM AHI:NREM AHI≥2, total sleep time (TST) in REM sleep 15%. An ESS score of 10 or more , on a scale that ranges from 0 to 24, was considered to reflect excessive sleepiness.Demographics and ESS score were reviewed and the characteristics of snoring, morning headaches, use of tobacco were recorded. PSG parameters recorded were: TST, sleep latency (SL), sleep efficiency (SE), AHI, REM AHI, NREM AHI, oxygen desatüration Index.Statistical analysis was performed using unpaired t-test.
Results: Mean age was 52(38-67) years, mean BMI was 31(24-41) kg/m2 , mean ESS scores was 9.4, 56% of the patients were female and 44% of the patients were male. The incidence rate were greather in famele patients than in male for the symptoms of morning headache and high blood pressure. No differences were obtained for snoring, ESS score, depression, diabetes, hyperlipidemia between two groups.
Conclusion: REM SDB patients are likely to be female. Among patients whit REM SDB, ESS scores are not associated whit gender, age or BMI.

0441

BELIEFS AND ATTITUDES TOWARD OSA EVALUATION AND TREATMENT AMONG BLACKS

Shaw RN[1,2], McKenzie S[3], Taylor T[1], Olafiranye O[1,2], Zizi F[1,2], Boutin-Foster C[4], Ogedegbe G[5], Jean-Louis G[1,2]
[1]Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [2]Brooklyn Health Disparities Center, SUNY Downstate Medical Center, Brooklyn, NY, USA, [3]Physical Education Recreation and Health, Keane University, Union, NJ, USA, [4]Center of Excellence in Disparities Research, Weill Cornell Medical College, New York, NY, USA, [5]Center for Healthful Behavior Change, NYU Medical Center, New York, NY, USA

Introduction: Although blacks are at higher risk for obstructive sleep apnea (OSA), they are not as likely as their white counterparts to receive OSA treatment. Evidence shows that only 38% of blacks adhered to physician-recommended OSA evaluation. Thus, specific ethno-cultural barriers might limit access to available sleep services in black communities. This study assessed knowledge, beliefs, and attitudes toward OSA evaluation and treatment among blacks residing in Brooklyn, NY.
Methods: Data for our analysis came from 39 individuals participating in five focus groups conducted at SUNY Downstate Medical Center. Groups comprised an average of 8 participants and lasted about 30-40 minutes. An experienced facilitator led semi-structured discussions to explore participant's knowledge, attitudes, and beliefs about sleep, OSA, and assessment and treatment of OSA. Discussions were recorded, transcribed verbatim, and uploaded into a qualitative software for coding and analysis.
Results: The mean age of the sample was 49±16yrs; 55% were female and 31% did not complete high school. Participants expressed their lack of awareness of OSA, especially as a serious health condition. Barriers to OSA evaluation included problems sleeping in a strange environment and mistrust of medical studies. Barriers to CPAP treatment adherence were related to the strangeness of the device, fear of wearing a mask while they sleep, and concerns about their partner's perceptions of treatment. Despite these barriers, many indicated willingness to undergo OSA assessment and treatment if it could help alleviate their sleep problems.
Conclusion: Results from this study suggest that increasing awareness of OSA, improving trust between health care providers and patients, and familiarizing patients with the sleep study testing environment may be avenues to enhancing adherence to OSA testing and treatment. These themes will be used to inform and tailor a sleep apnea intervention designed to increase awareness and referral of OSA patients in black communities.
Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

0442

EVALUATION OF LINGUAL TONSIL HYPERTROPHY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: MAGNETIC RESONANCE IMAGING STUDY

Kim J[2,1], Sung M[2], Lee W[2,1]
[1]Otorhinolaryngology, Seoul National University Bundang Hospital, Seongnam, Republic of Korea, [2]Otorhinolaryngology, Seoul National University College of Medicine, Seoul, Republic of Korea

Introduction: This study is aimed to identify lingual tonsil (LT) hypertrophy and its associated factors in patients with obstructive sleep apnea (OSA) using a magnetic resonance imaging (MRI).
Methods: Patients underwent MRI of the upper airway and a full-night WATCH-PAT. OSA patients whose AHI was higher than 5 per hour were included. The thickness of LT was measured in the axial views of upper airway MRI, and laryngopharyngeal regurgitation (LPR) was evaluated by endoscopic examination. Age, sex and body mass index (BMI) were also analyzed.
Results: A total of 85 patients were included in the present study. The mean apnea hypopnea index (AHI) was 21.8 ± 3.3. Thirty patients had mild OSA (5 <AHI<15), 35 moderate OSA (15<AHI<30) and 20 severe OSA (30<AHI). The mean thickness of LT was 4.3 ± 2.4 mm. The thickness of LT was significantly correlated with BMI ($r = 0.256$, $p = 0.018$). The median thickness of LT was significantly different ($p = 0.002$) between patients without LPR (3.04 mm, interquartile 2.14 - 4.93) and with LPR (5.21 mm, interquartile 3.88 - 8.29). Age, sex and AHI were not significant factors for hypertrophy of LT.
Conclusion: Hypertrophy of the LT in OSA patients may be associated with higher BMI and presence of LPR.

0443

EFFECT OF SEVERITY OF OBSTRUCTIVE SLEEP APNEA ON RESPIRATORY EFFORT RELATED AROUSAL INDEX

Lim S, Dholakia S, Thakkar MM, Bollu P, Sivaraman M, Goyal MK, Sahota P
Neurology, University of Missouri Columbia, Columbia, MO, USA

Introduction: We hypothesize that subjects with mild obstructive sleep apnea (OSA) have lower respiratory effort related arousal (RERA) index compared to those with moderate to severe OSA.

Methods: A retrospective analysis was performed on patients with OSA who underwent baseline polysomnography and second night polysomnography for CPAP therapy at University of Missouri-Columbia Sleep Disorders Center from January 2011 to July 2011. Patients meeting following criteria were included: 1.Baseline AHI of more than five. 2. Presence of RERAs. Patient demographics, AHI and RERA index were obtained from baseline and second night polysomnograms.
Results: In our initial sampling, 92 patients were chosen based on inclusion criteria. Patients were divided into two groups based on AHI: mild OSA (AHI 5-14.9) and moderate to severe OSA (AHI >=15). 57 patients had mild OSA (mean AHI of 9.22) and 35 had moderate to severe OSA (mean AHI of 27.78). Significant increase ($p<0.05$) in mean RERA index was observed between mild OSA (mean RERA index of 10.47) and moderate to severe OSA (mean RERA index of 14.34). RERA index was significantly ($p<0.05$) reduced, from 11.94 to 6.03, after CPAP treatment.
Conclusion: 1. Patients with moderate to severe OSA have a higher RERA index than patients with mild OSA. 2. CPAP therapy is effective in reducing RERA index.

0444

INDIVIDUAL ITEM-ASSOCIATIONS FROM FOUR SLEEP QUESTIONNAIRES AGAINST IN-HOSPITAL POLYSOMNOGRAPHY VARIABLES AMONG PRE-SURGICAL CARDIAC PATIENTS

Thakre TP[1], Collop N[2], Stierer T[3], Kaw R[1], Tarler M[4], Kayyali HA[4], Andrews ND[1], Moul DE[1], Foldvary-Schaefer N[1]
[1]Sleep Disorders Center, Cleveland Clinic Foundation, Cleveland, OH, USA, [2]Emory University, Atlanta, GA, USA, [3]Johns Hopkins Medical Institutions, Baltimore, MD, USA, [4]ClevMed, Cleveland, OH, USA

Introduction: Sleep disordered breathing is common among cardiovascular disease patients, increasing their peri-operative risks. We examined the predictive value of items on sleep apnea (SA) questionnaires in a cardiac surgery cohort.
Methods: Scheduled cardiac surgery patients at Cleveland Clinic and Johns Hopkins Hospital completed the Epworth Sleepiness Scale (ESS), Berlin Questionnaire (BQ), Sleep Apnea subset of Sleep Disorders Questionnaire (SA/SDQ), and Global Sleep Assessment Scale (GSAQ) along with pre-surgery in-hospital polysomnography (PSG). Correlations between individual questionnaire items and combinations of items with PSG variables were calculated using different AHI cutoffs.
Results: 65 subjects had complete data including 58(89%) Caucasians and 38(58%) males, age 67.5±13.4 years. 47(72%) subjects had SA; severe (AHI > 30) in 21, moderate (AHI 15-30) in 10, mild(AHI 5-<15) in 16. Overall AHI was 21.2±20.1, REM AHI 23.3±23.9, supine AHI 21.9±21.4, and minimum SAO2 was 83±13.12%. No individual items on the 4 questionnaires correlated significantly with overall, REM or supine AHI, minimum SaO2 or sleep time with SaO2<90%. The best correlations with AHI were observed for ESS item 3, BQ items 3-6, SA/SDQ items 2,6,8,9, and 13, and GSAQ item 6. Using AHI cutoffs of >5,>10,>15,>30, item 6 on the BQ had correlation coefficients in the 0.30-0.31 range. The combination of Berlin-6 (relating to frequency of breathing pauses in sleep) and SA/SDQ-8 (relating to worsening of snoring/breathing problem after alcohol use) showed correlations between 0.31-0.34 with PSG variables.
Conclusion: In this historically largest, but limited, sample of cardiac surgery patients undergoing pre-operative in-hospital SA evaluations, PSG and self-report variables were not generally correlated significantly. Yet, while exploratory, the results suggest some item-specific predictiveness of SA from standard questionnaires. The best candidate items might be combined to develop a screening questionnaire that might be predictive of moderate to severe SA.

0445

IMPLICATIONS OF RESPIRATORY EFFORT RELATED AROUSALS ON THE SEVERITY OF SLEEP DISORDERED BREATHING IN PATIENTS UNDER AGE 50

Gebhardt N[1], Phadke J[1], Kane K[2]
[1]Neurology, Saint Vincent hospital, Worcester, MA, USA, [2]University of Massachusetts Medical School, Worcester, MA, USA

Introduction: Respiratory Effort Related Arousals (RERAS) cannot be analyzed in a 4 channel home Polysomnogram (PSG) due to lack of Electroencephalogram (EEG) data, therefore home studies underestimate degree of the respiratory disturbance. It is unclear if RERA'S are recognized by all auto CPAP sensing algorithms. We set out to identify the frequency of RERA episodes in patients aged 50years and under who were seen in an accredited sleep center and evaluated over a consecutive period of 13 months with a diagnostic whole or split night Polysomnogram(PSG).
Methods: Out of a total of 1240 patients who underwent PSG from September 2010 to October 2011, a total of 113 aged 50 years and below were identified. 15 of the 113 had no RERA's and were excluded and in the remaining ninety eight RERA index was correlated with age (divided into two group : <35 V/s >35 yrs.), gender, body position, and REM V/s Non REM sleep .
Results: Out of the 98 patients with a RERA index of 1 or above, 50% had a RERA index between 5 and 21 and the RERA's constituted a mean of 17 % of the total RDI. There was no significant difference seen in the frequency of RERA's between men and woman when age groups below and above 35 yrs were compared ($p=0.64$). A statistically significant difference was seen in patients >35 yrs during REM compared to NREM sleep ($p<0.02$). Significant difference was also seen comparing gender and body position, with men having more RERA in both the supine and lateral positions compared to woman. ($P<0.04$).
Conclusion: Limited 4 channels portable PSG does not identify RERA's and based on the above data, we suggest significantly underestimates the degree of the Sleep disordered breathing in patients under 50 years, potentially impacting decision to treat with CPAP.

0446

RESPIRATORY EFFORT RELATED AROUSALS: ASSOCIATION WITH INCREASED SYMPATHETIC MODULATION OF HEART RATE VARIABILITY (HRV)

Wang J, Sica A, Greenberg H
Pulmonary, Critical Care and Sleep Medicine, Hofstra-North Shore-LIJ School of Medicine, New Hyde Park, NY, USA

Introduction: Sympathetic activation as sequelae of sleep disordered breathing (SDB) represents a potential mechanism underlying increased cardiovascular morbidity and mortality. Traditionally, the apnea-hypopnea index (AHI) provided an index of SDB severity; however, that measure excluded respiratory effort related arousals (RERAs). We hypothesize that RERAs increase sympathetic modulation of HRV as estimated by autoregressive (AR) spectral analysis.
Methods: Subjects evaluated for SDB had standard overnight polysomnography with SDB defined according to AASM guidelines. Included subjects had AHI<15/h and RERA index >5/h. Those excluded had cardiac disease, and/or diabetes, or used medications affecting cardiac conduction or autonomic activity. AR spectra were constructed from two 10-minute samples of ECG, free of artifact, during Stage N2 sleep. Both samples included flow limited breathing (FLB), one with RERAs, one without RERAs.
Results: 15 subjects (8 m, 7 f) were aged: 46 ± 8.8 years; BMI: 32.3 ± 6.4 kg/m2; AHI: 3.8 ± 3.4/h; RERAs: 7 ± 1.6/h (mean ± s.d.). Paired t-tests showed that the percentage of total power in the low frequency spectral region (LF: 0.04 - 0.15 Hz), i.e., sympathetic modulation, was significantly greater with RERAs than without RERAs, 47% ± 18.1% and 29% ± 16.9%, respectively ($p < 0.05$). Conversely, the percentage

of total power in the high frequency region (HF: 0.15 - 0.4 Hz), mainly parasympathetic modulation, was significantly greater during FLB without RERAs than with RERAs, 70% ± 16.9% and 52% ± 18.1%, respectively ($p < 0.05$). Lastly, the LF/HF ratio was significantly greater with RERA than without, 1.15 and 0.52, respectively ($p < 0.05$).
Conclusion: This data supported our hypothesis that flow limitation with RERAs represents a potent modulator of cardiac autonomic activity with preferential activation of cardiac sympathetic discharge. Further, sympathetic activation may be recognized as important contributors to the increased risk of cardiovascular morbidity and mortality associated with SDB.

0447

RELATIONSHIP BETWEEN BODY FAT DISTRIBUTION AND UPPER AIRWAY DYNAMIC FUNCTION DURING SLEEP IN ADOLESCENTS

Yuan H[1,2], Schwab R[3], Kim C[3], He J[4], Shults J[4], Bradford R[1], Huang J[1], Marcus CL[1]
[1]Sleep Center, Children's Hospital of Philadelphia, Philadelphia, PA, USA, [2]Pulmonary, The First Hospital of Jilin University, Changchun, China, [3]Sleep Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA, USA, [4]Biostatistics, University of Pennsylvania School of Medicine, Philadelphia, PA, USA

Introduction: In adults, obstructive sleep apnea (OSA) is associated with increased visceral adipose tissue (VAT). However, few studies have evaluated the role of VAT in adolescents. Furthermore, studies have focused on polysomnographically-evident obstruction rather than functional upper airway measurements. We hypothesized that increased neck circumference (NC) and increased VAT would be associated with increased upper airway collapsibility.
Methods: Adolescents (24 obese OSA, 22 obese controls, 29 lean controls) underwent abdominal MRI. During sleep, they underwent measurement of upper airway pressure-flow relationships. inspiratory airflow was correlated with the level of nasal pressure applied via a mask. The slope of the upstream pressure-flow relationship (SPF) during both activated (reflecting structural plus neuromotor factors) and hypotonic (reflecting structural factors) upper airway states was used to characterize upper airway function.
Results: Both NC and VAT were greater in obese controls and obese OSA than lean controls ($P<0.001$); there were no differences between obese controls and obese OSA. Obese OSA had a greater activated SPF than the control groups ($P<0.001$) whereas hypotonic SPF was greater in both obese groups compared to lean controls ($P=0.01$). In lean controls and obese OSA, increased NC was associated with increased activated SPF, whereas in obese controls it was associated with decreased activated SPF ($P=0.03$). In contrast, increased NC was associated with increased hypotonic SPF in all 3 groups ($P<0.001$). There was no significant effect of VAT, subcutaneous or total adipose tissue on either activated or hypotonic SPF for any of the 3 groups.
Conclusion: Increased NC is associated with increased upper airway collapsibility in the hypotonic state. The data suggest that obese adolescents without OSA, despite a narrowed airway from adipose tissue encroachment, are protected from developing OSA by increased upper airway neuromotor activation. NC is of greater value than VAT in predicting upper airway collapsibility in obese adolescents.
Support (If Any): This study was supported by NIH grants UL1RR024134 and R01-HL58585. Dr. Yuan is a recipient of the state scholarship from the China Scholarship Council.

0448

REGIONAL REDUCTIONS IN SLOW-WAVE ACTIVITY IN OBSTRUCTIVE SLEEP APNEA: A HIGH-DENSITY EEG ANALYSIS

Jones S[1,2], Riedner B[1,2], Benca R[1,2]
[1]Wisconsin Center for Sleep Medicine and Research, University of Wisconsin-Madison, Madison, WI, USA, [2]Department of Psychiatry, University of Wisconsin-Madison, Madison, WI, USA

Introduction: Obstructive Sleep Apnea (OSA) leads to sleep fragmentation and intermittent hypoxemia and is commonly associated with cognitive impairments thought to be related to specific brain structural abnormalities. We sought to test whether sleep slow-wave activity SWA, a recognized measure of sleep need and a potential marker of synaptic plasticity, is altered in OSA patients, either globally or in a regionally specific manner.
Methods: We evaluated sleep using standard polysomnography along with high-density EEG (256 channels) in 24 subjects: 12 mild/moderate (AHI>10) untreated, asymptomatic OSA patients (mean age 51 yrs) and 12 normal controls matched for age, sex. After manual artifact removal (including EEG arousals), spectral analysis [fast Fourier transform routine, Hanning window, 30 s epochs (averages of five 6-s epochs] was performed for all 256 channels. Topographic power maps were calculated for standard frequency bands for all channels. Maps were then compared using both absolute and normalized power (z-scores computed for each subject across all electrodes). Topographic differences between groups were determined by statistical nonparametric mapping.
Results: Analysis of polysomnographic variables demonstrated no significant difference between groups in duration of N2, N3 or REM sleep. Total sleep time was significantly lower (369.7±24.1m vs. 403.1±26.3m, $p <0.01$), and N1 was significantly higher (83.0±14.8m vs. 36.5±10.8m, $p <0.01$), in OSA subjects. EEG power analysis re¬vealed a significant decrease in normalized SWA power in NREM sleep (N2 and N3) in OSA subjects compared to controls. This effect was localized to a cluster of electrodes above parietal cortex, adjacent to the standard 10-20 location Pz.
Conclusion: Our study provides evidence of regionally specific reductions of SWA in otherwise healthy OSA patients. Analyses of topographical changes in sleep may offer information on the neural consequences OSA, and has the potential to provide insight into the success of therapeutic interventions.

0449

REM SLEEP RELATED BREATHING DISORDERS: CLINICAL FEATURES AND IMPLICATIONS ON TREATMENT DECISIONS

Dholakia S, Goyal MK, Thakkar MM, Sivaraman M, Sahota P
Neurology, University of Missouri-Columbia, Columbia, MO, USA

Introduction: We report clinical features of REM sleep related breathing disorders (REM-SRBD) in a sleep disorders clinic population and discuss its impact on treatment decisions.
Methods: Retrospective chart review of baseline polysomnograms (PSG), performed at our accredited sleep center, was conducted. We included patients meeting the following criteria: 1) REM Apnea-Hypopnea index (AHI) of greater than 5 per hour. 2. REM AHI at least two times NREM AHI.
Results: A total of 165 patients met the criteria. 70% (115/165) were females and 30% (50/115) were males. The average age was 48.1 years (range 24-76 years). Average BMI was 39.7 (range 18.7-80). The mean total AHI was 8.81 (range 0.4- 27), REM AHI was 33.90 (5.2-87) and NREM AHI was 4.6 (0 - 25.1). The most common presenting complaints were snoring (70%), apnea (43%) excessive daytime sleepiness (42%) and fatigue (22%).
Conclusion: Our study suggests that a subset of symptomatic patients have REM-SRBD. This is more common in women and in obese indi-

viduals, with mild disease (mean total AHI 8.81). Presenting complaints included snoring, apnea, excessive daytime sleepiness and fatigue. It is essential to examine REM sleep during PSG to diagnose this entity and since REM sleep duration is longer during the latter part of the night, it is critical to perform all night PSGs. In addition, night-to-night biological variability may result in varying REM AHI, and therefore the total AHI. Respiratory events are longer and are associated with a greater degree of hypoxemia in REM sleep. This is likely due to the higher stimulus intensity needed for an arousal from REM. This study demonstrates that for symptomatic patients, in addition to the total AHI, other factors such as REM AHI, amount of REM sleep obtained, body position, duration of respiratory events and degree of hypoxemia must be considered in making treatment decisions.

0450

PREVALENCE, EXTENT, AND BURDEN OF SLEEP-DISORDERED BREATHING SYMPTOMS AND RISK OF OBSTRUCTIVE SLEEP APNEA AMONG AFRICAN AMERICANS IN THE JACKSON HEART STUDY

Fulop T[1], Rack MJ[1,6], Hickson DA[1,2,3], Wyatt SB[1,2,4], Bhagat R[1,5], Gowdy O[7], Taylor HA[1,2], Flessner MF[1]

[1]School of Medicine, University of Mississippi Medical Center, Jackson, MS, USA, [2]Jackson Heart Study, University of Mississippi Medical Center, Jackson, MS, USA, [3]Jackson State University, Jackson, MS, USA, [4]School of Nursing, University of Mississippi Medical Center, Jackson, MS, USA, [5]Pulmonary Medicine, G.V. Sonny Montgomery Veterans Administration Medical Center, Jackson, MS, USA, [6]Reggie White Sleep Disorder Centers, Southaven, MS, USA, [7]Internal Medicine Associates, Meridian, MS, USA

Introduction: Limited data are available from well-characterized African American cohorts regarding sleep-disordered breathing (SDB). We examined the prevalence and burden of symptoms suggestive of SDB and their risk for obstructive sleep apnea (OSA) in the Jackson Heart Study (JHS), an all-African-American cohort of 5,301 adults.
Methods: Data on selected daytime and nighttime sleep symptoms were collected using a modified Berlin questionnaire during the baseline examination. Risk of OSA was calculated using the prediction method developed by Rodsutti et al. Age-adjusted multivariable logistic regression models were used to examine the associations between potential risk factors and measures of sleep.
Results: Unadjusted prevalence rates for snoring (61.1%) and daytime somnolence (64.0%) were relatively high in this cohort. Sleep symptoms and risk of OSA were high among men and women in the JHS and increased with age and obesity. Poor to fair perceived health and stress were associated with odds of adverse sleep symptoms. Prevalent hypertension was associated with odds of risk for OSA in both men (OR=1.56, 95%CI: 1.13, 2.18) and women (OR=2.59, 95%CI: 1.90, 3.52). In men, cardiovascular disease was associated with increased risk for OSA (OR=2.37, 95%CI: 1.22, 4.61). Waist circumference was positively associated with increased risk of OSA in men. Before multivariable adjustment, the odds of OSA increased nearly four-fold (OR=3.87, 95%CI: 3.32, 4.51) for each 3-cm increase in neck circumference in men. This relationship was partially attenuated after multivariable adjustment (OR=1.69, 95%CI: 1.33, 2.15).
Conclusion: SDB symptoms in JHS had a strong positive association with features of visceral obesity, stress, and poor perceived health. Our study reaffirmed the impact of body anthropometrics on symptoms of SDB and risk for OSA. There was a substantial burden of symptoms of SBD in this large community-dwelling African-American population.
Support (If Any): The authors would like to give sincere thanks to the Jackson Heart Study participants, staff, and interns for their long-term commitment to the study.

0451

PREDICTORS OF SURGICAL COMPLICATIONS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Stevens DR

Medicine, KU Medical Center, Kansas City, KS, USA

Introduction: Obstructive sleep apnea (OSA) is associated with an increased rate of post surgical complications (PSCs) in most studies. Predictors of PSCs in patients with OSA have not yet been established. Understanding these predictors may increase physician awareness of risk and guide protocol development to minimize these potential complications.
Methods: Data was gathered from the United Healthsystem Consortium on patients with obstructive sleep apnea hospitalized at KU Medical Center in 2010 for a surgical procedure. These patients were separated into two groups based on the presence or abscence of PSCs. The patients were then characterized by sex, race, age, financial class, risk of mortality, severity of illness, hospital length of stay and type and number of comorbid diseases. Data analysis determined if there was a statistically significant difference in characteristics between the two groups.
Results: 814 patients were included in the analysis of which 168 patients had PSCs while 646 had no complications. There was no statistically significant difference in race or sex between the two groups. The group with PSCs was 2.72 years older than the group without complications. The risk of PSCs increased as length of stay, severity of illness and risk of mortality increased. Emergent and routine priority of admission both increased risk for PSCs when compared to urgent priority of admission. Complicated hypertension, peripheral vascular disease, renal disease and liver disease were the major comorbidities associated with increased risk of PSCs. Patients with a higher number of comorbidities (4,5 and 6 comorbid conditions) were at higher risk of PSCs.
Conclusion: Hypertension, peripheral vascular disease, renal disease and liver disease were identified as likley predictors of PSCs in patients with OSA . Future prospective studies should be performed to better clarify the relationship between these comorbid conditions and PSCs.

0452

PREDICTION OF OBSTRUCTIVE SLEEP APNEA BY ANESTHESIOLOGISTS, OTOLARYNGOLOGISTS, AND INTERNISTS USING VISUAL PHOTOGRAPHIC ANALYSIS

Cheung K[1], Ishman SL[2], Tron L[1], Moy N[1], Gamaldo C[3], Collop N[4], Stierer T[1]

[1]Department of Anesthesia and Critical Care Medicine, Johns Hopkins School of Medicine, Baltimore, MD, USA, [2]Departments of Otolaryngology-Head and Neck Surgery, Pediatrics & Pulmonary and Critical Care Medicine, Johns Hopkins School of Medicine, Baltimore, MD, USA, [3]Departments of Neurology and Pulmonary and Critical Care Medicine, Johns Hopkins School of Medicine, Baltimore, MD, USA, [4]Divisions of Pulmonary, Allergy, and Critical Care Medicine and Neurology, Emory School of Medicine, Atlanta, GA, USA

Introduction: Obstructive sleep apnea (OSA) has been historically under-diagnosed and can be associated with grave peri-operative complications. The American Society of Anesthesiologists and American Academy of Sleep Medicine recommend screening for OSA prior to surgery. However, only a minority of patients are actually screened for OSA preoperatively. The aims of this study were to determine the proficiency of anesthesiologists, otolaryngologists, and internists at predicting the presence of OSA by visual photographic analysis and to determine if accuracy of prediction differs by provider type.
Methods: After IRB approval, 56 patients referred to a hospital-based sleep center consented to frontal and lateral photographs of the face and torso prior to polysomnography. Twenty anesthesiologists, 10 otolaryngologists, and 11 internists viewed patient photos and scored the patient as OSA "positive" or "negative". Patients with an RDI ≥ 15 were consid-

ered "positive". Providers were then given the patient's co-morbidities and rescored the photographs.
Results: Nineteen patients had a respiratory disturbance index (RDI) <15, 19 had an RDI of > 15 but < 40, and 18 had an RDI >40. The mean RDI was 28.7 ± 26.7 (range 0-125.7) and the mean body mass index (BMI) was 34.1 ± 9.7 (range 17.4-63.7). Overall, providers predicted the correct answer with 61.2% accuracy without knowledge of co-morbidities and 60.0% with co-morbidities (p=0.15). There was no difference between provider groups (p=0.77). Prediction accuracy was unrelated to age (p=0.76), gender (p=0.85) or race (p=0.57) of the patients.
Conclusion: The ability to predict the presence of OSA based on visual inspection of frontal and lateral photographs is marginally superior to chance and did not differ by provider type. Furthermore, knowledge of co-morbidities did not aid the providers in the accuracy of their predictions.

0453

POSITIONAL SENSITIVITY AS A CONFOUNDER IN DIAGNOSIS OF SEVERITY OF OBSTRUCTIVE SLEEP APNEA

Sunnergren O[1,2], Broström A[1], Svanborg E[1]
[1]Clin. Neurophysiology, IKE, Linköping University and University Hospital, Linköping, Sweden, [2]Ear-Nose and Throat Clinic, Ryhov County Hospital, Jönköping, Sweden

Introduction: The apnea- hypopnea index (AHI) is used to grade obstructive sleep apnea (OSA) into mild, moderate and severe forms. Obstructive events are most common in the supine position. The amount of supine sleep thus influences total AHI. The aim of this study was to determine the prevalence of position dependent OSA (POSA) and its relation to OSA severity classification as recommended by the American Academy of Sleep Medicine (AASM).
Methods: 265 patients with suspected OSA syndrome underwent whole-night respiratory home recordings to determine AHI in the supine and non-supine positions, respectively. POSA was defined as supine AHI at least double as high as the non-supine AHI, and with supine AHI at least 5.
Results: 53% of the patients had POSA, 22% had non-position dependent OSA and 25% had normal respiration in all positions. By AASM classification, 81 subjects did not have OSA, but 42% of them had some degree of obstruction when supine and 5 subjects would have been classified as moderate - severe if they had only slept supine. Conversely, of the 53 cases classified as mild - moderate OSA, 44% would have changed to a more severe classification if they had exclusively slept supine.
Conclusion: POSA was common both in subjects that by AASM classification had OSA, as well as those without. The severity of OSA, as defined by AASM, is dependent on supine sleep time in a majority of patients.
Support (If Any): The Swedish Heart and Lung Fund, FORSS and Futurum Research Fund, Jönköping County.

0454

VALIDATION OF THE ARABIC VERSION OF THE STOP-BANG

El-GEndy A[1,2], El-Gendy A[1,2], Elhennawy H[3,4], Hamdan A[1,2]
[1]Florida Lung & Sleep Associates, Lehigh Acres, FL, USA, [2]Chest Institute, Lehigh Acres, FL, USA, [3]Psychiatry, 6th of October University, 6th Of October, Egypt, [4]Aviation Medical Council, Cairo, Egypt

Introduction: STOP-BANG questionnaire is a validated tool that is widely used in English speaking countries to screen for obstructive sleep apnea (OSA) before surgery. The aim of the study is to develop an Arabic version of the simple-to-use 8-point questionnaire (A-STOP-BANG) in Arabic-speaking countries.
Methods: A-STOP-BANG was created according to the recommendations of the ISPOR Task Force for Translation and Cultural Adaptation by forward translation, backward translation, harmonization and testing in bilingual individuals. It was distributed to a group of 196 bilingual individuals from different backgrounds that are fluent in English and Arabic.
Results: Of the 196 bilingual individuals, 158 individuals (81%) answered all of the items on the questionnaire. Only these subjects were included in the analysis. In total, there were 66 males (42%) and 92 females (58%). Of the 158 respondents who completed the survey, 97 (61%) were of Egyptian background, 14 (9%) of Palestinian background, 9 (6%) of Libyan background, 9 (6%) of other backgrounds, 3 (2%) of Algerian background, 3 (2%) of Jordanian background, 1% of Syrian, Iraqi or Yemeni background , and < 1% of UAE, Oman, Saudi Arabia, Kuwait, Lebanon, Morocco, or Bahrain background. The mean STOP-BANG score was 1.79 in the English version and 1.73 in the translated Arabic version (p=0.63). The A-STOP-BANG and the English questionnaire were highly correlated (r=.912, p<.0001).
Conclusion: Although there are language, dialect and cultural differences, our study validates the translated A-STOP-BANG questionnaire as a simple and useful tool to be used in Arabic-speaking countries. Further studies need to be conducted in order to evaluate the validity of A-STOP-BANG questionnaire to screen for obstructive sleep apnea (OSA) before surgery.
Support (If Any): Florida Lung & Sleep Associates, Chest Institute.

0455

VALIDATION OF THE STOP-BANG QUESTIONNAIRE AMONG PATIENTS REFERRED FOR SUSPECTED OSA

Boynton G[1,2], Vahabzadeh A[1], Hammoud S[1], Burns JW[3], Ruzicka DL[1], Chervin RD[1]
[1]Sleep Disorders Center and Department of Neurology, University of Michigan, Ann Arbor, MI, USA, [2]University of Michigan Medical School, University of Michigan, Ann Arbor, MI, USA, [3]Michigan Tech Research Institute, Michigan Technological University, Ann Arbor, MI, USA

Introduction: Obstructive sleep apnea (OSA) has substantial adverse health impact, but remains greatly underdiagnosed, in part because laboratory-based polysomnography, the gold-standard assessment of sleep and breathing, involves considerable time and expense. The STOP-BANG questionnaire is an easy-to-use tool recently developed for OSA screening of surgical patients at preoperative clinics. This study was conducted to assess the utility of the STOP-BANG questionnaire among patients referred to a sleep laboratory for suspected OSA.
Methods: Patients undergoing baseline polysomnography for clinical indications were eligible if they were at least 18 years old and had no prior OSA diagnosis. Subjects completed the STOP-BANG questionnaire, answering four yes/no questions and self-reporting weight, height, age, neck circumference, and gender. Values for patient weight, height, age, neck circumference, and gender were also measured or assessed, and recorded by sleep laboratory technicians. Patients were considered to be at high risk for OSA if they had a score ≥ 3 points, out of the 8 possible points on the questionnaire. To validate the questionnaire, STOP-BANG scores were compared to the main polysomnographic measure of OSA severity, the apnea-hypopnea index (AHI, number of apneas or hypopneas recorded per hour of sleep).
Results: Among 219 patients, the sensitivities of the STOP-BANG for AHI>5 (mild OSA or worse), >15 (moderate OSA), and >30 (severe OSA) were 82, 93, and 97% respectively. The corresponding negative predictive values were 44, 87, and 96%. Specificities were low (48, 40, and 33%) but could be raised with higher STOP-BANG cutoffs.
Conclusion: Among patients referred to a sleep laboratory for suspected OSA, the STOP-BANG may effectively screen for severe OSA (AHI>30), and could help to prioritize resource-limited testing. If sensitivity is maintained in community settings, the STOP-BANG may also

prove useful for population screening for a highly prevalent, consequential, yet often occult condition.
Support (If Any): NIH 5 T35 HL7690-29; University of Michigan Sleep Disorders Center.

0456

VALIDATING THE USE OF A SINGLE CHANNEL PORTABLE MONITOR FOR PRE-OPERATIVE OSA SCREENING

Chang NS[1], Castillo JW[1], Becker K[1], Chang JW[1], Myung SR[1], Vassantachart PB[1], French K[1], Wigler E[1], Hwang D[1,2]
[1]Sleep Medicine, Kaiser Permanente, Fontana, CA, USA, [2]Pulmonary, Critical Care, Sleep Medicine, NYU School of Medicine, New York, NY, USA

Introduction: OSA is associated with an increased rate of post-operative complications, especially in moderate-severe disease. Questionnaire based screening is suboptimal in stratifying OSA severity. We incorporated into a pre-operative screening protocol use of a single channel portable monitor based on nasal pressure (SCPM) that provides a Respiratory Event Index (REI). We validated its ability to stratify severity and prospectively validated use in a clinical setting by non-sleep laboratory personnel.
Methods: Initial Validation: SCPM (RUSleeping®, Philips) was performed simultaneously with attended polysomnography; REI was compared to OSA indices. Prospective Validation: Orthopedic surgery department identifies patients at risk for OSA with a STOP-BANG questionnaire score ≥3. They subsequently undergo a one-night SCPM dispensed by the Peri-Operative Department nurse. Moderate-severe OSA is presumed with a REI ≥20, and patients are managed peri-operatively with CPAP and other precautions. Formal polysomnography (attended or ambulatory) was recommended with REI ≥10 and results compared for further validation.
Results: Initial Validation: 82 patients had SCPM simultaneously with attended polysomnography. REI correlated best with AHI4% (R=0.75, p<0.001) and less well with RDI and ODI. Mean difference was 3.0 (2SD 31.4) using a Bland-Altman plot. REI threshold of ≥20 identified patients with an AHI4%≥15 with a sensitivity of 76%, specificity of 79%. Prospective Validation: 210 peri-operative patients had STOP-BANG≥3 and 169 (80.5%) underwent SCPM. All were successful, although 6 (3.6%) required 1 repeat. Of these, 117 completed polysomnography (27 attended, 94 ambulatory). REI again correlated best with AHI (R=0.69, p<0.001). Bland-Altman revealed mean difference 12.2 (2SD 27). REI threshold of ≥20 identified patients with an AHI4%≥15 with a sensitivity of 94%, specificity of 46%.
Conclusion: SCPM can be practically incorporated by non-sleep personnel as a simple method of stratifying OSA severity when this information may alter management of patients at risk, such as in the peri-operative setting.
Support (If Any): Philips Respironics.

0457

USE OF A LEVEL 3 PORTABLE MONITOR IN DIAGNOSIS AND MANAGEMENT OF SLEEP-DISORDERED BREATHING IN AN IN-PATIENT TERTIARY CARE SETTING

Povitz M, Kimoff R
Respiratory Division and Sleep Laboratory, McGill University Health Centre, Montreal, QC, Canada

Introduction: Sleep-disordered breathing (SDB) may impact on the course of medical illness in hospitalized patients. Access to testing during hospitalization to assess this may be limited by wait times for laboratory polysomnography. Consequently, level 3 portable monitors (PM) are being used for in-patient diagnosis and assessment of SDB treatment in our institutions. The objective of this study was to retrospectively assess the rate of technically adequate studies, the diagnostic information obtained, and the impact on patient management.
Methods: PM (Embletta, Medcare, Inc) were installed by respiratory therapists with subsequent unattended recording on inpatient wards at three tertiary hospitals. To date 100 records from the past 2 years have been reviewed. We recorded demographic and clinical data, including admitting diagnoses and co-morbidities, indication for sleep study, diagnostic information obtained from recordings, change in clinical management subsequent to the PM and clinical evolution post-discharge.
Results: : Of 100 studies reviewed 88 were deemed technically adequate with respect to signal quality and recording duration. Subjects were 65 ± 14 years old; 42 of 88 (48%) were male. The commonest admitting diagnoses were COPD (n=16), heart failure (n=16), pneumonia (n=5), hypoventilation (n=5) and asthma (n=4). Median length of stay was 13 days $CI_{25,75}$(7,33); the median time from admission to PM was 6 days $CI_{25,75}$(2,14). 78 studies were diagnostic. PM and clinical data supported diagnoses of obstructive sleep apnea (n=57), central sleep apnea (n=5), nocturnal hypoxemia/hypoventilation (n=2), or no abnormality (n=14). The 10 studies performed on SDB treatment showed persistent SDB (n=3), new central apnea (n=1), and no diagnostic abnormality (n=6). Results from the PM were documented to influence clinical management during hospitalisation in 48 of 88 (55%) cases.
Conclusion: Unattended Level 3 PM studies are technically feasible in hospitalized patients and may provide information which alters clinical management.

0458

USE OF RESPIRATORY DISTURBANCE INDEX (RDI) AS A PARAMETER TO TREAT SYMPTOMATIC PATIENTS WITH OBSTRUCTIVE SLEEP APNEA WITH LOW AHI (APNEA HYPOPNEA INDEX) WHO WOULD NOT OTHERWISE QUALIFY FOR CPAP

Tamanna S, Baran A, Ullah MI, Richert A, Khemka D, Raza S
General Internal Medicine, University of Mississippi Med Ctr, Jackson, MS, USA

Introduction: Obstructive respiratory events are typically scored as apneas or hypopneas to calculate the apnea-hypopnea index (AHI). The Respiratory disturbance index (RDI), often used synonymously to AHI, can additionally include respiratory effort related arousals (RERAs). Previous studies have revealed that respiratory effort related arousals and associated sympathetic activation can play a key role in the cardiovascular risks and excessive daytime sleepiness (EDS) associated with obstructive sleep apnea. We have anecdotally noted that many patients with low AHI but frequent RERAs benefit symptomatically from CPAP use if prescribed. The purpose of this study was to formally investigate whether such patients subjectively benefit from CPAP.
Methods: Retrospective analysis was performed using the polysomnographic database of the University of Mississippi Medical Center. Diagnostic polysomnograms performed between August 2009 through July 2011 with AHI<5 and RDI>10 were selected. Age, BMI, gender, RDI, AHI, and lowest oxygen saturation during polysomnography were extracted. Patients were surveyed by telephone regarding the subjective status of EDS. Of those prescribed CPAP, minimum required compliance for inclusion was >5 hours/night for >4 nights per week for >3 months.
Results: Forty nine patients were successfully surveyed, of which 28 were treated with CPAP with adequate compliance. 67% of surveyed patients were obese (BMI >30 kg/m2), 56% were >45 years old, and 77% were male. The patients using CPAP were 10.8 times more likely to have subjective improvement in their EDS (95% CI 2.54-45.87, p = 0.0013) compared to those who were not prescribed CPAP.
Conclusion: Use of RDI is of clinical value in making treatment decisions among symptomatic patients with low AHI but an elevated RDI. Treatment with CPAP in these patients can improve their EDS significantly. Future studies with a larger sample size and objective measurement of EDS before and after CPAP will be necessary for more definitive conclusions.

0459

THE USE OF STOP-BANG QUESTIONNAIRE TO SCREEN FOR OBSTRUCTIVE SLEEP APNEA AMONG NON-SURGICAL PATIENTS

El-Gendy A[1,2], El-Gendy A[1,2], Hamdan A[1,2]
[1]Florida Lung & Sleep Associates, Lehigh Acres, FL, USA, [2]Chest Institute, Lehigh Acres, FL, USA

Introduction: STOP-BANG questionnaire is a validated tool that is widely used to screen patients for obstructive sleep apnea (OSA) before surgery. It is a self-administered simple to use eight yes/no questions (Snoring, Tiredness during daytime, Observed apnea, High blood Pressure, Body mass index >35, Age >50, Neck circumference >40 cm, Male Gender). The purpose of our study is to evaluate the sensitivity, specificity, positive predictive value, and the negative predictive value of this questionnaire to screen for OSA in non-surgical patients consulted at an accredited outpatient sleep center.
Methods: As a prospective study from December 2010 to November 2011, the STOP-BANG questionnaire was administered to 129 outpatient sleep center patients. In total, there were 71 males (55%) and 58 females (45%). One-hundred-twenty-six (97.7%) of these patients underwent diagnostic in-lab polysomnography study (PSG). Three (2.3%) declined to give consent or didn't show up for the study. A score of 3 or more out of the eight questions was considered suggestive of OSA. This score was compared to apnea-hypopnea index (AHI) determined by PSG. AHI was scored in accordance with American Academy of Sleep Medicine (AASM) scoring manual published in 2007.
Results: The prevalence of OSA defined as an AHI 5-<15 (3.2%), 15-<20 (23.6%), 20-<30 (20.1%), and >30/h (28.9%). Mean AHI was 34.2±22.6/h. One-hundred-twenty-three (94.6%) of the subjects had a STOP-BANG score ≥3 with a mean score of 5.26±1.45. The overall sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were respectively 96.8%, 100%, 100% and 33%.
Conclusion: STOP-BANG questionnaire proves to be a useful clinical tool to screen for OSA among non-surgical patients with a high PPV in accredited sleep centers. In view of a low NPV, a score of less than 3 should not preclude the clinical judgment of a board certified sleep specialist to proceed with further testing.
Support (If Any): Florida Lung & Sleep Associates, Chest Institute.

0460

THE SLEEP SYMPTOMS CHECKLIST PROVIDES DISTINCTIVE PROFILES FOR SLEEP APNEA, CHRONIC INSOMNIA, AND NO SLEEP DISORDER FOR PRIMARY CARE PATIENTS

Bailes S[1,5], Baltzan M[3,4,5], Grad R[1,5], Pavilanis A[2,5], Rizzo D[1,7], Creti L[1], Amsel R[5], Fichten CS[1,5,6], Libman E[1,5]
[1]Jewish General Hospital, Montreal, QC, Canada, [2]St. Mary's Hospital Centre, Montreal, QC, Canada, [3]Mount Sinai Hospital Centre, Montreal, QC, Canada, [4]OSR Medical, Montreal, QC, Canada, [5]McGill University, Montreal, QC, Canada, [6]Dawson College, Montreal, QC, Canada, [7]Universite de Montreal, Montreal, QC, Canada

Introduction: Obstructive sleep apnea (OSA) is under-recognised in general medical practice. Symptom presentation is highly variable and includes complaints of poor sleep, poor daytime functioning, and psychological distress in addition to the "classic" signs of daytime sleepiness and loud snoring. We developed and validated the Sleep Symptom Checklist (SSC) as a brief screening tool to identify patients who do not fit the stereotypical profile of a sleepy, obese male, but where sleep disorder is highly probable. In the present study, we investigate whether the SSC subscales (Insomnia, Daytime Distress, Sleep Disorder, Psychological) show distinct patterns for those with a diagnosis of OSA, those who have insomnia, and individuals with no sleep problem.
Methods: Participants were 15 primary care patients recently diagnosed with OSA, 10 patients seeking cognitive-behaviour therapy for insomnia (CBT-I), and 9 community participants with no sleep problems (Controls). Primary care participants underwent overnight polysomnography. Most CBT-I participants had been screened for OSA by PSG. Control participants were screened for OSA using a home monitoring device. All completed the SSC.
Results: The 3 groups (OSA, CBT-I, Controls) were compared using ANOVA on the 4 SSC subscale scores. Distinct SSC subscale patterns emerged: Compared to Controls, the OSA group was characterised by significantly higher Insomnia, Daytime, and Sleep Disorder scores. Compared to the OSA group, CBT-I participants had significantly worse Insomnia and better Sleep Disorder, and somewhat worse Psychological scores.
Conclusion: The SSC has potential to identify primary care patients at risk for OSA, as they show a pattern of subscale scores that distinguishes them from those presenting for Insomnia treatment or healthy, uncomplaining controls. Notably, OSA patients in primary care present substantial insomnia but not elevated psychological distress.
Support (If Any): Canadian Institutes of Health Research.

0461

THE ROLE OF SLEEP POSITION IN OBSTRUCTIVE SLEEP APNEA SYNDROME IN KOREAN PEOPLE

Kim T, Lim H, Lee S, Hong S
Psychiatry, St. Vincent hospital, Catholic University of Korea, Suwon, Republic of Korea

Introduction: The aim of this study is to analyze the role of sleep position in obstructive sleep apnea syndrome (OSAS) in Korean people.
Methods: The subjects were 75 obstructive sleep apnea syndrome patients suffering excessive daytime sleepiness or snoring. Patients with co-morbidities of other sleep disorders such as narcolepsy or periodic limb movement syndrome were excluded. All subjects underwent polysomnography. Patients were stratified in a group of position dependent patients (PP) and a group of non-position dependent patients (NPP). We associated the apnea hypopnea index (AHI) of the supine position with the AHI of the other positions.
Results: We identified that a non-supine position was related with the decrease in AHI, especially in the PP group. BMI and AHI were higher in the NPP group. In our study, 61.3% were PP (AHI in supine 2 times greater than AHI in other positions). In polysomnography tests, both group showed no significant difference in AHI in supine position, but NPP group had significantly higher AHI in non-supine position. NPP group showed significantly higher total wake time and respiratory arousal index. PP group had higher average oxygen saturation and higher lowest oxygen saturation.
Conclusion: This study confirms the finding that OSAS is position dependent in more than 50% of patients and non-supine position would lower the AHI of OSAS patients. AHI in non-supine position of PP group was significantly lower than AHI in supine position. Even in NPP group, AHI in non-supine position was lower than AHI in supine position. We may need more comprehensive and in-depth studies to find the efficacy and effectiveness of positional therapy for OSAS patients.

0462

THE RISK OF DIAGNOSTIC MISCLASSIFICATION IN SINGLE-NIGHT POLYSOMNOGRAPHY FOR SLEEP APNEA

Eiseman N[1], Westover MB[1], Ellenbogen JM[1,2], Bianchi MT[1,2]
[1]Neurology, Massachusetts General Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: The presence and severity of obstructive sleep apnea (OSA) is based on apnea and hypopnea rates per hour of sleep. Obtaining this information from a single overnight polysomnogram (PSG) presents a diagnostic challenge, given that certain factors influencing severity exhibit night-to-night variability, such as body position and the

composition of sleep stages. This study investigated the roles of body position and sleep stage regarding the potential of misclassification of OSA.
Methods: We retrospectively analyzed 300 consecutive diagnostic polysomnograms performed at our center. The population consisted mainly of those with absent, mild, or moderate severity OSA. The apnea-hypopnea index (AHI) was determined according to sleep stage and body position.
Results: The median percent of rapid eye movement (REM) sleep was 16% (presumably due to a first night effect), and the median percent supine sleep was 65%. Fewer than half of PSGs contained >10 minutes in each of the four possible combinations of REM/non-REM and supine/non-supine. Half of patients had >2-fold worsening of the AHI in REM sleep, and ~60% had >2-fold worsening of AHI while supine. Body position was associated with greater risk of under-estimating the AHI as compared to the impact of under-representation of REM sleep. Misclassification of categorical severity depended strongly on body position, with time spent non-supine predicting OSA under-estimation.
Conclusion: Position-dependence accounts for substantial variance in single night AHI observations. Misclassification risk can be mitigated by appropriate consideration of body position in the subset of patients exhibiting supine-dominant sleep apnea. The results have implications for the interpretation of single-night apnea measurements in clinical practice, especially with trends toward home testing devices that may not measure body position.
Support (If Any): Department of Neurology, Massachusetts General Hospital.

0463
TARGETED SCREENING FOR SLEEP APNEA IN A HIGH RISK POPULATION
Vohra KP[1,2], Howe J[1,2]
[1]Pulm/CCM/Sleep Medicine, St Vincent Hospital, Indianapolis, IN, USA, [2]St Vincent Heart Center of Indiana, Indianapolis, IN, USA

Introduction: There is a significant correlation between cardiovascular disease and sleep apnea. The purpose of this study was to assess the effectiveness of a simple, easily administered screening questionnaire in helping select patients with cardiovascular disease and high pre-test probability of sleep apnea.
Methods: A 4 question questionnaire was used to screen patients for possible sleep apnea. Yes on 2 out of 4 questions was considered a positive screen. All patients were adults and both genders were included. The screening was done by care coordinators at a specialty heart hospital in a midsize city. Patients screened were inpatients or in the short stay unit of the hospital. Data was collected from January 2011 through September 2011.
Results: There were 73 unique patients who underwent diagnostic polysomnograms or split night studies after they screened positive. There were 52 men and 21 women. 89.04% of these patients tested positive for sleep apnea defined as Apnea-Hypopnea Index (AHI) > 5. 58.9% were severe (AHI> 30), 13.69% were moderate (AHI 15-30), 16.43 % were mild (AHI 5-14.9) and 10.95% had AHI< 5.
Conclusion: A simple easily administered screen is a powerful tool in predicting sleep apnea in specific disease based high risk populations. Future studies are being planned to expand screening to other sleep apnea co-morbid disease states to help select patients with high pre-test probability of sleep apnea. This may also help allocation of resources more efficiently.

0464
PORTABLE MONITORING FOR SLEEP BREATHING DISORDERS
Zancanella E[1,2], Carvalho LB[1], Prado LF[1], Crespo AA[2], Prado GF[1]
[1]Neuro-Sono, UNIFESP, São Paulo, Brazil, [2]Otolaryngology Dept, UNICAMP, Campinas, Brazil

Introduction: Sleep Breathing Disorders (SBD) are prevalent and require complementary test for the diagnosis. Portable Monitoring for SBD diagnosis can be performed at patient's home and is less expensive than polissomnography. The Portable Monitoring type 2 has few data in the literature.
Methods: 40 patients were selected by a Protocol (anamnesis and physical examination) with high probability for SBD. All the patients were submitted 02 Portable Monitoring with 02 EEG channels, EMG, EOG, nasal cannula, plethismography thorax and abdomen belts, position, pulse and oxygen saturation in consecutive dates: half started at home (unattended) and other half started in the lab (attend) - using the same equipment - Embletta X100. All the sleep summary data and the AHI were compared. The sleep analysis was performed by a blinded observer.
Results: 06 patients (15%) had data loss. We analyze data from 34 patients - 24 men and 10 women - (mean age 40,6 years old and the mean BMI 28.02, Epworth's scale mean 10.2). 14 patients (09 men and 05 women) started at home and 20 in the lab (15 men and 05 woman). The mean sleep efficiency at home was 72.5% and in the lab 79.4%. The AHI 0-5: 08 home and 09 lab, 05-15: 14 home and 15 lab, 15-30: 07 home and 03 lab, over 30: 05 home and 07 lab. The Correlation Coefficient ICC 0.885 CI 95% (0,782;0,941).
Conclusion: We concluded that Portable Monitoring attend in the lab compared to unattended at home has a good correlation and can be an option to selected patients for Sleep Breathing Disorders diagnosis.

0465
PRELIMINARY EXPERIENCE OF HOME SLEEP TESTING IN PRIMARY CARE SETTINGS
Kayyali HA[4], Schwieterman T[1], Orr R[3], Segal S[2], Scovill K[1]
[1]Midmark, Versailles, OH, USA, [2]Lake Zurich Family Treatment Center, Lake Zurich, IL, USA, [3]Family Medical Group of Silverton, Silverton, OR, USA, [4]CleveMed, Cleveland, OH, USA

Introduction: Sleep Disordered Breathing (SDB) affects more than 40 million people in the US; yet, more than 80% of affected individuals are undiagnosed and/or untreated. HST is expected to speed sleep diagnosis by permitting testing in convenient settings such as the primary care practice; however, the success of HST in this setting has not been evaluated.
Methods: A HST program was developed and tested in 2 primary care settings: LZ, SL. The program screened patients using ESS, BMI, STOP-BANG and clinical evaluation. Patients suspected of OSA were trained on the sensor hookup during the office visit and dispensed a monitor for self-administration in the home. The monitor channel set was consistent with AASM guidelines for portable monitoring. Once received by the practice, data from the monitor was uploaded to a web portal where studies were scored by a registered technologist and interpreted by a sleep physician licensed in the state where the test occurred. Finally, the primary care physician reviewed results with patient and ordered treatment or more extensive workup based on the sleep specialist report.
Results: Preliminary analysis from seventeen (17) tests done at each site show high occurrence of OSA in each site (14/17). Overall, results show an average AHI of 17.7 for LZ, 13.2 for SL. Average BMI was high (30.4 for LZ, 33.9 for SL) but ESS scores showed weak correlation to OSA in both settings. One in 34 studies was inconclusive and required a repeat in-lab PSG. Average duration from study upload time to specialist report completion was 1.2 days for LZ, 1.4 days for SL.

Conclusion: Our preliminary experience shows that HST in the primary care practice is successful, and can speed access to sleep diagnosis and treatment.

0466

PREVALENCE OF OBSTRUCTIVE SLEEP APNEA SYNDROME ACROSS DIFFERENT AGES BETWEEN CHINESE MEN AND WOMEN

Li Z, Lei F, Liu H, Wang D, Tang X
West China Hospital of Sichuan University, Chengdu, China

Introduction: The age differences between men and women in the prevalence of obstructive sleep apnea syndrome (OSAS) have received great attentions during the past two decades, which may link to the differences in BMI across ages. Chinese population appear to be less obese in terms of BMI compare to Caucasians, but few studies have examined the differences in age and gender for the prevalence of OSAS among Chinese.
Methods: We retrospectively reviewed the polysomnographic and demographic data among a total of 2355 subjects (1960 men and 395 women) who received an overnight polysomnographic examination due to suspected OSAS.
Results: For the prevalent rate across five different ages (<35, 35-45, 45-55, 55-65 and >65 years old), men did not show significant differences (87 vs. 90% for AHI>5 in age <35 vs. >65, 70 vs.74% for AHI>15 and 49 vs. 47 for AHI>30), but women had significant increases (44 vs. 85% for AHI>5, 20 vs. 71% for AHI>15 and 9 vs. 50 for AHI>30). For AHI>5, the men had significantly greater prevalence than women among age<55 years old and no differences among age>55 years old. For AHI>15 and >30, the men had significantly greater prevalence among age<65 years old and no differences among age>65 years old. The average BMI in men were significantly greater in the age<55 years old than in women, and no difference were obtained in the age>55 years old.
Conclusion: The results illustrated that the prevalent rate of OSAS appears to be significantly higher in men than in women among individuals younger than 55 years old, and no gender differences in the age older than 55 years old. The BMI may play an important role in age and gender differences in the prevalence of OSAS, even among less obese population of Chinese.
Support (If Any): Chinese National Science Foundation 30870891.

0467

PREVALENCE OF OBSTRUCTIVE SLEEP APNEA SYNDROME AMONG HABITUAL SNORING ADULTS IN ASIAN: A COMMUNITY BASED STUDY

Chang Y[1], Lin C[2,3], Lin W[2], Chao C[1], Wu J[4]
[1]Department of Otolaryngology, Tainan Municipal Hospital, Tainan, Taiwan, [2]Department of Otolaryngology, Tainan Hospital, Department of Health, Tainan, Taiwan, [3]Department of Occupational and Environmental Medicine, Medical College and Hospital, National Cheng Kung University, Tainan, Taiwan, [4]Department of Otolaryngology, Medical College and Hospital, National Cheng Kung University, Tainan, Taiwan

Introduction: Obstructive sleep apnea (OSA) is a public health issue. However, large-scale studies analyzing the epidemiology of OSA among habitual snoring adults in Asian are rare. Our study is a community-based program designed to obtain prevalence of OSA among habitual snoring adults by using home sleep test (HST).
Methods: This is a cross-sectional, community-based study with a 2-stage model. Patients with severe snoring problems at local clinics were recruited. Firstly, history taking, upper airway examination, and questionnaire assessment were performed by ENT doctors. Subjects, who were diagnosed as habitual snoring, would be persuaded to get into the second stage. They worn the HST devices by trained sleep specialist at the clinics and were tested at their homes. All the interpretations of HST were done by the same otolaryngologist.
Results: Twenty nine clinics in southern Taiwan were recruited and 284 subjects completed this study. The mean age was 43.0 years-old. Two hundred twenty five were male. Mean weight was 73.3 Kg. The body mass index (BMI) was 26.0. Neck circumference was 38.3 cm. Waist-hip ratio was 0.9. The prevalence of underlying disease was 19.1 % with hypertension, 5.0% with cardiovascular disease and 1.4% with diabetics. The mean apnea-hypopnea index (AHI) was 18.5/hr. Simple snoring without sleep apnea syndrome was diagnosed in 25.3% subjects. The classification of OSA included mild (27.4 %), moderate (26.7%) and severe (20.6%). Mean lowest oxygen saturation (SpO2) was 81.7%. Multiple regression statistical analysis revealed that BMI was the significant factor affecting the severity of OSA ($p< 0.001$).
Conclusion: This study demonstrated high prevalence of OSA among habitual snoring adults in Asian. Subjects with higher BMI may cause worse OSA severity. Thus we recommended that physicians should take notice of habitual snoring patients who had higher BMI.

0468

STOP!: HOW USEFUL ARE SLEEP APNEA SCREENING TOOLS WITH AMBULATORY MONITORING?

Skjodt NM, Platt RS
Sagatech Electronics, Calgary, AB, Canada

Introduction: Community-based sleep apnea screening has been referenced against laboratory polysomnography but not against community-based portable monitoring. We assessed the correlation, sensitivities and specificities of the Epworth Sleepiness score (ESS), adjusted neck circumference (ANC), STOP and STOP-BANG screening tools.
Methods: A convenience sample of 2000 ambulatory Remmers Sleep Monitor (Sagatech Electronics, Calgary, AB) studies ordered by specialists and family physicians through CPAP vendors were studied. Data to calculate the ESS, ANC, STOP and STOP-BANG scores were prospectively entered into the monitor before overnight studies with >= 9, > 38 cm, >= 2 and >= 3 scores identifying high risk patients. Estimated respiratory disturbance indices (RDIs) were derived through automated scoring of overnight recordings. Pearson's product moment correlation coefficients (R), sensitivity (Sn) and specificity (Sp) values were calculated for each screening tools using RDI cutoffs of 5 and 15/h.
Results: The prevalence of sleep apnea was 61.3 and 31.2% with RDI 5 and 15/h. ESS, ANC, STOP and STOP-BANG R values were 0.133, 0.358, 0.219 and 0.326 (each $p < 0.001$ and $df = 1999$). Using RDI >= 5 the ESS, ANC, STOP and STOP-BANG Sn values were: 0.592, 0.968, 0.847 and 0.937; Sp values were 0.410, 0.126, 0.246 and 0.212. Using RDI >= 15/h the ESS, ANC, STOP and STOP-BANG Sn values were: 0.618, 0.989, 0.615 and 0.894; Sp values were: 0.421, 0.094, 0.560 and 0.366.
Conclusion: A high prevalence of sleep apnea was seen with high ANC and STOP-BANG sensitivities but poor specificities for all screening tools.

0469

SHARED MEDICAL APPOINTMENTS AS A SOLUTION TO DELAYED ACCESS IN THE DIAGNOSIS OF OSA

Kelley DM, Erokwu C, Strohl KP
Pulm/Sleep, VAMC, Cleveland, OH, USA

Introduction: This report describes the development, experience, and effect of a shared medical appointment (SMA) in the initial consultation to sleep medicine for the complaint of suspected sleep apnea in a tertiary Veteran Affairs Medical Center population (VAMC). The VAMC SMA is based on the chronic care model in which groups of patient's (10-15) are seen by a multidisciplinary team (Nurse Practitioner and Sleep Psychologist) in a one hour appointment. The symptoms, diagnosis, and treatment options for Obstructive Sleep Apnea (OSA) as well as sleep

factors are highlighted during the encounter. All patients having an electronic consult placed to the sleep disorders clinic were eligible to participate. After triage of the consult by a sleep provider for appropriateness, letters were sent to the individuals offering them a group appointment. At scheduling, patients were given the opportunity to opt out and be scheduled for an individual appointment.
Methods: Veterans who attended a SMA in 2010 were included. Participants completed the Cleveland Sleep Habits Questionnaire, a self report multiple choice instrument which provides demographic data, Epworth Sleepiness Scale score (ESS), sleep disorder symptoms, sleep hygiene factors, and co-morbidities. Upon completion of the group process the electronic record was followed for data pertaining to sleep diagnostic modalities as well as final sleep disorder diagnoses.
Results: A total of 488/966 potential individuals (50.5%) attended the group, 461 men, 27 women. Average age was 54.9 years (range 22-92 years), average weight 236.7 pounds (range 129-400 pounds), ESS average 10.96, Neck Circumference 17.37 inches, 93% reported snoring, 40% are active smokers, 5.4% refused workup, 69% completed polysomnography and were diagnosed with OSA.
Conclusion: We conclude that a SMA is feasible. The SMA increased the efficiency of information delivery 5 fold (1 hour compared to 30 minutes) and facilitated a decision for further diagnostic testing.

0470

OSA OUTCOMES AFTER 6 MONTHS OF CPAP TREATMENT: A SHAM CONTROLLED STUDY

Mello-Fujita L, Cintra F, Mendonca E, Rizzi CF, Tufik S, Poyares D
Psychobiology, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: The objective of this study is to analyze the influence of CPAP treatment in clinical, echocardiographic and metabolic parameters, in a 6-month placebo controlled study design.
Methods: OSA patients, with AHI> 20, who had never had contact with CPAP, were randomized into two groups: CPAP and Sham CPAP groups. All patients then underwent full polysomnography for CPAP and Sham CPAP titration. The exclusion criteria were: BMI > 40; severe systemic disease; report of near miss accident. Patients were evaluated at baseline, 1st month, 3rd month, and 6th month of either CPAP or Sham treatments. The following parameters were obtained at all times: Epworth Sleepiness Scale, anthropometric measures, blood pressure, echocardiogram, and blood analyses. The later also included glycemia, cholesterol profile, brain natriuretic peptide, and C-reactive protein. ANOVA for repeated measures and Chi Square were used to analyze main data.
Results: CPAP group: (n=22) mean age = 52.6±9.5, 13 male, IAH = 35.1±12.7, BMI = 27.5±4.6; and Sham group: (n=23) mean age = 54.9±9.2, 16 male, IAH = 29.2±10.2, BMI = 29.8±3.0 (p>0.05, all). The hours of CPAP and Sham use were similar during the entire study CPAP group 4.4± 1.5 h/night; Sham group 4.3±1.6 h/night (p= 0.62). There were no significant differences between groups on anthropometrics, blood pressure measurements, echocardiographic and laboratorial parameters during baseline, 1, 3 and 6 months of follow-up (p>0.05, all). Epworth sleepiness scale (ESS) reduced significantly only in the CPAP group, since the first month of treatment (p= 0.01).
Conclusion: Sleepiness is the only variable which improved in the first six months with effective CPAP treatment. These results suggest that longer period of CPAP use is required to improve cardiovascular and other consequences of OSA.
Support (If Any): Acknowledgement: CEPID/FAPESP, AFIP.

0471

THE EFFECTS OF CPAP ON ENDOTHELIUM-DEPENDENT MICROCIRCULATORY REACTIVITY IN OBESE SUBJECTS WITH OBSTRUCTIVE SLEEP APNEA

Bakker JP[1], Balachandran J[1], Tecilazich F[2], DeYoung P[1], Rahangdale S[1], Yim-Yeh S[1], Veves A[2], Malhotra A[1]
[1]Sleep Disorders Research Program, Brigham & Women's Hospital, Harvard Medical School, Boston, MA, USA, [2]Department of Surgery, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: The exact pathways by which the repetitive upper airway collapse characteristic of obstructive sleep apnea (OSA) leads to cardiovascular disease are not fully understood, but one possible mechanism is injury to endothelial cells. We aimed to assess microvascular reactivity in a sample of obese OSA patients, before and after six months of continuous positive airway pressure (CPAP) treatment.
Methods: A convenience sample of adult obese CPAP-naïve patients with no major co-morbidities was identified. All underwent a polysomnography study before and after six months of CPAP treatment. Microcirculatory reactivity was assessed at each time point in the fasting state within three hours of awakening by LASER Doppler flowmetry at the forearm. The change in skin blood flow resulting from administration of acetylcholine (ACh) and sodium nitroprusside (SNP) were used to determine endothelium-dependent and endothelium-independent microvascular reactivity, respectively.
Results: The fifteen subjects (11 male) had a mean age of 44.7 (range 26-60) years, mean+/-SD baseline apnea-hypopnea index 54.1+/-39.5 events/hour, and mean+/-SD body mass index 36.5+/-7.7 kg/m2. Six months of CPAP resulted in a significant reduction of the AHI (p<0.01). Skin blood flow increased by 45.8% in response to ACh measured at baseline, and 71.8% measured post-treatment (Cohen's d=0.94, p=0.05 over time). Administration of SNP did not result in a significant change in skin blood flow over the treatment period (Cohen's d=0.3, p=0.85).
Conclusion: These pilot data suggest that CPAP treatment may be associated with improvements in endothelium-dependent vascular reactivity. Further research is required to determine long-term treatment effects and its impact on the microcirculation in OSA.
Support (If Any): NIH K24 HL 093218; NIH R01 HL 073146.

0472

NOCTURNAL GASTROESOPHAGEAL REFLUX AND RESPIRATORY SYMPTOMS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA, BEFORE AND AFTER CPAP TREATMENT, COMPARED TO THE GENERAL POPULATION -THE ICELANDIC SLEEP APNEA COHORT (ISAC) STUDY

Gislason T[1,2], Arnardottir ES[1,2,3], Janson C[4], Benediktsdottir B[1,2], Juliusson S[5], Emilsson I[1,2], Pack A[3]
[1]Dept of Respiratory Medicine and Sleep, The National University Hospital of Iceland, Reykjavik, Iceland, [2]Faculty of Medicine, University of Iceland, Reykjavik, Iceland, [3]Center for Sleep and Respiratory Neurobiology, Division of Sleep Medicine/Department of Medicine, University of Pennsylvania School of Medicine, Philadelphia,, PA, USA, [4]Department of Medical Sciences: Respiratory Medicine and Allercology, Uppsala University, Uppsala, Sweden, [5]Dept of Otolaryngology, The National University Hospital, Reykjavik, Iceland

Introduction: To estimate the prevalence of reported nocturnal gastroesophageal reflux (nGER) in obstructive sleep apnea (OSA) subjects compared to the general population. Also to evaluate what characterizes those who report nGER and whether it changes in OSA patients with continuous positive airway pressure (CPAP) treatment.
Methods: 826 newly diagnosed subjects with OSA (The Icelandic Sleep Apnea Cohort [ISAC]), referred for CPAP treatment. Of those, 623 subjects have had a 2 year follow-up visit with objective CPAP compliance

data collected (n=412 CPAP users, n=211 nonusers). The control group consisted of 939 subjects randomly selected from the general population (81% response rate). Both groups answered the same questionnaires, including reporting of nGER, sleep, respiratory symptoms, general health and quality of life measured by SF-12. A sleep study was performed in ISAC participants only.
Results: Altogether 18.6% of OSA females and 13.6% of males (p=0.07) compared to 7.5% of controls (p<0.001) reported nGER (≥ 1x a week). Wheeze during the last 12 months was more common among OSA subjects with nGER compared to without nGER (42.5% vs. 29.3%, p=0.005). Bringing up phlegm in the morning at least 3 months the last year was also associated with reporting nGER (35.7% vs. 24.8%, p=0.02). Among OSA patients prevalence of nGER was not related to smoking, obesity, hypertension, diabetes or OSA severity. SF-12 showed that among those with nGER both physical component scores (40.7+/-10.9 vs. 37.4+/-10.3, p=0.003) and mental scores (49.0 +/-10.8 vs. 44.1 +/-11.1, p<0.0001) were significantly lower. At two year follow-up nGER was only reported by 6.2% of the 618 OSA patients and was lowest (3.8%) among full CPAP users (p<0.0001).
Conclusion: nGER is a common clinical symptom of OSA and often related to respiratory symptoms. Prevalence of nGER decreases with CPAP treatment in a majority of OSA patients.
Support (If Any): NIH grants HL72067 and HL94307, the Eimskip Fund of the University of Iceland and the Landspitali University Hospital Research Fund.

0473

INDIVIDUALIZED APAP THERAPY AIDS IN RESOLVING INSOMNIA SYMPTOMS AND IMPROVES ADHERENCE IN PATIENTS WITH OSA INITIALLY TREATED WITH FIXED CPAP

Dahm C, Goswami U
Internal Medicine/PACCSM, University of Minnesota, St. Paul, MN, USA

Introduction: Continuous positive airway pressure (CPAP) is commonly prescribed for OSA. However many patients have difficulties adhering to therapy due to various barriers. Insomnia symptoms predict worse adherence. This report describes the response to individualized autotitrating PAP (APAP) therapy in patients initially set up with CPAP.
Methods: Observational case series with cross-over from CPAP to APAP therapy. Retrospective chart review.
Results: Six consecutive patients were diagnosed with severe OSA (AHI 34.7/h to 123.6/h) during in-lab split night polysomnography. Two patients were women. Titration suggested therapeutic CPAP levels between 5 and 13 cm. Patients were set-up in CPAP mode with PAP devices of two companies. At the first follow-up visit all patients described varying degrees of insomnia symptoms including waking up at night, a sense of airhunger, or "taking mask off unknowingly". Usage pattern confirmed interruptions. Usage ranged from 3 h 41 min to 6 h 20 min. Daily details showed several nights with clusters of residual obstructive events or increased leak prior to interruption. Based on PSG, clinical response and download data, CPAP therapy was changed to APAP mode allowing higher pressure delivery. In subsequent follow-up visits symptoms of airhunger and "taking mask off unknowingly" resolved. APAP pressures were higher than CPAP pressures suggested by in-lab titration. Usage pattern confirmed resolution of nighttime interruptions. Usage increased in all patients (few minutes to 3.5 hours). Patient with mask discomfort had less improvement. Residual AHI decreased (difference 0.7/h to 12.5/h). All patients rated sleepiness, daytime energy and sleep quality subjectively better on APAP compared to CPAP.
Conclusion: Fixed CPAP therapy may lead to insomnia symptoms due to residual airflow limitation in clusters. Individually adjusted APAP therapy assists in resolving insomnia symptoms and leads to improved adherence and better subjective ratings of sleepiness, daytime energy and sleep quality.

0474

SLOWING OF HEART RATE IN NREM WITH SLEEP AND PAP THERAPY

Singh H[1,2], Goyal V[2], Dabbagh O[2], Thakkar MM[2], Sahota P[2]
[1]Neurology, Beverly Hospital, Danvers, MA, USA, [2]Neurology, University of Missouri, Columbia, MO, USA

Introduction: We report the effect of Sleep and Positive Airway Pressure (PAP) therapy on heart rate in patients with Sleep Apnea. We hypothesized that sleep duration and PAP therapy would lead to reduction in NREM heart rate. This would be one potential benefit of PAP therapy leading to reduction in cardiovascular risk.
Methods: The study involved retrospective chart review at our sleep center. Both baseline and PAP polysomnograms (PSGs) were reviewed. We excluded split night studies. The comparison was made between sleep during the first hour and the last hour of the study. Stage 3 and REM were not expected to be consistently seen between these portions and were excluded to avoid confounding effect of different sleep stages. The comparison was made between heart rate during the two portions on the same night and across baseline and CPAP studies. We only included patients with NREM AHI>5. Repeated measures ANOVA was used for statistical analyses.
Results: 46 patients met criteria with a total of 92 studies. 27/46 were males and 19/46 were females. Average age was 51. Average BMI was 37. Mean AHI was 16 (Range 7-31). Heart rate significantly (p< 0.0001) slowed down with sleep across both baseline and PAP studies with means for the two halves at 72.1 bpm (first) vs 68.3 bpm (second). The effect of PAP trended towards further slowing, however was not statistically significant (p=0.612). A larger sample size may reveal this difference.
Conclusion: PAP therapy trends towards reduction of heart rate compared to baseline. This reduction in turn may provide mortality benefit. Sleep significantly decreases heart rate in NREM in the last half of the night, even in sleep apnea patients and this may provide support for need of consolidated sleep.

0475

USABILITY-TESTING OF A MULTIMODAL SELF-CARE MANAGEMENT PROGRAM TO SUPPORT INDIVIDUALS BEGINNING CPAP TREATMENT

Dickerson SS[1], Obeidat R[1], Ten Brock E[2], Aquilina AT[2], Jungquist CR[1], Smith P[2], Dean GE[1]
[1]School of Nursing, University at Buffalo, Buffalo, NY, USA, [2]School of Medicine and Biomedical Science, University at Buffalo, Buffalo, NY, USA

Introduction: While CPAP is an effective treatment for OSA, patient adherence is sub-optimal. Previous research indicated that education alone does not improve compliance rates although cognitive behavioral therapy (CBT) showed some effectiveness. Qualitative interviews of new CPAP users indicated that developing a positive mindset, persevering through the initial troubles, accessing resources and problem solving, were effective strategies to make CPAP part of their routine. This program was developed using patient experiences, self-efficacy strategies, and CBT in a multimodal approach that allows patients to self-tailor to their most appropriate motivational support strategy for self-care management.
Methods: The multimodal format was developed using the Campbell (2000) Framework for Complex Intervention Design and Evaluation. After evaluation by sleep experts, CPAP users were recruited to review the program book and use a "talk-out-loud technique" by telephone interview to comment on usefulness and applicability. The interviews were recorded, transcribed and evaluated for thematic analysis.
Results: Ten CPAP users age 24-58 reviewed the program book including: 4 males, 6 females, 30% African American, 70% White, 40% high school education , 30% each- with some college and college education,

and AHI between 15-118. CPAP use ranged from 0-2 years with varying compliance. CPAP users suggested minor changes in format and content of the book. All found the information interesting, useful to understand their diagnosis, helpful to problem-solve, and monitor their progress. They appreciated the patient success stories and realized others had similar problems. Those who just received their CPAP used the program book to problem solve with providers and vendors. All CPAP users wished they had the book when first diagnosed.

Conclusion: This book provides useful information to educate, empower, and motivate patients to troubleshoot problems, monitor their progress and understand success. Future research plans include clinical testing in a RCT with new CPAP users.

Support (If Any): The Garman Fund, School of Nursing , University at Buffalo.

0476

POOR SLEEP HYGIENE AND PERSISTENT SLEEPINESS IN CPAP TREATED OBSTRUCTIVE SLEEP APNEA PATIENTS

Yagi T[1], Takashima A[1], Itoh H[3], Yamashiro Y[2], Kato K[1], Chiba S[3], Ota F[2], Sasaki M[1]

[1]Ota Memorial Sleep Disorders Center, Kawasaki, Japan, [2]Ota General Hospital, Kawasaki, Japan, [3]The Jikei University of School of Medicine, Minatoku, Japan

Introduction: Poor sleep hygiene is one of the important cause of persistent sleepiness even after introduction of nasal continuous positive airway pressure (CPAP) in patients with obstructive sleep apnea syndrome (OSAS). Residual sleepiness is an attractive therapeutic target and Modafinil has been approved prescribe in Japan for the residual sleepiness with CPAP treated OSAS patients. We have to pay attention to improve poor sleep hygiene for the proper use of Modafinil to these patients. The purpose is to examine the relationship between the sleep habits and persistent sleepiness in CPAP treated OSAS patients.

Methods: We interviewed 1405 OSAS patients (1270 men, 135 female) under treatment with CPAP in Ota Memorial Sleep Disorders Center. Factors examined were usual duration of sleep (hr), sleep irregularity determined as more than 2hr shift on bed time or wake-up time between weekdays and weekends, subjective sleepiness evaluated by Japanese Epworth Sleepiness Scale (JESS), mean CPAP usage in a month (hrs), duration of CPAP usage (months) and baseline AHI at diagnosis. Differences of the sleep habits, CPAP compliance and the baseline severity of OSAS between two groups, group S showed greater than 11 points of JESS and group N less than 11 points, were compared in this study.

Results: Mean JESS of the subjects was 7.1±5.2 points and mean duration of sleep was 5.9±1.1hr. There are 324 patients (21.6% of the subjects) in group S who complain persistent sleepiness. Duration of sleep was significant lower in group S than in group N (5.7±1.1hr, 6.0±1.1hr). There are no significantly differences in frequency of sleep irregularity between two groups (43.8%, 38.8%). Mean CPAP usage hours and baseline AHI were significant lower in group S than in group N.

Conclusion: This study showed that short duration of sleep was related to persistant sleepiness in CPAP treated OSAS patients rater than the sleep irregularity.

0477

SLEEP RELATED OCCUPATIONAL IMPAIRMENT BEFORE AND AFTER CPAP TREATMENT FOR OBSTRUCTIVE SLEEP APNEA

Kucharczyk E[1,2], Morgan K[1], Hall A[2]

[1]Clinical Sleep Research Unit, Loughborough University, Loughborough, United Kingdom, [2]Anaesthesia and Sleep Disorders Medicine, Leicester General Hospital, Leicester, United Kingdom

Introduction: While occupational performance is routinely assessed as a correlate of excessive daytime sleepiness, and as an outcome following CPAP treatment for Obstructive Sleep Apnea (OSA), such assessments tend to be informal and unstandardized. This study evaluated the utility of pre and post CPAP treatment assessments using the Loughborough Occupational Impact of Sleep Scale (LOISS; a new 19 item metric which quantifies sleep-related occupational impairment) in a series of newly diagnosed OSA patients.

Methods: 32 newly diagnosed OSA patients were serially recruited from a sleep medicine facility in Leicestershire, UK. Inclusion criteria were: aged 18+; eligible for CPAP treatment; in paid employment; and not diagnosed with any other sleep disorder. LOISS measurements were included among the routine pre-treatment (baseline) and post-treatment (average 4.5 weeks later) assessments. CPAP adherence indices were also recorded at post-treatment.

Results: Participant characteristics were as follows: predominantly male (n = 25); predominantly white-collar (67%); mean age 51 ±7 years; mean BMI 35 ±7 kg/m^2; mean Apnea-Hypopnea Index (AHI) 30±17; mean ESS 13 ± 5; and mean LOISS 20 ± 18. At follow-up, analyses indicated significant improvements from baseline in; mean ESS scores 7 ± 5 ($p<0.001$); mean LOISS scores 10 ± 2 ($p<0.001$); and mean AHI 6 ± 4. ($p<0.001$). In a multiple regression model adjusted for age, both ESS, and average hours of CPAP usage/day were significant predictors of LOISS scores ($r^2=0.36$, $F(3,22)=5.70$, $p<0.01$). Bivariate correlations between ESS and LOISS (baseline to follow-up) change scores ($r=-.47$, $r2=0.22$, $p<0.01$) indicate a modest but significant degree of shared variance in these indices of treatment improvement.

Conclusion: Sleep related occupational performance was significantly reduced following CPAP therapy. The formal assessment of sleep related occupational impairment could usefully augment standard clinical pre-post metrics.

0478

EXPLORING ADHERENCE WITH POSITIVE AIRWAY PRESSURE (PAP) DEVICE USE IN INDIVIDUALS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

Husain NF[1], King BJ[1,2], Carnes M[1,2]

[1]William S. Middleton VA Hospital, Madison, WI, USA, [2]University of Wisconsin, Madison, WI, USA

Introduction: Eighteen million adults in the United States have OSA, yet only 10-15% are currently diagnosed and treated with PAP devices. PAP adherence rates are 5-50% internationally and 40-60% in the US. Veteran population's non-adherence rate is 41%. Non-adherence in this population has generally been attributed to psychiatric, medical co-morbidities, chronic pain, and socioeconomic status. Little is known about in depth factors attributing to non-adherence in veterans. This study explores veterans' perceptions of PAP device use, specifically identifying patterns of use and barriers encountered which may influence adherence.

Methods: This study utilized a mixed methods design. Grounded/dimensional analysis (qualitative) was used to explore patients' perceptions of PAP device use, actions patients take in relation to their understanding, and consequences of those actions for the patients. Quantitative design was used to describe subject demographics, Epworth Sleepiness Score and adherence data (percentage of daily use, having ≥70% of the used days; and percentage of use > 4 hours of nightly use) to identify adherent and non-adherent subjects.

Results: The patient experience was explored from pre sleep study, during nocturnal polysomonography, patient education program, and PAP use at home. Patients described several categories that influenced their adherence to PAP use. Four salient categories emerged from the data; 1) Mechanical and physical factors; 2) Psychological factors; 3) Life style changes; and 4) Re-enforcers affecting adherence.

Conclusion: Results from this study will provide insight into other factors that influence adherence to PAP use in a veteran population. Furthermore, it will help to improve alignment of resources for educating patients, partners, technicians and physicians involved in management of OSA in the veteran population. Further research is needed to continue

to explore patients' experiences and identifying predictors for better outcomes to improve adherence patterns in the clinical setting.
Support (If Any): Geriatric Research, Education, and Clinical Center Center for Women's Health Research.

0479

THE SOMNUSEAL ORAL MASK IS REASONABLY TOLERATED BY OTHERWISE CPAP NON COMPLIANT PATIENTS WITH OSA

Pillar G[1,2], Segev A[1], Kutrz E[2]
[1]Sleep Lab, Rambam Medical Center and Technion, Haifa, Israel, [2]Sleep Clinic, Clalit Health Cervices, Haifa, Israel

Introduction: Compliance with CPAP is the major limiting factor in treating patients with OSA. Nasal masks may cause skin abrasions or eruptions, mask pressure on the ridge of nose, air leaks, claustrophobia and nasal stuffiness. The novel SomnuSeal mask is an oral self-adaptable mask located between the teeth and the lips, ensuring no air leaks or skin abrasions. It adjusts better to the patient's specific anatomical structure. Aim: To evaluate the efficacy and compliance of the SomnuSeal oral mask for a one month treatment period in otherwise non-compliant (untreated) patients with moderate-severe OSA.
Methods: 29 patients with RDI>20 had tried the mask (connected to an AutoPAP with heated humidifier) for one month. Efficacy (respiratory indices), convenience (questionnaire) and compliance (usage meter) were monitored in all patients.
Results: 29 patients (24 males) with mean age 56±11 years, BMI 33.3±4.7 Kg/m2, RDI 48±20/h have tried the treatment. Of them, 7 were satisfied and complied well with it (for an average of 27 nights, 4.8 hours per night), 3 struggled with it (average usage of 15 nights, 3 hours per night), and 19 could not comply with it. Whenever used, the efficacy was good, with a residual RDI of less than 5/hour. Interestingly, the required optimal pressure decreased from an average of 9.2cmH2O to 4.9cmH2O.
Conclusion: The SomnuSeal oral interface is effective, and may result in converting non-compliant untreated patients with OSA into well treated ones. In the current study 7 of 29 patients (24%) who were CPAP non-compliant and remained otherwise untreated, were satisfied and well tolerated the SomnuSeal mask. These results are encouraging to offer this mask and reduce the currently high prevalence of CPAP non-compliant untreated patients with OSA.

0480

THE ROLE OF CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT ON INTRATHORACIC AIRFLOW OBSTRUCTION IN PATIENTS WITH ASTHMA AND SLEEP DISORDERED BREATHING

Mohamed Hosni A[1,2], Pranathiageswaran S[1,2], Sankri-Tarbichi A[1,2], Badr M[1,2]
[1]Wayne State University/DMC, Detroit, MI, USA, [2]John D. Dingell VAMC, Detroit, MI, USA

Introduction: Sleep disordered breathing (SDB) is common in asthmatics. Difference exists in site and extent of airway obstruction between both conditions. We hypothesized that expiratory intra-thoracic airway narrowing contributes to SDB in patients with asthma, with recurrent episodes of unstable breathing manifesting by decreased flow and sleep fragmentation. In addition, we sought to ascertain the effect of continuous positive airway pressure (CPAP) treatment on lung mechanics including expiratory air flow limitation.
Methods: We studied 5 controlled asthmatics with SDB (AHI 27.5±19.3 event/hr, using alternate criteria) Overnight polysomnography was performed while monitoring esophageal pressure, airflow and supraglottic pressure (Psg). CPAP was applied and titrated to resolution of inspiratory flow limitation. Total pulmonary resistance (RLA) and upper airway resistance (RUA) were calculated.
Results: Periods of decreased flow were associated with increased expiratory RLA (32.12 ± 24.14) as compared to baseline (21.69 ± 18.76, $P<0.05$,) with no significant increase in RUA. Optimal CPAP was associated with decreased expiratory RUA (3.47±1.51 Vs. 13.96±5.01, $P<0.05$), while there was a decline of inspiratory RUA (4.74±1.07 Vs. 19.26±13.37, $P>0.05$) inspiratory RLA (15.46±15.96 Vs. 31.48±14.13, $P>0.05$) and expiratory RLA (26.58±8.17 Vs. 32.12±24.62, $P>0.05$) when compared to cycles of unstable breathing, which did not reach statistical significance possibly due to small sample size.
Conclusion: Sleep-disordred breathing in patients with asthma may be due to intrathoracic airway narrowing, as evidenced by increased total pulmonary resistance. Cycles of unstable breathing, flow limitation and respiratory arousals may represent hypopnea secondary to intrathoracic, rather than upper airway narrowing. CPAP titration in patients with asthma should target resolution of inspiratory flow limitation. CPAP ameliorates SDB and flow limitation in patients with asthma-related SDB. Therefore special attention to the contribution and reduction of lower airway resistance with CPAP therapy in patients with asthma and SDB should be studied. Larger sample size is necessary to evaluate CPAP and asthma outcomes.
Support (If Any): NHLBI and VA Merit Review.

0481

VIGILANCE AND WELL-BEING FOLLOWING CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY IN OBSTRUCTIVE SLEEP APNEA PATIENTS

van Schie M[1], Overeem S[2,3], Walschot L[2], Pevernagie DA[2], Lammers G[1], van Dijk J[1]
[1]Neurology and Clinical Neurophysiology, Leiden University Medical Center, Leiden, Netherlands, [2]Center for Sleep Medicine "Kempenhaeghe", Heeze, Netherlands, [3]Neurology, Radboud University Nijmegen Medical Center, Nijmegen, Netherlands

Introduction: CPAP therapy usually results in an improvement in the apnea/hypopnea index in obstructive sleep apnea syndrome, but not necessarily in subjective improvement. The reasons for this discrepancy are unknown. To explore whether subjective improvement or its lack is related to remaining vigilance problems, we investigated the Sustained Attention to Response Task (SART) in OSAS patients before and after CPAP. The SART is a 4' 20'' vigilance task, known to respond to improvement of excessive daytime sleepiness. This abstract concerns preliminary data of this study.
Methods: The SART is a reaction task in which subjects have to decide not to respond occasionally. Two SART sessions with a 1.5-hour break were administered on two visits before and one after start of CPAP. Both the number of errors and reaction time were studied. Results were analyzed in relation to clinical characteristics, including the AHI, Epworth Sleepiness Scale (ESS), Patient Clinical Global Impression of Change (PCGI-C), and visual-analogue scales targeting general well-being.
Results: SART results are available for 13 patients on visit 1, for 7 on visit 2, and for 4 on visit 3 (during CPAP). Mean SART error scores on baseline visits 1 and 2 were 10.8 and 10.6 respectively, and mean reaction times were then 325 and 358 ms. Data during CPAP, when compared to the baseline data of these 4 patients show an average improvement of SART error score by 4 points, an ESS improvement of 10.5 points and a mean PCGI-C score of 1.5, i.e. 'major improvement'.
Conclusion: The high SART error rate at baseline reflects impaired vigilance in OSAS patients. The preliminary treatment results suggest that CPAP improves SART results, accompanied by subjective improvement in well-being.

0482

WEEKLY TEXT MESSAGING TO IMPROVE CPAP COMPLIANCE: A RANDOMIZED PROSPECTIVE TRIAL

Cotton J, Zarrouf FA
Lung and Sleep Center, AnMed Health, Anderson, SC, USA

Introduction: Effectiveness of CPAP as a treatment for Obstructive Sleep Apnea (OSA) can be limited by poor compliance. Our goal is to explore in a prospective randomized study the effects of short-term text messaging (weekly for 4 weeks) compared to usual care, on CPAP compliance in newly diagnosed patients. We also aim to specify the most commonly expressed reasons for CPAP non-adherence and suggest modalities for early interventions.
Methods: Diagnosed adult OSA patients treated with CPAP were randomized to one of two groups: Group A:Weekly Text Messaging, Group B: Usual care only. Groups were correlated with three compliance card data (average hours of device use, percent of days more than 4 hours use and percent of days the device was used) using bivariate correlations, independent sample- t tests and one-way ANOVA. Expressed encountered complaints affecting CPAP compliance were also explored.
Results: 12 patients were randomized at the time of this abstract, six of them had compliance and follow up data available (3M/3F), mean/SD for age=44.2/8.89, ESS=11.83/3.06, AHI=22.68/9.28, Arousal-I= 22.63/ 5.49, Percent with >4H= 76.65/22.0. Although we found a trend for a different compliance between the two groups, but this was not statistically significant for average hours (6.33/ .577 vs 5.17/ 1.44 p= 0.263) or for percent >4hours (86.63/5.77 vs 66.66/29.67, p= 0.316) .
Conclusion: The first part of our study showed that patients' compliance may change by weekly "texting" to help patients deal with some of the emerging troubles when using CPAP. Randomizing more patients and increasing our study n will help explore this theory and also explore the most common reasons for non-compliance in this group.
Support (If Any): The authors report no financial relationship with any company whose products are mentioned in this manuscript, or with companies of competing products.

0483

DIAPHRAGM POSITION AS PREDICTOR OF PAP ADHERENCE IN SLEEP APNEA

Garcha P[1], Cumbo-Nacheli G[2], Bae C[1], Minai OA[1], Aboussouan LS[1]
[1]Sleep Disorders Center, Cleveland Clinic, Cleveland, OH, USA, [2]Respiratory Institute, Cleveland Clinic, Cleveland, OH, USA

Introduction: Hyperinflation is associated with lower sleep efficiency in the overlap syndrome. We sought to determine whether radiographic measurements predict PAP adherence in sleep apnea.
Methods: We analyzed a cohort of subjects with sleep apnea on PAP therapy and with objectively measured adherence data. Two authors independently measured lung length (LL), anteroposterior diameter (APD) and right diaphragmatic arc height (RDAH).
Results: Data from 250 subjects were analyzed [161M; 89F]. Baseline demographics of study population were mean (SD) age 49 (12.83) years, height 171.8 (9.85) centimeters, neck size 40.74 (8.22) centimeters, weight 109.4 (29.2) kilograms, BMI 36 (9.95) and AHI 22 (14.9). There was no correlation between the overall PAP therapy compliance and radiographic measurements (p=NS) except in patients on bilevel PAP (n=15), where the average daily use of bilevel PAP on the days used was higher in patients with RDAH > 3.9 cm (higher diaphragm position) compared to those with RDAH ≤ 3.9 cm (5 hours/night vs. 1.5 hours/ night; p = 0.028). There was a trend for increased average daily use on used days with an increase in the RDAH (higher diaphragm position) (r=0.46, p = 0.08). There was a statistical relationship between AHI and APD (r = 0.34, p=0.001) and between the CPAP/EPAP and APD (r = 0.28, p = 0.01), but the APD correlated strongly with the neck circumference (r = 0.64, p < 0.001).
Conclusion: A mechanically more favorable and higher diaphragm position correlates with improved PAP adherence in patients requiring bilevel PAP. Although an increased APD was associated with worse AHI and higher CPAP/EPAP pressure, the APD was also strongly correlated with the neck circumference which confounds the influence of APD vs. neck circumference on the overall AHI.

0484

AUTONOMIC RESPONSE TO HEMODYNAMIC CHALLENGES IN OSA PATIENTS BEFORE AND AFTER 6 MONTHS OF CPAP TREATMENT

Rizzi CF, Poyares D, Ferraz M, Mello-Fujita L, Mendonca E, Tufik S
Psychobiology, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: It has been extensively reported autonomic alterations in OSA patients, mostly due to increment in sympathetic tonus. It is still unclear whether long-term CPAP treatment affects autonomic balance in these patients. The objective of this study was to evaluate the baseline autonomic tonus and its response to hemodynamic challenges in a standard protocol test ANSAR®.
Methods: Nineteen moderate to severe OSA patients were consecutively assigned to 6-month CPAP treatment. They underwent baseline comprehensive evaluation including baseline and CPAP titration PSG, and autonomic evaluation with ANSAR® (ANX 3.0, ANSAR Medical Technologies, Inc., Philadelphia, PA) technology. ANS (Autonomic Nervous System) test included 5 challenges (baseline, deep breathing, baseline, valsalva, baseline, stand) performed at entry and 6 months after effective treatment. Autonomic tonus was calculated using wavelet (time and frequency combined domains). Breathing was simultaneously recorded, and its influence on sympathetic/parasympathetic balance was taked into account. All patients full filled adherence CPAP criteria (usage > 5 hours nightly), and had no major cardiopulmonary or neuromuscular conditions.
Results: Patients mean age was 52.2 ± 8.8 years old, 14 were male, mean AHI was 44.2 ± 29.1. Mean CPAP pressure titration was 9.5 ± 2.4 cmH2O. There were no differences on baseline for the following parameters: baseline sympathetic (Lfa) (1.3 ± 1.0 to 1.4 ± 1.0 bpm^2) and parasympathetic (Rfa) (0.8 ± 0.6 to 1.1 ± 1.2) bpm^2) modulation, Lfa/Rfa balance ratio (1.9 ± 1.4 to 1.9 ±1.2), low frequency (LF) (69.2 ± 13.6 to 62.4 ± 13.6 nu), and high frequency (HF) (31.2 ± 13.4 to 37.5± to 13.7nu). Responses to deep breathing, valsalva maneuver, and standing challenges did not change even after 6 months of effective CPAP treatment.
Conclusion: Conclusion: Six months of CPAP treatment did not influence either baseline autonomic tonus, or its response to hemodynamic challenges in moderate to severe OSA patients.
Support (If Any): CEPID, AFIP, FAPESP.

0485

EARLY ADHERENCE PREDICTS OVERALL EIGHT-WEEK ADHERENCE IN A CLINICAL TRIAL

Gharibeh TR[1,3], Thomas C[2], Male M[2], Hayes A[4], Aylor J[2], Mehra R[1,2,3]
[1]Pulmonary, Critical Care and Sleep Medicine, University Hospitals of Cleveland Case Westren Reserve University, Cleveland, OH, USA, [2]Center for Clinical Investigation, Case Western Reserve University, Cleveland, OH, USA, [3]Department of Medicine, University Hospitals Case Medical Center, Cleveland, OH, USA, [4]Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, OH, USA

Introduction: Although early adherence to continuous positive airway pressure (CPAP) has been identified as a predictor of long-term adherence in clinic-based settings, there are scant data investigating adherence patterns in interventional trials. We postulate that early CPAP and sham CPAP adherence during the first week of exposure predicts 8-week adherence in a clinical trial.

Methods: CPAP and sham CPAP adherence were assessed in 144 participants of a randomized controlled trial aimed to evaluate the effects of CPAP on intermediate cardiovascular outcomes. Adherence was objectively assessed by electronic compliance meters and calculated as percentage of days with >4 hours usage. Linear regression analyses were performed to assess 1-week adherence as a predictor of 8-week adherence in the CPAP and sham CPAP groups. Unadjusted and fully adjusted models (considering age, gender, race and body mass index (BMI)) are presented.
Results: Subjects were: age 51.2 ± 12 years, 54% male, 56% Caucasian, BMI 36.6 ± 7.5 kg/m2. There was no difference between CPAP and sham CPAP groups in age, gender, race and BMI. In the CPAP group, 1-week adherence predicted overall 8-week adherence in the unadjusted model and this relationship persisted in the fully adjusted model such that for each 5% increase in adherence during the first week, there was a 2.6 % increase in 8-week adherence ($p<0.0001$). Similarly, in the sham CPAP group, 1-week adherence predicted overall 8-week adherence in the unadjusted model and this relationship persisted in the fully adjusted model such that for each 5% increase in adherence during the first week, there was a 3.2% increase in 8-week adherence ($p<0.0001$).
Conclusion: :Consistent with referral clinic-based data, CPAP and sham adherence in an interventional trial during the first week is a predictor of overall 8-week adherence. These findings have implications on potentially intensively targeting CPAP and sham CPAP adherence education early in a clinical trial.
Support (If Any): : NIH/NHLBI HL079114 K23 Mentored Patient-Oriented Clinical Research Career Development Award, Clinical Translational Science Collaborative Small Pilot Grant, Central Society of Clinical Research Career Development Award.

0486

SERVO VENTILATION IN CENTRAL SLEEP APNEA PATIENTS

Kryger M[1], Winslow DH[2], Javaheri S[3]
[1]Sleep, Yale University and the VA Connecticut Healthcare system, New Haven, CT, USA, [2]Sleep, Kentucky Research Group, Louisville, KY, USA, [3]Sleep, Sleepcare Diagnostics Inc., Cincinnati, OH, USA

Introduction: Therapy titration for any form of central sleep apnea can be challenging due to complicated breathing patterns and time to distinguish the efficacy of therapy. A device that effectively adjusts inspiratory and expiratory pressure and breathing frequency may improve the efficiency of the titration process..
Methods: 21 patients (17 males, 4 females) age 57.6 ± 10.8 (mean ±SD) years, BMI 34.7 ± 4.8, newly diagnosed with central sleep apnea underwent polysomnography (PSG) (diagnostic, CPAP titration, and titration with automatic servo-ventilation (BiPAP autoSV Advanced, Philips Respironics). Servo ventilation titration was conducted with device default settings (EPAP range 4 - 21 cm of H20, Max pressure 25 cm of H2O, Pressure Support range 4 - 21 CM of H20, automatic back up rate). PSG respiratory events were manually scored using 2007 AASM recommended criteria by a central laboratory.
Results: The AHI was lowest on the ASV night [6.1 (12.8 ± 21.2)] [median (mean ± SD)] compared to the CPAP [29.7 (37.0 ± 25.2)] ($p<0.001$) and the diagnostic nights [54.2 (55.5 ± 26.6)] ($p<0.001$). The CAI was lowest on the ASV night [0.0 (0.1 ± 0.3)] compared to the CPAP [9.3 (16.2 ± 15.2)] ($p<0.001$) and the diagnostic nights [30.1 (25.4 ± 19.4)] ($p<0.001$). The oxygen desaturation index was lowest on the ASV night [5.3 (12.6 ± 22.1)] compared to the CPAP [13.4 (22.3 ± 20.5)] ($p=0.021$) and the diagnostic nights [42.1 (44.8 ± 27.7)] ($p<0.001$). The arousal index was lowest on the ASV night [23.4 (22.5 ± 11.5)] compared to the CPAP [32.8 (36.6 ± 23.4)] ($p=0.001$) and the diagnostic nights [45.3 (46.1 ± 22.6)] ($p=0.002$). No significant differences were observed in sleep efficiency between any of the nights.
Conclusion: The automatic servo-ventilation night demonstrated significant improvements in respiratory events during sleep in patients with central apnea and improved the efficiency of titration process.
Support (If Any): Philips Respironics.

0487

EFFECT OF HEATED WALL TUBING WITH HEATED HUMIDIFICATION ON PAP USAGE AT 30 DAYS POST PAP INITIATION

Speer TK[1], Webb R[2]
[1]Sleep Interpretations LLC, Katy, TX, USA, [2]Monitor Medical, Stafford, TX, USA

Introduction: Heated humidifiers have been proven to benefit patient adherence to PAP mask and pressure. However, under a variety of circumstances with increased temperature settings the problem of condensation has interrupted sleep and lead to limited use. This study compared heated humidification with heated wall tubing between a closed system with an algorithm that adjusts the temperature in the tube and one that has a constant temperature in the heated wall tubing under real-use conditions.
Methods: Enrollment included 42 patient diagnosed with OSA who had been referred for initiation of PAP therapy. Patients were randomly selected from a database of patients whom had successfully completed 30 days of usage. Group 1 used heated wall tubing that was added to the system with its own power supply (Hybernite) Group Two used the integrated heated wall tubing with auto heat control of the humidifier (Climateline). The matched Control group used an integrated heated humidifier with blower. The humidifier setting for Group 1 and the control group was set at 2. Usage data collected per standard operating procedure of the DME company.
Results: The average daily use on days used was statistically different between the two treatment groups and matched controls over the first 30 days of use. The average time of use for Group 2 was 6.8 hours and the average time of use for Group 1 and the Controls was 5.8 hours. Average PAP pressure in the combined groups was 11.4 cmH2O (SD = 0.29). No statistical differences on general demographic parameters and severity of OSA (Avg. AHI=28.8, SD=3.1).
Conclusion: Heated wall tubing can produce improved usage to PAP therapy, however, the temperature and humidity at the interface does affect overall usage of PAP therapy when matched with sufficient temperature at the humidifier plate to maintain effective relative humidity.

0488

PLATELET CATECHOLAMINE LEVELS AFTER ONE-YEAR OF CPAP TREATMENT IN OBSTRUCTIVE SLEEP APNEA PATIENTS

Feres MC[1], Mello-Fujita L[1], Rizzi CF[1], Cintra F[1], Souza AA[1], Tufik S[2], Poyares D[1]
[1]Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [2]Psychobiology, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: Obstructive sleep apnea (OSA) is associated to augmentation in sympathetic autonomic activity and arterial hypertension (HYP). Nevertheless, the tests and measures that estimate sympathetic tone are not standardized in clinical practice, since urine and plasma are often not replicate. The objective of this study was to test performance of platelet catecholamine method in patients with OSA before and after one year of effective CPAP treatment.
Methods: One-hundred and fifty four OSA patients were selected from the clinic of sleep Institute of Sao Paulo city, Brazil. Patients were randomly allocated into 4 groups:G1 (OSA+HYP, n=64), G2(OSA, n=50), G3(HYP, n=16) and G4(controls, n=24). Nine patients were treated with CPAP in one-year period. These patients underwent to 24-h urine (U), plasmatic (PL) and platelets (PT) catecholamine (adrenaline-ADR and noradrenaline-NOR) dosages (radioimmunoassay method). The de-

scriptive analysis was based on the comparison between the four groups performed by ANCOVA with age, abdominal circumference and body mass indice (BMI) as covariate. Spearman tests, roc curves, binary logistic regressions were carried out to test these new measurements and Wilcoxon test was used to compare patients before and after treatment.
Results: Urinary, plasma and platelet catecholamine concentrations were higher in OSA+HYP, OSA, OSA and HYP groups compared with controls but presented high variability. Significant correlation (r=0.64) was found between urinary (UAD) and platelet adrenaline (PTAD) and between urinary (UNA) and platelet noradrenaline (PTNA)(r=0.60). A logistic regression model, controlled for age and BMI, showed that UAD(OR=1.55[1.35-1.85]) and UNA(OR=1.00[1.00-1.09]) as risk factors for OSA+HYP group; Higher levels of UAD (OR=1.63[1.43-1.92]) and UNA(OR=1.03[1.00-1.07]) for HYP and Higher levels of PTNA(OR=1.01[1.00-1.04]) for OSA without HYP. After 1-year CPAP treatment a small sample showed decrease of levels of UNA and PTNA.
Conclusion: Urinary noradrenaline levels were able to detect the condition of hypertension with and without OSA, whereas platelet noradrenaline was superior in detecting OSA without comorbidity. This finding is consistent with our hypothesis that in OSA, nocturnal sympathetic activation may be reliably detected by a technique that increases catecholamine availability, such as platelet dosage.
Support (If Any): AFIP, FAPESP, CEPID, CNPq, CAPES.

0489

RETROSPECTIVE STUDY: COMPLICATED SLEEP BREATHING DISORDERS TREATED BY THE MODIFIED AUTO SERVO-VENTILATION

Mao MM, Huban KM
Center for Sleep-Wake Disorders, Miami Valley Hospital, Dayton, OH, USA

Introduction: The BiPAP auto servo-ventilation (ASV) Advanced device is specifically designed for treating patients with primary central, Cheyne-Stokes Respiratory (CSR), or complex sleep apneas emerged during the titration of conventional CPAP or Bi-Level treatment. The challenges limiting the effectiveness of treatment have included difficulties with effective titration and the management of mask leak. In our daily clinical practice, we developed a modified ASV titration protocol by using EPAPmin = EPAPmax = 4 or 5 cm H2O as a basic setting, increasing EPAPmin/max simultaneously, and defaulting other settings (PSmin = 0, PSmax = 15, a max pressure 30 cm H2O, and auto respiratory rate) to stabilize patients' breathing patterns. We hypothesize that this modified titration protocol could effectively determine treatment settings with the BiPAP autoSV Advanced device.
Methods: We reviewed patients' medical charts from October 2010 to December 2011.
Results: Total 40 patients (38 male, 2 female, age 66.7 ± 10.4 years, BMI 33.3 ± 7.2 kg/m2, acute/chronic coronary artery disease 60.0%, heart failure 42.5%, atrial fibrillation 42.5%, narcotic drug 35%, chronic obstructive pulmonary disease 15%) were diagnosed with primary central or complex sleep apnea (baseline AHI 61.8 ± 26.0) and subsequently underwent polysomnogram with the ASV protocol. The mean arousal index of the ASV was significantly less than that of CPAP (19.9 ± 15.4 vs. 9.6 ± 7.6, $p < 0.01$). The mean AHI (5.2 ± 3.5) of the ASV was significantly less than the AHI (58.0 ± 20.3) of CPAP ($p < 0.01$).
Conclusion: The retrospective data demonstrated that the modified ASV titration protocol can effectively determine treatment settings for central and complex apnea.

0490

SUSTAINED TOLERANCE OF CPAP USING MAS SUPPORTED NASAL PILLOWS

Boota AM[1], White JR[2], Essick G[3], Pardue T[3]
[1]Pulmonary, St.Francis Sleep Center, Greenville, SC, USA, [2]Dentistry, Cleveland St Family Dentistry, Greenville, SC, USA, [3]School of Dentistry, University of North Carolina, Chapel Hill, NC, USA

Introduction: Recently, we demonstrated that CPAP tolerance can be improved using a mandibular advancement splint (MAS) to physically support and stabilize the position of nasal pillows (2011 AADSM abstract). However, it was unknown whether patients' lack of complaints and adherence to therapy would persist beyond the initial trial period.
Methods: Data were available for nine CPAP-intolerant patients (mean age= 57.1 yrs, BMI = 29-33.8) treated with hybrid therapy. Patients were fitted with a MAS that advanced the jaw 71% of maximum protrusion. A metal rod was secured facially to the upper compnonent to provide support and positional stability for nasal pillows (TAP-PAP chairside, Airway Management Inc., Dallas, TX). PSG: Lab sleep data were obtained from patients; initial diagnostic and CPAP titration studies, and final PAP titration with MAS. CPAP Tolerance: Using a 13-item checklist, patients reported reasons for intolerance to conventional CPAP, and to PAP combined with MAS at the start of treatment and 10.1 (range 5 - 13.6) months later.
Results: Mean AHI was 61.3 events/hr (range 10-108) prior to any treatment, 5 events/hr (Range 0 -20.7) at optimum CPAP of 11.5 cm H20 (10 - 16) without MAS, and 1.8 events/hr (0 - 6.1) at optimum CPAP of 9.9 cm H20 (9-15) with MAS. Each patient reported 2 - 6 reasons associated with intolerance to conventional CPAP: Most commonly 'can't keep in place' (77.8% patients), 'unconsciously remove' (56.6%), 'mask uncomfortable' (44.4%), 'mask leaks' (44.4%). During the initial trial period of hybrid therapy, only two patients reported a single negative experience: 'unconsciously remove', 'pull of hose applies force to teeth'. 10.1 months later, patients reported only two negative experiences (both related to MAS) and using the hybrid therapy 6.6 nights/week for 7.4 hrs/night, on average. Mean ESS remained low at 3.6.
Conclusion: Adherance to CPAP therapy can be improved and maintained using hybrid therapy, which proves to be as efficacious as conventional CPAP.

0491

A PROFILE OF CPAP EDUCATION OUTCOMES IN A TEACHING HOSPITAL IN SINGAPORE

Venkateswaran S
Respiratory, Changi General Hospital, Singapore, Singapore

Introduction: CPAP education is the cornerstone in improving patient acceptance of CPAP. CPAP education is provided in our hospital for patients who require CPAP therapy. This is done in our CPAP clinics which are staffed by both sleep technologists and CPAP vendors who provide different aspects of counselling and education to the patient. A free 1-month trial of CPAP is provided after the initial counselling. This study is an audit of patients who attended the CPAP clinic between Janaury and December 2010 and who successfully went on to use CPAP.
Methods: This is a retrospective case review of patients who succesfully went on to using CPAP after attending the CPAP clinic between January 2010 and December 2010.
Results: There were 235 patients who attended the CPAP clinic between Janaury and December 2010. Of these only 45(19.1%) subsequently purchased CPAP and used it.Of the 45, there were 37(82.2%) males and 8(17.8%) females. The racial breakdown showed that there were 36(80%)Chinese patients, 3 Malay(6.6%) and 6(13.4%) Indian patients. Their mean age was 50.2±11.6 years. The mean BMI (of 9/45 patients who had it recorded) was 30.2±6.5 kg/m^2. The mean ESS score (in 26/45 who had it recorded) was 8.6±4.6. The mean RDI and mean REM RDI were 44.8±26.1 and 44.8±23.7 events/hour respectively. Majori-

ty(91.4%) of the patients did not feel claustrophobic during the 1-month CPAP trial. There were 29(67.4%) mouth breathers, but 33/34(97.1%) of them did not use chin straps. Most people(70%) slept in an air-conditioned environment. Only a minority(25%) had used CPAP prior to undergoing formal CPAP counselling. The type of mask used was nasal in 17(37.7%), oro-nasal in 24(53.4%) and nasal pillow in 4(8.9%). The most common size(used by 48.8% in this cohort)was medium. There were 8 patients who had some form of upper airway surgery prior to trialling CPAP. After the initial CPAP counselling session, patients received on average 5.2±1.9 follow-up telephone calls. The average number of days after the first CPAP counselling to the time of purchase of the CPAP machine was 61.2±39.4 days. At the time of submission 25 patients have purchased CPAP machines in 2011.
Conclusion: CPAP acceptance is poor by patients at our institution. Of those who did go on to use CPAP, they were predominantly male, middle-aged, obese, not hypersomnolent, and had severe OSA. Despite constant reminders and support, it took more than two months on average for this group to buy a CPAP machine.

0492

CHANGES IN DAYTIME SLEEPINESS LEVELS FOR CAREGIVERS DURING CPAP TREATMENT FOR PATIENTS WITH PARKINSON'S AND SLEEP APNEA

Carbungco A[1], Bradley L[1], Avanzino JA[1], Lichter L[1], Neikrug AB[1,2], Maglione JE[1], Loredo JS[3], Ancoli-Israel S[1,2,3]
[1]Department of Psychiatry, University of California San Diego, La Jolla, CA, USA, [2]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, , San Diego, CA, USA, [3]Medicine, UCSD, La Jolla, CA, USA

Introduction: Very little research on daytime sleepiness has been conducted for caregivers of Parkinson's disease (PD) patients diagnosed with obstructive sleep apnea (OSA). It is likely that since the patient's sleep is disturbed, the caregiver's sleep would also be disturbed and would result in daytime sleepiness. We hypothesized that as the patient's sleep improved, the caregivers daytime sleepiness would also improve.
Methods: As part of a larger study on the effect of treating OSA, patients with PD were screened for OSA and randomized to either therapeutic CPAP (tCPAP) or sham CPAP (sCPAP). 23 caregivers of the PD patients were studied. Each caregiver completed the Epworth Sleepiness Scale before CPAP treatment (baseline, BL) of the PD patient and three weeks after CPAP treatment. T-tests comparing ESS scores between caregivers of PD patients in the tCPAP group (n=13) and caregivers of PD patients in the sCPAP were conducted.
Results: At BL, caregivers of patients in the tCPAP group had lower mean ESS (mean ESS =4.85, SD=2.15) when compared to caregivers of patients in the sCPAP group (mean ESS=6.78, SD=5.70)(p=0.0.015). At 3-weeks post-CPAP treatment, the mean ESS for the tCPAP group =5.00 (SD=2.00) vs. mean ESS=8.9 (SD=5.11) for the sCPAP group (p=0.029). The change in ESS from BL to 3-weeks was not significant in either group. Note that all values were below the ESS cut-off of 10.
Conclusion: Results show that, in general, caregivers of PD+OSA patients are not sleepy and treatment of the OSA in the patient does not change the reports of daytime sleepiness.
Support (If Any): NIA AG08415, UC1RR031980, the Research Service of the Veterans Affairs San Diego Healthcare System and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

0493

A RETROSPECTIVE STUDY ON ORDERING SUBSEQUENT CPAP TITRATION STUDIES IN MILD SLEEP APNEA WITH REM PREDOMINANCE

Oster JM[1,2], Mayakrishnan I[2,1]
[1]Neurology, Lahey Clinic, Burlington, MA, USA, [2]Neurology, Tufts University School of Medicine, Boston, MA, USA

Introduction: REM related sleep apnea is not a well studied entity. There are no guidelines on when to order follow up evaluations when REM predominant sleep apnea is identified. This study retrospectively characterizes a population of patients from 2008 that exhibited REM related sleep apnea in which the Apnea/Hypopnea Index(A/HI) in REM >= 5/hour with an A/HI <=15 overall who subsequently presented for CPAP titration studies.
Methods: Patients who underwent a diagnostic Polysomnogram(PSG) at Lahey Clinic in Burlington MA in 2008 were identified and the PSGs were retrospectively reviewed. Cases were reviewed with an A/HI in REM >=5/hour when A/HI overall is <=15/hour on Polysomnography(PSG) as the inclusion criteria for the study.
Results: Our results identify a population of approximately 3% of the total number of patients who present for diagnostic PSGs who meet the above inclusion criteria in a medical center such as ours. Approximately 40 % of such patients may go on to have CPAP titration evaluations ordered. The clinical indications on selecting and not selecting such patients for subsequent CPAP titrations need further evaluation.
Conclusion: REM related sleep apnea is an emerging concept. Our study identifies that there already exists a population of patients who exhibit the above noted inclusion criteria, who might or might not be treated with CPAP. Characterization of these patients may deserve further study.

0494

BACKGROUND CHARACTERISTIC IN OBSTRUCTIVE SLEEP APNEA PATIENTS WITH AUTO-ADJUSTING CONTINUOUS POSITIVE AIRWAY PRESSURE BY THE GRADING SYSTEM

Ohshima Y[1], Hokari S[1], Nakayama H[1], Ohdaira T[2], Takada T[1], Narita I[1]
[1]Respiratory medicine, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan, [2]Respiratory medicine, National Hospital Organization Nishi-Niigata Chuo National Hospital, Niigata, Japan

Introduction: For the Obstructive Sleep Apnea (OSA) patients, auto-adjusting continuous positive airway pressure therapy (APAP), which is widely used in Japan, greatly reduces the Apnea-Hypopnea Index (AHI). However, we observed that there exist some patients who had less improvement on the AHI after APAP. The aim of this study is to detect these characteristics to affect the effectiveness of APAP.
Methods: We evaluated 507 Japanese patients (444 men and 63 women, age 56.6 ± 12.9 years, body mass index (BMI) 27.5 ± 4.6 kg/m^2, AHI 49.1 ± 21.3 /h) who had been diagnosed as moderate to severe OSA by polysomnography (PSG) and treated with APAP between August, 1999 and November, 2010 based on their medical records. According to the result of PSG under APAP, we categorized patients into three groups; the good titration group (AHI ≤10), the adequate titration group (AHI >10 but reduced AHI by 75% from the baseline), and the unacceptable titration group (except above). We compared their baseline characteristics among those three groups by one-way ANOVA with Bonferroni post hoc analysis.
Results: 392 patients (77.3%), 42 patients (8.3%), and 73 patients (14.4%) belonged to the good titration group, the adequate titration group, and the unacceptable titration group, respectively. Comparison with other 2 groups, the adequate titration group was younger and had higher BMI and higher AHI at the diagnostic PSG (p<0.05). On the other hand, the good titration group and the unacceptable titration group

had no obvious difference except higher ratio of OSA type ($p<0.05$) in the former group.
Conclusion: Effectiveness of APAP seems to be involved in age, BMI, severity of OSA syndrome and the proportion of type. We had better pay attention to those patient.

0495

DIFFICULTY WITH USE OF POSITIVE AIRWAY PRESSURE EQUIPMENT AND ADHERENCE TO THERAPY AMONG OLDER VETERANS: A PILOT STUDY

Fung CH[1,2], Martin JL[1,2], Jouldjian S[1], Josephson KR[1], Alessi CA[1,2]
[1]GRECC, VA Greater Los Angeles Healthcare System, Los Angeles, CA, USA, [2]David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

Introduction: Positive airway pressure (PAP) therapy for sleep-disordered breathing (SDB) necessitates nightly equipment assembly, which requires joint mobility. This process may be challenging for older adults with comorbidities (e.g., arthritis) and could affect adherence. This pilot project aims to determine if difficulty with using PAP equipment is associated with less PAP use and more daytime symptoms.
Methods: Within a larger epidemiologic study of sleep problems among Veterans aged >= 60 years, Veterans were asked about history of SDB, current/prior PAP therapy, and presence of daytime sleepiness and impaired attention/memory. Participants rated degree of difficulty using PAP equipment (5 items; 5-point Likert-like scales), including putting on the mask, adjusting straps, turning dials/pushing buttons, disconnecting tubing, and removing the water chamber. Participants reported PAP use in the past week and were categorized into two groups: non-user versus >= 1 night of use. Analyses included Fisher's exact tests.
Results: Among 232 Veterans surveyed, 106 reported a history of SDB, and 87 responded to PAP equipment questions. 40% (n=35) of respondents to PAP questions reported no PAP use in the past week, and 14% (n=12) reported marked difficulty with PAP equipment (defined as >= 1 responses of "quite a lot" or more difficulty with PAP equipment). 73% of those with marked difficulty with PAP equipment were non-users, while only 39% of those without marked difficulty were non-users (1-sided Fisher's test, p=.04). Those with difficulty reported higher rates of impaired attention/memory (100% vs. 73% among those without difficulty, 1-sided Fisher's test, p=.04), but not daytime sleepiness (91% vs. 88% among those without difficulty, 1-sided Fisher's test, p=.62).
Conclusion: In this pilot study, difficulty with PAP equipment use was associated with less use of PAP therapy and impaired attention/memory. More studies are needed to better understand these difficulties and to identify strategies to improve equipment use.
Support (If Any): Department of Veterans Affairs Advanced Geriatrics Fellowship Program, Veterans Administration Health Services Research and Development (Alessi IIR 08-295); Veterans Administration Greater Los Angeles Geriatric Research, Education and Clinical Center.

0496

DETERMINANTS OF CONTINUOUS POSITIVE AIRWAY PRESSURE IN A SLEEP CLINIC COHORT OF SOUTH FLORIDA HISPANIC VETERANS

Wallace DM[1,2], Vargas SS[3], Schwartz SJ[4], Aloia M[5], Shafazand S[3]
[1]Neurology, University of Miami Miller School of Medicine, Miami, FL, USA, [2]Neurology, Miami VA Healthcare System, Miami, FL, USA, [3]Medicine, Division of Pulmonary, Critical Care and Sleep, University of Miami Miller School of Medicine, Miami, FL, USA, [4]Center for Family Studies, University of Miami Miller School of Medicine, Miami, FL, USA, [5]Medicine, National Jewish Health, Denver, CO, USA

Introduction: There are little existing data on Continuous Positive Airway Pressure (CPAP) adherence in US Hispanic veterans with Obstructive Sleep Apnea (OSA). Our aim was to describe determinants of one-month adherence in a sleep clinic cohort of South Florida Hispanic veterans.
Methods: Hispanic veterans referred to the Miami VA sleep clinic were recruited and completed questionnaires about sleep apnea risk, sleep quality, insomnia symptoms, sleepiness, depression/anxiety, acculturation, personality traits and cognitions about OSA and CPAP. Individuals at risk for OSA were scheduled for baseline polysomnography (PSG), followed by in-lab CPAP titration or a trial of auto-CPAP. Participants with OSA accepting CPAP therapy were asked to return after 7 and 30 days of treatment for adherence verification and to repeat questionnaires.
Results: One hundred-twenty four participants (94% men) were enrolled with 114 completing overnight PSG. Eighty-six out of 95 participants (91%) with sleep apnea syndrome or moderate-to-severe OSA accepted CPAP treatment. Fifty-nine participants completed both follow up visits with a mean CPAP use at 30 days of 3.6 ± 2.0 hours. The only independent predictor of 7-day mean daily CPAP use was the baseline insomnia severity index while the best predictor of 30-day mean daily CPAP use was the 7-day mean daily use.
Conclusion: Our study suggests that South Florida Hispanic veterans with OSA evaluated in a sleep clinic show poor CPAP adherence. Insomnia and poor early use predicted poor adherence overall. Larger prospective studies with other race-ethnic groups are needed to determine the role of ethnicity and race in CPAP adherence amongst US veterans with OSA.
Support (If Any): Dr. Shafazand was supported by a grant from the American Sleep Medicine Foundation.

0497

CONTINUOUS POSITIVE AIRWAY PRESSURE ADHERENCE IN THE ELDERLY

Budhiraja R[1,2], Luraschi-Monjagatta C[2], Alzoubaidi M[2], Hannah C[1], Koebnick J[1], Quan SF[3,1,2]
[1]Medicine, Southern Arizona VA Healthcare System, Tucson, AZ, USA, [2]Medicine, University of Arizona, Tucson, AZ, USA, [3]Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Beneficial effects of continuous positive airway pressure (CPAP) therapy for obstructive sleep apnea (OSA) are incumbent upon adequate adherence to therapy. There are few studies assessing CPAP adherence in elderly.
Methods: We retrospectively reviewed the charts of patients with newly-diagnosed OSA who were started on CPAP therapy. We compared adherence to therapy assessed ~4 weeks after initiation of CPAP in 247 elderly patients (age≥60 years) to that in 144 younger patients (age<60 years) .
Results: The mean age of the elderly patients was 67.5±6.7 years and that of younger patients was 51.4±6.7 years. Elderly had similar Epworth sleepiness scale (ESS) scores (10.8±5.4 vs. 11.7±5.9, P=0.13) and diagnostic apnea hypopnea index (AHI) (37.6±30.0 vs. 36.4±33.1, P=0.82) as the young. Regression models did not show an association between initial AHI, blood pressure, BMI or ESS and CPAP adherence in either group or the entire sample. Elderly group used CPAP on 84% of the days versus 76% in younger group (P=0.003). Usage index (percentage of days when CPAP was used more than 4 hours) (63.0±32.2% vs. 53.3±33.1%, P=0.004) and average daily/ nightly hours of use (4.9±2.9 vs. 4.1±2.3, P=0.01) were also higher in the elderly. To understand whether 'elderly' constituted a homogeneous group from adherence perspective, these patients were divided into quartiles based on age. While the adherence was similar in the bottom 3 age quartiles (60-62 years, 62-67 years and 67-73years), the adherence in the highest quartile (>73 years old) tended to be lower than the bottom age quartile in this group [average nightly use 4.3±2.4 hours vs. 5.1±2.4 hours, P=0.058; usage index 56.7% vs. 68.7%, P=0.048].
Conclusion: Elderly patients with OSA demonstrate better short-term CPAP adherence than their younger counterparts. However, adherence may decline in very old.

0498

COMPARISON OF THE EFFECTS OF CPAP, AIO AND AEROBIC EXERCISE IN OBSTRUCTIVE SLEEP APNEA SYNDROME

Schutz TC, Cunha TC, Moura-Guimarães T, Luz GP, Ackel-D'Elia C, de Mello M, Tufik S, Bittencourt LA
Psychobiology, Universidade Federal de São Paulo, São Paulo, Brazil

Introduction: Introduction: Obstructive sleep apnea syndrome (OSA) refers to a breathing disorder characterized by obstruction of the upper airway during sleep, partial or complete, usually associated with a decrease in arterial oxygen saturation, sleep fragmentation, and hypercapnia (AASM, 1999). There are several forms of treatment (sleep hygiene, weight loss, use of oral appliances and otorinolaryngologic surgery) that can be used to reduce the signs and symptoms of OSA. Few studies have evaluated the effectiveness of a physical training program in reducing the symptoms of OSA. Objective: The above data also highlight the need to assess the effect on the subjective and objective measures of sleep, quality of life and mood of physical exercise in the OSA and the comparison with traditional forms of OSA treatment such as CPAP and oral appliance.
Methods: Methods: Male patients with moderate to severe sleep apnea and BMI below 30 were assigned randomly in three groups: CPAP (n=8), OA (n=8) and Physical Exercise (n=7). Polysomnographic recordings, blood sample and daytime sleepiness were obtained prior to and after two months of physical exercise (three times a week and one hour per session) or treatment with CPAP or OA.
Results: Results: Subsequent to the treatment with CPAP or AIO, patients presented a significant reduction in apnea-hypopnea index-AHI (25.06±10.54 to 1.86±1.16 and 30.76±19.00 to 9.59±10.27, respectively). In physical exercise group, we did not observe changes in sleep parameters studied. In blood analysis, we verified statistically significant changes only in physical exercise group. In this group, there was a reduction in the following parameters: T leukocytes, glucose, triglycerides, VLDL and potassium. The program of physical exercise three times a week and one hour per session, lasting two months, causes a serious positive impact on subjective daytime sleepiness, the Epworth sleep scale reduced from 14.14±5.64 to 9.57±4.24, (polysomnography).
Conclusion: Conclusion: Our results suggest that physical exercise resulted in marked blood alterations and subjective daytime sleepiness modifications, but no change in the objective variables of sleep.
Support (If Any): Funding: AFIP, FAPESP, CNPq.

0499

CHANGES OF BODY WEIGHT AND APNEA SEVERITY OVER ONE YEAR AFTER CPAP TREATMENT IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA-HYPOPNEA SYNDROME (OSAHS)

Mukomatsu Y, Ogawa S, Yamaguchi Y
Sleep Disorder Center at Fukuoka, Fukuoka, Japan

Introduction: Obesity is a cause of OSAHS and is the most significant risk factor for the apnea severity. And, the most common and effective treatment for OSAHS is a CPAP treatment. However, there are few reports how much the weight would change in OSAHS patients treated with CPAP for long duration. This retrospective study sought to determine whether OSAHS patients treated with CPAP over one year would lose or gain weight.
Methods: A total of 287 male OSAHS subjects treated with CPAP and re-evaluated with the PSG over 1-year follow-up was enrolled. The age was 50.6 + 12.3 years, BMI was 27.5 + 4.3, and the mean AHI was 53,3 + 27.3. Female OSAHS patients were excluded because of the small number of subjects and the influence of female hormones.
Results: 1) The ratio of weight reduction or gain of more than 7 % over one year CPAP treatment in all participants was 9.8 % and 4.5 %, respectively. The ratio of 3-7 % weight loss, weight unchanged of + 3 %, and 3-7 % weight gain was 14.3 %, 57.5 %, and 14 %, respectively. 2) The AHI was reduced by 49 % with weight loss of more than 7 % among patients of BMI < 25 and BMI > 25. Weight loss of more than 7 % in OSAHS subjects of BMI < 25 (non-obese) resulted in the AHI improvement of 65 %. On the other hand, apnea severity was worsened by 31 % in patients of BMI > 25 (obese) with weight gain of more than 7%.
Conclusion: The support and education for overweight will result in significant improvement in obese OSAHS patients, and also, it seems to be important that weight loss would make the apnea severity improve remarkably in non-obese patients.

0500

CAN VIDEO BASED POSITIVE AIRWAY PRESSURE (PAP) EDUCATION IMPACT ACCEPTANCE, SELF EFFICACY AND ADHERENCE TO PAP IN THE MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA?

Moore WR[1,2], Olson EJ[3,2], Vickers Douglas K[5,6], Dierkhising RA[4], Sikkink VK[1,2], Heim-Penokie PC[1,2], Ryan KS[1,2], Abbasi AA[2], Slocumb NL[2], Escalante P[3,2]
[1]Nursing/PCCM, Mayo Clinic, Rochester, MN, USA, [2]Mayo Center for Sleep Medicine, Mayo Clinic, Rochester, MN, USA, [3]Division of Pulmonary Critical Care Medicine, Mayo Clinic, Rochester, MN, USA, [4]Biomedical Statistics and Informatics, Mayo Clinic, Rochester, MN, USA, [5]Division of Psychiatry and Psychology, Mayo Clinic, Rochester, MN, USA, [6]Division of Patient Education, Mayo Clinic, Rochester, MN, USA

Introduction: Compliance with positive airway pressure (PAP) for obstructive sleep apnea (OSA) is challenging. This study explored the impact of video education on PAP self efficacy and compliance in newly diagnosed OSA patients.
Methods: Prospective, randomized controlled study of usual PAP initiation cares (n=198) versus usual cares plus video education (n=201). Self efficacy and PAP compliance were measured at baseline and 45 day follow-up. Video participants completed a survey rating their perceptions of the video.
Results: Using a Likert survey (1 = no impact; 9 = quite a bit), video participants rated the mean (SD) impact of the video on attitude toward PAP as 7.4 (1.97), impact on PAP behavior 7.2 (2.1), and confidence related to PAP treatment 7.8 (1.7). However, at follow-up, the groups did not differ with respect to changes in the Stanford Self-Efficacy Score (mean video 0.58 versus mean usual care 0.42, p=0.49), Self-Efficacy Measure for Sleep Apnea (SEMSA) perceived risk score (mean video -0.0001 versus mean usual care -0.058, p=0.29), SEMSA outcome expectancies score (mean video 0.085 versus mean usual care 0.012, p=0.13), and SEMSA self-efficacy score (mean video 0.124 versus mean usual care 0.058, p=0.23). The majority of patients in both groups used their PAP 95% of the nights assessed (mean video 52% versus mean usual care 59%, p=0.18) and mean nightly hours PAP use were equivalent (mean video 5.91 hours [1.52] versus mean usual care 6.18 [1.72]).
Conclusion: Subjective benefit in attitude, behavior and confidence toward PAP were reported with video education. Yet, our in-house produced video was not associated with increased self efficacy ratings or PAP adherence during the first 45 days compared to our usual care. The high rates of PAP use in the controls likely made it more difficult to discern an impact of the video.
Support (If Any): This study is funded by the Department of Pulmonary Critical Care, Department of Nursing and Department of Education, Mayo Clinic Rochester, MN.

0501

CAN CPAP TITRATION PRESSURE BE PREDICTIVE FOR OSAS TREATMENT WITH ORAL APPLIANCES THERAPY ?

Machado MA, Juliano M, Balsalobre R, Carvalho LB, Prado LF, Prado GF
Neurology/ Neuro-Sono, Federal University of Sao Paulo, Brazil, Sao Paulo, Brazil

Introduction: Many studies have established success predictors for OSAS treatment with oral appliances therapy although there are inconclusive findings. The aim of this study is to assess if CPAP titration pressure can be considered a success predictor for OSAS treatment with oral appliances.
Methods: Polysomnography Titration CPAP was performed in 22 patients with mild, moderate and severe OSAS, mean age 55 years (17 men). They were unable to tolerate CPAP therapy and oral appliance therapy was indicated for OSAS treatment. Polysomnography was performed at the end of oral appliance protocol. Two groups were formed: the treated group (group I) who achieved AHI<5/h and the untreated group (group II). We compared the CPAP-titration pressure in both groups through t-test.
Results: The group I had 4 patients with severe OSAS, 4 patients with moderate OSAS and 1 patient with mild OSAS. The AHI baseline in group I was 30.7/h while the post-treatment AHI was 2.8/h. The Group II had 7 patients with severe OSAS, 5 patients with moderate OSAS and 2 patients with mild OSAS. The AHI baseline in group II was 37.1/h and the AHI was 12.3/h at the end of oral appliance titration. The CPAP mean titration pressure was 8.9 cmH2O in group I and 10.3 cmH2O in group II (p=0.231).
Conclusion: Although there are no statistical significant findings, these preliminary results suggest that CPAP pressure in patients that achieved success with oral appliance therapy has the tendency to be less or close to 9 cmH2O.
Support (If Any): FAPESP # 2010/04475-5.

0502

CPAP COMFORT SCALE AS AN INDICATOR OF CPAP COMPLIANCE

Freedman AR, Doros M, Smith-Cappucci J, DiSanto S, Kelly L, Watson G, Frey S
Central Jersey Sleep Disorders Center, East Brunswick, NJ, USA

Introduction: Sleep apnea is a medical condition with significant prevalence in the population and is characterized by considerable morbidity. The generally accepted standard of care is CPAP. Adherence to the therapy is presently a major challenge with overall compliance recognized to be in the range of 50%. Compliance can be defined as percent nights greater than 4 hours of use of CPAP (%C). The Central Jersey Sleep Disorder Center created a questionnaire as part of its package to assess patient satisfaction, called the CPAP Comfort Scale (CSS), which is routinely completed by the patient at the completion of the CPAP titration sleep study. The CPAP comfort scale was a numerical scale with 8 questions scored on the scale of 0-3, 0 being the least comfortable, 3 being the most comfortable. A score of 24 implied significant comfort. Questions addressed comfort related to air pressure, facial pressure, dryness, the overall CPAP experience, and desire to continue to use CPAP, among others. The theory was that the CSS could help predict subsequent patient compliance, and in so doing, identify potential problem patients early, allowing us the opportunity to focus resources in sleep clinic to improve patient compliance and address comfort issues.
Methods: 100 sleep patient cases from the sleep clinic were reviewed covering the period June 2008 to January 2011. Patients were included if there was a completed CPAP comfort scale and follow up compliance data within the first two months of use of CPAP. Compliance was read from the data chip in the CPAP unit.
Results: The lowest score noted was 10 with a maximum score of 24. The CSS and mean respective %C were as follows: 10 - 5%; 12 - 1.5%; 15 - 53.8%; 16 - 63.6%; 17 - 52.3%; 18-55.5%; 19 - 51.5%; 20 - 73.7%; 21.0 - 84.9%; 22 - 79.2%; 23 - 68.1%; 24 - 62.0%. When graphed as a plot of CSS (x axis) against %C (y axis), the R2 value was 0.5911 with equation y= 3.1034x, supporting a weak, though positive, linear correlation between the CSS and the %C.
Conclusion: The CPAP Comfort Scale can be a useful tool obtained at the time of the sleep study to help sleep clinic staff identify patients who may not be successful with CPAP or should pursue other modalities of therapy.

0503

EFFICACY AND TOLERANCE OF AUTOCPAP TO DIFFERENT OPTIMUM CPAP LEVELS

Thommi G[1,2], Shehan JC[1,2], Meyers P[1,2], Mcleay MT[1,2]
[1]Pulmonary/Sleep medicine, Creighton University, Omaha, NE, USA, [2]Pulmonary/ Sleep medicine, Midwest Pulmonary and Critical Care, Omaha, NE, USA

Introduction: Patients with obstructive sleep apnea (OSA) are initiated on Auto CPAP (ACPAP) without CPAP titration. Studies demonstrating success with ACPAP have compared its efficacy only to the severity of OSA but not to optimum CPAP levels.
Methods: OSA patients evaluated for CPAP/BiPAP titration were entered into the study. Patients that failed to respond to CPAP/BiPAP were discarded. The three ACPAP chosen were Fisher Paykel, Respironics and Resmed. Patients were randomly assigned to on one of the three ACPAP devices either prior to or after manual CPAP titration for at least two hours.
Results: One hundred and sixty one patients were evaluated, 53 patients for the Respironics device and 54 patients for the other two devices. Optimum pressures for CPAP ranged from 4 cm to 18 cm. Response to CPAP/ACPAP was documented if the apnea hyponea index (AHI) was less than 5/hr. Partial response was documented if the AHI fell between 5 and 10/hr. The optimum CPAP pressure was the lowest pressure with an AHI of <5/hr. At optimum CPAP of 4 cm, success with ACPAP was 93% for the Fischer Paykel and less than 60 % with the other two devices. At 6 cm optimum CPAP, success with all three devices was less than 55%. At optimum CPAP levels of 8 cm and above success with all three devices was less than 25%.
Conclusion: OSA patients fail to respond to ACPAP if the optimum CPAP levels are 8 cm and above. We recommend that CPAP titration be performed prior to ACPAP initiation and the optimum pressure obtained be the basal pressure for ACPAP. Limit on the upper level for ACPAP may be necessary for patients that deteriorate on higher CPAP levels.

0504

HIGHER PRESSURE IS ASSOCIATED WITH INCREASED CPAP COMPLIANCE

Stanley JJ, Palmisano J, Binns L, O'Brien LM
Univ Michigan, Ann Arbor, MI, USA

Introduction: Compliance with continuous positive airway pressure (CPAP) is a significant problem in the treatment of obstructive sleep apnea (OSA). When compliance is defined as an average CPAP use >4 hours/night, 46-83% of patients are non-compliant. Poor compliance reduces the overall effectiveness of treatment and leaves undertreated patients at increased risk for cardiovascular and neurocognitive morbidity. The goal of this study was to determine factors that could predict CPAP compliance.
Methods: An anonymous survey of patients attending a CPAP follow-up clinic was conducted between March 2010 and February 2011. Patterns of current CPAP use were assesed. In addition, pressure settings and comorbidities were recorded. Compliance was defined as an average CPAP use >4 hours/night.

Results: A total of 410 adult subjects (58% male) participated. Mean CPAP pressure was 10.6 ± 3.8 cm H2O, 44% had a diagnosis of hypertension, and 17% had diabetes. 58% of subjects reported a CPAP pressure ≥ 10 cm H2O. Regression analysis to predict compliance vs. non-compliance, controlling for age, gender, ethnicity, diagnosed hypertension, and diagnosed diabetes showed that ≥10 cm H2O was independently predictive of compliance, odds ratio 2.7 (95% CI 1.2-5.8).
Conclusion: CPAP compliance is a complex multifactorial clinical problem. In patients undergoing routine follow-up, higher CPAP settings were found to be associated with improved compliance.

0505

HEADACHES REDUCE LONG-TERM CPAP COMPLIANCE IN VETERANS

Parr M[2,4], Schwartz SW[1,4], Rosas JA[4], Foulis P[3,5], Anderson WM[2,4]
[1]Epidemiology and Biostat, University South Florida, Tampa, FL, USA, [2]Division of Pulmonary, Critical Care & Sleep Medicine, University South Florida, Tampa, FL, USA, [3]Department of Pathology and Cell Biology, University South Florida, Tampa, FL, USA, [4]Medical Service, James A. Haley VA Hospital, Tampa, FL, USA, [5]Laboratory Service, James A. Haley VA Hospital, Tampa, FL, USA

Introduction: CPAP treatment is gold standard therapy for OSA, but compliance is often poor. While the effect on compliance of demographics, psychiatric disorders and some physical conditions (e.g. sinusitis) have been studied, very little is known about the effects of headaches.
Methods: We included 75 Veterans with headaches (63 migraine only; 7 tension only; 5 both), and 267 controls matched up to 4 to 1 by exact year of age and partially by gender. Women had fewer matches available. All patients received CPAP between 2003 and 2007 and returned a micro-electronic card that recorded CPAP adherence. Compliance data was summarized as average hours used and percent of days used for more than 4 hours during the first 3 weeks, and for one month intervals centered at 6, 18 and 30 months. A linear model was used to adjust for gender, BMI, race, OSA severity, insomnia, ptsd and mood disorder.
Results: Mean age and BMI of the sample was 54 years and 34 kg/m2 respectively. Cases were more likely to be women (17% vs 9% p=0.02). There was a trend toward headache cases having a lower compliance than controls at later time points. The difference was significant at 6 and 30 months. At 30 months, mean average daily use was 4.56 +/- 2.90 and 6.00 +/-2.74 for cases and controls respectively (p= 0.010); mean percent days used more than 4 hours was 59.5% +/- 37.6 and 76.4% +/- 32.4 for cases and controls respectively (p= 0.006). The differences were reduced after adjusting for other risk factors but results for percent days used 4+ hours remained significant at 30 months (p=0.044).
Conclusion: Headaches may reduce compliance with CPAP, especially over longer time periods. Long-term monitoring of CPAP compliance should be prioritized for those with headache and other conditions that may increase discomfort in using CPAP.

0506

FAMILY HISTORY OF SUCCESSFUL CPAP TREATMENT IS ASSOCIATED WITH IMPROVED CPAP COMPLIANCE

Stanley JJ, Palmisano J, Binns L, O'Brien LM
Sleep Disorders Center, University of Michigan, Ann Arbor, MI, USA

Introduction: Non-compliance with continuous positive airway pressure (CPAP) is a significant problem in the treatment of obstructive sleep apnea (OSA). Poor compliance leaves undertreated patients at increased risk for the cardiovascular and neurocognitive sequelae of OSA. Factors known to affect CPAP compliance include disease severity, perceived symptomatic benefit, and intensive and early support through the sleep clinic. It is hypothesized that familial support, by way of modeling CPAP use, may also improve compliance.
Methods: An anonymous survey of 682 adult patients attending CPAP clinics was conducted between March 2010 and February 2011. Patterns of current CPAP use were assessed and compliance was defined as an average CPAP use > 4hours/night. Subjects were also surveyed regarding the presence of first degree relatives with a diagnosis of OSA, their use of CPAP, whether they described their CPAP as "helpful" and whether or not they "liked" using their CPAP device.
Results: Forty three percent of the patients surveyed (n=292) had a family member who also used CPAP. Of those with a family history of CPAP use, 92% of compliant patients had a family member who described their CPAP as "helpful" vs. 71% of noncompliant patients (p=0.002). Regression analysis to predict compliance vs. non-compliance, controlling for age, gender, ethnicity, diagnosed hypertension and diagnosed diabetes showed that having a family member who found CPAP helpful was associated with an odds ratio for compliance of 4.70 (95% CI 1.99 - 11.07, p value <0.001). In addition, 72% of compliant vs. 60% of noncompliant patients had a family history of CPAP use with a family member who" liked" their CPAP (p=0.3).
Conclusion: CPAP compliance is a complex multifactorial clinical problem. Familial support, in the form of modeling CPAP use and self-described helpfulness of CPAP therapy, appears to improve CPAP compliance.

0507

EFFECTIVENESS OF A RESPIRATORY THERAPIST BASED CPAP FOLLOW-UP PROGRAM

Becker K[1], Chang NS[1], Chang JW[1], Moss B[1], Daclan AL[1], Bertone IE[1], Henry LK[1], Villapando C[1], Hwang D[1,2]
[1]Sleep Medicine, Kaiser Permanente, Fontana, CA, USA, [2]Pulmonary, Critical Care, Sleep Medicine, NYU School of Medicine, New York, NY, USA

Introduction: Literature fails to reveal factors that consistently predict or improve CPAP compliance, and the effectiveness of extended clinical follow-up after initiating CPAP therapy is unclear. We instituted a respiratory therapist-based CPAP follow-up program (Follow-up Pathway) and compared compliance to patients without additional follow-up (Traditional Pathway).
Methods: Patients undergoing ambulatory polysomnography were randomly assigned to the Traditional or Follow-up Pathway. In both pathways, patients revealing OSA underwent a one week autoCPAP titration, and CPAP was ordered according to usual clinical practice. Traditional Pathway: CPAP was purchased without structured follow-up. Follow-up Pathway: CPAP was rented up to 3 months with monthly compliance checks. At each month, CPAP was converted to purchase without additional follow-up if compliant; If non-compliant, patients underwent troubleshooting with additional month trial. Patients in both pathways were called to return for 3 month compliance check (Final Check) for direct comparison.
Results: 160 OSA patients were identified (83 Traditional; 77 Follow-up). To date, 53 patients are still pending Final Check. Follow-up Pathway cumulative compliance rates at months 1, 2, and 3 were: 26% (21/77) vs 64% (49/77) vs 68% (52/77); 12 combined patients declined CPAP at months 1 and 2. However, at the Final Check, the overall compliance was not significantly different between the Follow-Up and Traditional Pathways (52% vs 37%, p=0.48). Estimated cost analysis accounting for price of purchasing and renting CPAP showed a 12% lower CPAP related costs in the Follow-Up Pathway. A fair correlation was seen between compliance rates on the 1 week autoCPAP titration and Final Check (R=0.38, p<0.001). No other baseline factors, including Epworth, AHI, nor CPAP pressure were associated with compliance.
Conclusion: A Respiratory Therapist-based CPAP follow-up program may reduce CPAP costs but, to date, the intervention has not been shown to significantly impact long-term CPAP compliance. Ambulatory autoCPAP titration compliance rates may be modestly predictive.
Support (If Any): Philips Respironics.

0508

EFFECT OF OSA DISEASE SEVERITY ON CPAP ADHERENCE

Zamora T[1], Edwards C[1], Barker R[1], Stepnowsky C[1,2]
[1]VA San Diego Healthcare System, San Diego, CA, USA, [2]Medicine, University of California, San Diego, San Diego, CA, USA

Introduction: Obstructive sleep apnea (OSA) is a common chronic disease and potentially life threatening. Continuous positive airway pressure (CPAP) treatment can reduce mortality, reduce cardiovascular disease risk, and improve quality of life. CPAP adherence is suboptimal. The relationship between baseline OSA severity and CPAP adherence in a large clinical population of new CPAP users was examined.
Methods: A large retrospective study of nearly 510 CPAP users was conducted by chart review.
Results: The sample had a mean age of 59.6±12.0, mean AHI of 39.6±22.5 and mean BMI of 33.4±6.5. Baseline OSA severity level was categorized as mild (AHI 5-14.9), moderate (AHI 15-29.9), and severe (AHI>30). CPAP adherence on night 1 and night 14 was statistically significantly different between the three OSA severity groups, with adherence rates of 3.1±3.3, 3.2±3.0, 4.3±3.3 (on night 1; F=6.889, p<0.0001) and 2.2±2.4, 2.6±2.4, and 3.6±2.5 hrs/nt (on night 15; F=11.863, p<0.0001) for mild, moderate and severe, respectively. Only those with severe OSA approached having an adequate level of CPAP use (operationally defined as ≥ 4 hrs/nt) at night 14 (3.8), night 30 (3.7) and 6-month (3.6). Those with moderate OSA used CPAP 2.7 hrs/nt and those with mild OSA 2.4 hrs/nt after only 2 weeks on therapy. When severe AHI was further classified into low severe (AHI 30-59.9) and high severe (AHI >60), CPAP adherence was significantly higher in the most severe group (3.4 ± 2.5 vs. 4.3 ± 2.6; p<0.01).
Conclusion: Mild and moderate OSA patients only use CPAP for a relatively small portion of the night. Clinical guidelines published by AASM in 2009 recommend a number of secondary therapeutic options. It may be time to take a more serious look at these therapeutic options for those OSA patients with mild, and perhaps even moderate, OSA, given the substandard use of CPAP therapy.
Support (If Any): Department of Veteran Affairs HSR&D IIR 02-275-1; IIR 07-163; PPO 10-101; AHRQ R18HS017246; and VA San Diego Healthcare System Research Service.

0509

NOCTURNAL OXYGEN SATURATION IN OSA SUBJECTS TREATED WITH AUTO-PAP: COMPARISON OF EXHALATION PRESSURE RELIEF TO STANDARD PRESSURE DELIVERY

Rosenthal L[1], Woidtke R[2], Andry J[3], Rafati S[3], Garcia M[1], Gordon N[4]
[1]Sleep Medicine Associates of Texas, Dallas, TX, USA, [2]Sleep for Nurses, Castro Valley, CA, USA, [3]Sleep Therapy and Research Center, San Antonio, TX, USA, [4]Gordon and Associates, Berkeley, CA, USA

Introduction: Treatment of OSA with AutoPAP has gained acceptance in clinical practice. It provides reduction of respiratory events at lower average PAP pressures. In addition, expiratory pressure relief (PR) has become a comfort feature available from various manufacturers. However, Auto-PAP and expiratory PR might result in persistent sleep-related oxygen desaturations despite seemingly adequate control of the AHI. This study determined if the SmartFlex™ technology (DeVilbiss Healthcare Inc) yields stable oxygen saturation during treatment with AutoPAP.
Methods: A randomized, double blinded, crossover study compared oxygen saturation with (or without) SmartFlex™ (Flex of 3 / flow rounding of 3) during AutoPAP therapy (6 to 18 cwp). Subjects age ≥18, AHI ≥15, CPAP naïve (ESS ≥10) with no sleep co-morbidity (or acute medical condition) and adequate response to laboratory titration were eligible to participate. IRB approved consent form was signed prior to participation. SmartFlex™ or Standard AutoPAP was used for 2 weeks with crossover to the other treatment for an additional 2 weeks. At the end of each treatment arm, 3 nights of overnight oximetry were completed while continuing treatment. Nonin Xpod pulse oximeters integrated in the SmartLink™ module of the blower were used (SpO2 range of 0-100% [accuracy ±1% at range of 70-100%]; pulse rate range of 18-300 bpm [accuracy of ±3 bpm] and sample rate of 0.25 Hz). Average oxygen saturation and the Oxygen Desaturation Index (ODI) ≥4% (lasting ≥ 10 sec) were analyzed. CPAP use (≥4 hours/night, ≥70% of nights) and an average of ≥4 hours of evaluable oximetry for each arm of the study were required. Blackwelder's test was used to demonstrate that the ODI is "at least as good" (within 5/h) during SmartFlex™-AutoPAP as with Standard AutoPAP.
Results: Subjects (M=13; F=10) were representative of adult OSA populations (age 48±11; BMI 34±7; AHI 44±24 and ESS 15±3). PAP use was comparable (Standard AutoPAP 5.7±1.0 vs SmartFlex™ 5.8±1.2). The AHI derived from the blower was comparable (Standard AutoPAP 5.1±3.0 vs SmartFlex™ 5.3±3.4). The mean SpO2 was 95.1±1.5 vs 95.0±1.7 respectively. The ODI was 3.47±4.50 vs 3.93±5.12 respectively (Blackwelder test at mu=5, p<0.0001).
Conclusion: These results add to the previous report characterizing comparable reduction in the AHI and improvement in daytime alertness using SmartFlex™ and standard AutoPAP. SmartFlex™ provided adequate therapeutic response while offering the subjective benefits derived from pressure relief.
Support (If Any): DeVilbiss Healthcare Inc, Somerset PA.

0510

META-ANALYSIS OF FACTORS ASSOCIATED WITH CPAP ADHERENCE

Stepnowsky C[1,2], DiMatteo R[3], DiNicola G[4], Edwards C[1], Zamora T[1]
[1]VA San Diego Healthcare System, San Diego, CA, USA, [2]Medicine, University of California, San Diego, San Diego, CA, USA, [3]Psychology, University of California, Riverside, Riverside, CA, USA, [4]Alliant University, San Francisco, San Francisco, CA, USA

Introduction: CPAP is the gold standard therapy for OSA, but low to moderate treatment adherence limits its effectiveness. A large number of factors associated with CPAP adherence have been studied, but the literature has not been quantitatively summarized.
Methods: This project systematically searched the PubMed database and used the techniques of meta-analysis to quantitatively summarize the results of all published empirical research related to CPAP adherence. The study identified and collected relevant research articles; categorized each article; extracted relevant data; coded moderators; and performed the analyses for each of the primary study aims. The "top down" Pubmed search was supplemented by a "bottom up" search strategy. Unweighted mean r, 95% confidence interval and p-value are reported for each factor.
Results: Over 6000 abstracts were reviewed by two staff to identify those studies for further review. Full studies were then reviewed for inclusion in the meta-analysis. The final number of included studies was 214. Effect sizes were significant for the following factors measured at baseline: age (r=0.14; 0.06-0.22; p<0.001), BMI (r=0.10; 0.04-0.16; p<0.001), AHI (r=0.09; 0.05-0.14; p<0.001), Epworth Sleepiness Scale (ESS) (r=0.14; 0.05-0.23; p<0.01), pressure level (r=0.09; 0.04-0.14; p<0.001); and for the following factors measured after CPAP start: CPAP side effects (r=0.12; 0.21-0.05; p<0.01); change in AHI (r=0.34; 0.08-0.65; p<0.01) and change in ESS (r=0.31; 0.10-0.52; p<0.01).
Conclusion: Several factors were found to be significantly associated with CPAP adherence in this meta-analysis. The highest effect sizes were seen for change in AHI and change in ESS, suggesting that while some baseline factors might be associated with CPAP adherence, the most important factors are the extent of reduction in OSA severity and sleepiness levels.
Support (If Any): AHRQ 2R03HS017478 and VA San Diego Healthcare System Research Service.

0511

META-ANALYSIS OF CPAP ADHERENCE RATES

Stepnowsky C[1,2], DiMatteo R[3], DiNicola G[4], Edwards C[1], Zamora T[1]
[1]VA San Diego Healthcare System, San Diego, CA, USA, [2]Medicine, University of California, San Diego, San Diego, CA, USA, [3]Psychology, University of California, Riverside, Riverside, CA, USA, [4]Alliiant University, San Francisco, San Francisco, CA, USA

Introduction: CPAP is the gold standard therapy for OSA, but low to moderate treatment adherence limits its effectiveness. This meta-analysis had an opportunity to examine CPAP adherence rates in this literature.
Methods: This project systematically searched the PubMed database and used the techniques of meta-analysis to quantitatively summarize the results of all published empirical research related to CPAP adherence. The study identified and collected relevant research articles using a "top down" Pubmed search that was supplemented by a "bottom up" search strategy. CPAP adherence data was used if the study reported adherence in hours per night.
Results: Over 6000 abstracts were reviewed by two staff to identify those publications for study inclusion. This meta-analysis found that subjective, self-reported adherence is significantly greater than objectively measured adherence, which was defined two ways: "time powered-on" and "time at prescribed pressure" (5.98±1.35; 4.95±0.96; 4.89±0.97, respectively; F=5.486; p=0.005). There was no difference in the two different objective measurements of CPAP adherence (t=0.391; p=0.696). CPAP adherence rates were higher in those studies performed outside of the United States (5.07±0.89 vs. 4.65±0.94; t=-2.797; p=0.006). When the countries were grouped according to continent, Europe had the highest adherence rates relative to Asia, Australia and the United States (F=4.204; p=0.007). There was a significant correlation between year of publication and CPAP adherence (r=-0.235; r=0.002).
Conclusion: As expected, subjective CPAP adherence was significantly higher than objective CPAP adherence, by about 1hr/nt. There does not appear to be a significant difference in objectively measured CPAP adherence (time "powered on" vs. time "at pressure"). Given that CPAP adherence was higher in Europe relative to other continents, it might be informative for future research to examine this difference. CPAP adherence rates have gone down over time in the medical literature.
Support (If Any): AHRQ 2R03HS017478 and VA San Diego Healthcare System Research Service.

0512

INITIAL ATTITUDES OF COMMERCIAL TRUCK DRIVERS TO OSA TREATMENT AND PREDICTION OF CPAP ADHERENCE

Licata C, Nolte CM, Bessler M, Eisenstadt ML
Sleep Associates of East Tennessee, Knoxville, TN, USA

Introduction: One of the greatest challenges in the treatment of sleep apnea with CPAP is the ability to predict those who are good candidates and those in whom treatment will be problematic. Resources are limited and need to be optimally focused. This is particularly true when treating very large numbers of subjects who can arise out of mass sleep apnea screening (e.g. CDL truckers).
Methods: Recruited drivers were administered screening questionnaires (Berlin, Epworth Sleepiness Scale, SF-36 and the FOSQ), followed by history and physical. Drivers with a high pre-test probability for OSA underwent in-cab type 3 portable monitoring that followed by APAP titration during their 34-hr restart. In-lab polysomnography was performed for AHI < 15 and when portable test results were technically suboptimal. Drivers were assessed on individual progress based on overall initial attitude to treatment and adherence at 121 and 160 days. Adherence for 90 days used the Medicare standard.
Results: Twenty-six drivers were included in the study. Twelve were rated by the sleep tech setting up CPAP treatment concerning the driver's attitude about treatment. Drivers who were in adherence at 120 days had sleep tech reported attitudes of: trusting (25%), accepting (8.3%), or doubtful (8.3%); while those not in adherence were rated as: trusting (8.3%), accepting (33.0%) or not sure (16.7%). Other driver attitudes (understanding of OSA, treatment, and the predication of compliance) showed little grouping.
Conclusion: Two initial driver attitudes about OSA treatment (trusting and doubtful), may be useful in predicting long-term treatment adherence; while drivers who are accepting or not sure will likely not achieve adherence. A more thorough study may find a means of identifying drivers at initial startup which may need additional monitoring and motivation for adherence.

0513

RACE-ETHNIC DIFFERENCES IN CONTINUOUS POSITIVE AIRWAY PRESSURE ADHERENCE AT THE MIAMI VA HEALTHCARE SYSTEM

Wallace DM[1,2], Wohlgemuth WK[1,3], Ramos AR[1], Aloia M[4], Gardener H[1], Carvalho DZ[5], Dayanand S[2], Abreu A[6], Shafazand S[6]
[1]Neurology, University of Miami Miller School of Medicine, Miami, FL, USA, [2]Neurology, Miami VA Healthcare System, Miami, FL, USA, [3]Psychology, Miami VA Healtcare System, Miami, FL, USA, [4]Medicine, National Jewish Health, Denver, CO, USA, [5]Neurology, Universidade Federal do Rio Grande do Sul School of Medicine, Porto Alegre, Brazil, [6]Medicine, Division of Pulmonary, Critical Care, and Sleep Medicine, University of Miami Miller School of Medicine, Miami, FL, USA

Introduction: Studies of continuous positive airway pressure (CPAP) adherence among US Hispanic patients are lacking.
Methods: We performed a cross-sectional analysis of 4-month CPAP adherence comparing White, Black, and Hispanic veterans. Inclusion criteria were 1) obstructive sleep apnea-hypopnea syndrome (OSAHS) and CPAP prescription in the preceding 5 years, and 2) CPAP adherence data ≥ 7 days. Exclusion criteria included 1) requiring supplemental oxygen or 2) surgery for OSAHS. Participants had CPAP use download and completed questionnaires on demographics, sleepiness, insomnia, and social cognitive measures. Medical history and polysomnography details were obtained from medical record. CPAP adherence was defined as mean daily use ≥ 4 hours. Categorical and continuous data were compared among race-ethnic groups using Chi-Square or ANOVA or Kruskal-Wallis test, respectively. Post-hoc pairwise comparisons employed Tukey's test. Logistic regression modeling was used to explore the impact of measured variables on CPAP adherence.
Results: Four hundred forty-seven veterans (95% male, age 58±11 years) were included. Whites were significantly older than Blacks or Hispanics (p<.001). Blacks had significantly lower levels of education than other groups. There were no significant group differences in disease severity or CPAP pressure. Blacks reported significantly greater sleepiness and insomnia and lower self-efficacy to use CPAP compared with Whites. Blacks attempted to use CPAP on significantly fewer nights and used CPAP over 1 hour less compared to Whites and Hispanics. No CPAP adherence differences were noted between Whites and Hispanics. Logistic regression demonstrated that Black race (OR .36, 95% CI .20-.67), self-efficacy (OR 3.7, 95% CI 2.1-6.5), insomnia severity index (OR .91, 95% CI .87-.96), Epworth sleepiness scale (OR .95, 95% CI .90-.99), and the apnea-hypopnea index (OR 1.01, 95% CI 1.003-1.02) were significantly associated with CPAP adherence.
Conclusion: Blacks have significantly lower CPAP adherence than Whites and Hispanics. This may be mediated through insomnia, lower self-efficacy, or other unmeasured barriers.

0514

REM REBOUND DURING SPLIT-NIGHT CPAP TITRATION PREDICTS EARLY CPAP ADHERENCE

Bercovitch R[1], Goelz K[1,2], Lee-Chiong T[1], Aloia M[2]
[1]Medicine, National Jewish Health, Denver, CO, USA, [2]Psychosocial Medicine, National Jewish Health, Denver, CO, USA

Introduction: The purpose of this study was to correlate polysomnogram (PSG) variables with future CPAP adherence in subjects with obstructive sleep apnea (OSA). It has been previously reported that increased sleep efficiency during full-night CPAP titration is correlated with improved CPAP adherence. No data exists on the correlation between PSG variables during split-night CPAP titration and future CPAP adherence.
Methods: Subjects were included from the control arm of a study examining the effect of behavioral intervention on CPAP adherence. PSG with CPAP titration was performed on all subjects, in a split-night fashion when feasible. Standard PSG variables were recorded. CPAP adherence was assessed at 7, 30, 60 and 90 days by smart card download.
Results: Split-night PSG was performed on 72 subjects, with adherence data at 90 days available for 43 subjects. Among standard PSG variables, only measures of REM sleep were significantly correlated with future CPAP adherence. Time of REM sleep during titration was correlated with increased CPAP use at 7 and 30 days ($p<0.05$). Increase in time and percentage of REM sleep from baseline to titration (REM rebound) was correlated with increased CPAP use at 7 and 30 days ($p<0.05$). Individuals with high REM rebound had more than an hour of increased use compared to subjects with low REM rebound. These effects were all attenuated by day 60 of CPAP use. Other standard PSG variables, including change in sleep efficiency, were not correlated with future CPAP adherence.
Conclusion: REM rebound during split-night CPAP titration predicts early CPAP adherence, but this effect is attenuated by day 60 of CPAP use. REM rebound is associated with subjective improvement in sleep quality, but is an early effect of CPAP treatment, possibly explaining why the effect on CPAP adherence is limited to early use.
Support (If Any): NIH R01HL067209-07.

0515

QUESTIONNAIRE SURVEY FOR ORAL HEALTH UNDER CPAP USE WITH OBSTRUCTIVE SLEEP APNEA

Tsuda H[1], Moritsuchi Y[2], Higuchi Y[1], Tsuda T[2]
[1]General Oral Care, Kyushu University Hospital, Fukuoka, Japan, [2]Sleep Center, Kirigaoka Tsuda Hospital, Fukuoka, Japan

Introduction: Recently from the view point of dental field, it is reported the relationship between obstructive sleep apnea (OSA) and periodontitis (Gunaratnam 2009). However, it is not clearly investigated the characteristics of dental disease in OSA patients. The questionnaire-based study was conducted to estimate the prevalence of oral symptoms and the substantial dental care in CPAP users.
Methods: Questionnaire to ascertain their oral conditions included questions regarding age, sex, CPAP use, smoking history, presence of Diabetes Mellitus (DM), frequency of dental clinic visit, denture use, and oral symptoms of present and since CPAP use. SPSS software has been used for statistical analysis. A $P<0.05$ was considered as significant.
Results: Some 744 subjects completed the questionnaire. Age, AHI, BMI, Length of CPAP use were 55.1±12.9 years, 40.9±23.2/h , 27.9±5.2kg/m2 and 49.1±30.7months respectively. 66.6 percent of subjects visited the dental clinic in last year. Prevalence of smoking, DM, denture use was 19.4%. 17.8% and 20.9% respectively. 39.4% of subjects reported some kind of oral symptom; however 37.8% of them didn't treat it. Bad breath was most frequent symptom (30.4%) and dry mouth was most frequent symptom since CPAP therapy (44.6%). DM patients were older (57.8±11.9 vs 54.2±12.8 years), had higher rate of denture use (28.3 vs 19.0%), dental clinic visit (71.4 vs 58.7%) and oral symptoms (50.0 vs 38.2%) than non DM patients ($p<0.05$). There was no significant correlation between oral symptoms and age, BMI, length of CPAP use or sleep related variables.
Conclusion: This study exhibited that almost 40% of CPAP users had oral symptoms. Especially OSA comorbid DM may be high risk of oral disease. It is suggested that the careful considerations for oral health should be required at the management of CPAP use.

0516

POOR COMPLIANCE OF CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY IN PATIENTS WITH MIXED-DOMINANT SLEEP APNEAS

Koo D, Hwang K, Kim S, Joo E, Hong S
Neurology, Samsung Medical Center, Seoul, Republic of Korea

Introduction: Due to the instability of breathing, patients with central apnea are presumed to have poorer continuous positive airway pressure (CPAP) adherence or compliance compared to those with obstructive sleep apneas. Mixed apneas share both central and obstructive components. In this study, we aim to investigate CPAP compliance according to types of apnea (dominant mixed apnea, predominant obstructive apnea, and pure obstructive apnea).
Methods: We enrolled 153 patients who were diagnosed with obstructive sleep apnea (OSA) by polysomnography and prescribed nasal CPAP therapy. Patients were divided into 3 types of OSA: pure-OSA (obstructive apnea 100%), predominant-OSA (70%-100%), mixed-OSA (mixed apnea >30% of total apneuic events). Good compliance of CPAP was defined by use in >75% of days with >4 hour usage a night. The compliance of CPAP in all patients was analyzed and the degree of improvement of Epworth sleepiness scale (ESS) was compared among three groups after CPAP therapy.
Results: Eight-eight % of patients were male. Mean age was 54.0±10.6 years and mean AHI was 38.5±25.0/hr. The percentage of CPAP using days was 80.2±20.1 %, and the mean CPAP usage time per night was 5.2±1.5 hours. Overall CPAP compliance of all patients was 61%. When patients were classified according to apnea types, 25 were included in mixed-OSA (AHI 43.6±18.8/hr), 72 were in predominant-OSA (42.2±17.9/hr), and 56 were in pure-OSA group (31.5±16.1/hr). There were no significant differences in ESS scores and other PSG parameters among groups. Percentage of CPAP using days and CPAP usage time per night in each group are as follows; 1) mixed-OSA, 74.2±24.3 %, 4.4±1.7 hours, 2) pure-OSA, 82.5±18.7 %, 5.4±1.5 hours, and 3) predominant-OSA group, 81.5±20.0 %, 5.3±1.4 hours. Thus, CPAP compliance was significantly poorer in the mixed-OSA group (good compliance, 40%) as compared with the pure-OSA (64%), and predominant-OSA groups (67%) ($p=0.035$, ANOVA). The improvement of ESS after CPAP was statistically definite in the pure-OSA (10.4±4.9 → 7.7±4.2, paired t-test, $p<0.001$) and predominant-OSA patients (10.6±5.2 → 7.2±3.7, $p<0.001$), not in the mix-OSA group (10.2±5.6 → 8.6±4.1, $p=0.056$).
Conclusion: In patients with the mix-OSA, CPAP adherence were reduced compared with pure-OSA and predominant-OSA groups. Poorer CPAP compliance may affect the insufficient improvement of daytime sleepiness in mix-OSA patients with CPAP therapy.

0517

POLYSOMNOGRAPHY PREDICTOR OF "PERSISTENT" COMPLEX SLEEP APNEA

Sadrnoori B
Pulmonary, Critical Care, Sleep, Holy Family Hospital, Methuen, MA, USA

Introduction: Complex sleep apnea is determined by emergent central apnea (CA) after initiation of positive airway pressure. The natural history of complex sleep apnea has been evaluated in several published studies and has been divided into emergent CA which improve within two months periods and persistent CA which persists beyond two months.

Even though several PSG findings have been described as predictors of emergent CA, there are no PSG predictions of persistent CA.
Methods: Reevaluated PSG finding of 28 patients with CPAP emergent CA age 44-75, all male patients, all patients had obstructive apnea with AHI of 38.0 +/- 12, CA 5.6 +/- 3, mixed apnea 7.0 +/- 5, LSAT +/- 3. All patients developed CA upon initiation of CPAP (pressure range 4-16cm). We separated those patients who developed CA immediately upon initiation of CPAP as low as 4cm and worsened with incremental pressure vs the one that CA emerged at higher pressure of CPAP and persistent with the higher titration. All patients have been evaluated at the end of an 8 week period with downloading CPAP.
Results: We selected 16 patients of which the downloading CPAP showed persistent elevated CA. The repeat PSG was performed on patient's own CPAP (pressure range 4-16cm). We classsified this group as having "persistent CA". Correlation was made with the PSG finding during diagnostic test and the timing of occurence of CA with CPAP. There was high correlation between repetitive CA as soon as the CPAP begun even at 4cm with persistent CA in 8 weeks time.
Conclusion: In this study, it was determined that immediate repetitive emergence of CA upon initiation of the nasal CPAP is highly predicted of "persistent CA" in complex sleep apnea.

0518

PERFORMANCE OF ADAPTIVE SERVOVENTILATION AND ENHANCED ADAPTIVE SERVOVENTILATION IN HEART FAILURE PATIENTS WITH CENTRAL SLEEP APNEA

Oldenburg O[1], Bitter T[1], Prib N[2], Lohse M[2], Koerber B[1], Fischbach T[1], Schmidt A[2], Horstkotte D[1]
[1]Department of Cardiology, Heart and Diabetes Center North Rhine-Westphalia, Bad Oeynhausen, Germany, [2]IKFE-HDZ, Bad Oeynhausen, Germany

Introduction: Adaptive servoventilation (ASV; ResMed AutoSet CS2) is indicated to treat central (CSA) and complex sleep apnea (CompSA). ASV to date has used a fixed expiratory positive airway pressure (EPAP) to which a variable amount of inspiratory pressure support (IPAP) is added. The goal of the study was to compare the performance two different generations of adaptive servo ventilators in the treatment of CSA. Enhanced Adaptive Servoventilation (ASVAuto) with variable, automated expiratory positive airway pressure (EPAP) was compared in a randomized crossover study with Adaptive Servoventilation with fixed EPAP.
Methods: A total of 21 heart failure patients (Age 69.5 ± 8.7 years, BMI 29.4 ± 3.9 kg/m^2, 19 males (90.5%), NYHA class II/III 4/16 patients, systolic/diastolic HF 12/9 patients) with chronic ASV treatment for CSA were randomized to ASV versus ASVAuto in a cross-over design. The pressure support settings were comparable, the fixed EPAP was set between 4 and 10 cmH2O and the variable EPAP was set between 4 and 15 cmH2O. Full polysomnography was performed and analyzed blinded. Scoring was performed in accordance to AASM guidelines.
Results: The EPAP on ASV was 6.1 ± 1.6 cmH2O while the average EPAP on eASV was 7.0 ± 2.3 cmH2O. Both devices controlled CSA well, ASVAuto reduced respiratory events significantly better than ASV (AHI 8.2 ± 11.6/h vs. 5.0 ± 5.6/h, p=0.022; AI 0 ± 0.1/h vs. 0 ± 0.1/h, p=0.892; HI 8.1 ± 11.6 /h vs. 4.9 ± 5.6/h, p=0.017). The oximetry results showed a significant decrease in the oxygen desaturation index with ASVAuto vs. ASV (4.9 ± 5.6 vs. 8.2 ± 11.8/h, p=0.016), while mean and minimal saturation levels were comparable. Sleep efficiency was comparable with both devices. In terms of sleep quality there was a trend for less sleep stage N2 with ASVAuto vs. ASV (43.0 ± 8.5% vs. 48.0 ± 12.4 of TST, p=0.071) and for more REM sleep (15.3 ± 7.7 vs. 12.6 ± 7.0, p=0.084).
Conclusion: ASVAuto is not inferior to ASV in treatment of CSA in heart failure patients. Respiratory events were better suppressed by ASVAuto than ASV. In addition, there is a trend for better sleep quality with ASVAuto.
Support (If Any): Funded by ResMed Ltd., Australia.

0519

SERVO-VENTILATION THERAPY IN CHRONIC PAIN PATIENTS WITH SLEEP DISORDERED BREATHING

Wylie PE[1], Pegram V[2], Rosenberg R[3], Muehlbach MJ[4], Holle R[5], Shapiro C[6], Jain S[7], Chung SA[7]
[1]Sleep, Arkansas Center of Sleep Medicine, Little Rock, AR, USA, [2]Sleep, Sleep Disorders Center of Alabama, Birmingham, AL, USA, [3]Sleep, NeuroTrials Research, Inc., Atlanta, GA, USA, [4]Sleep, Clayton Sleep Institute, St. Louis, MO, USA, [5]Sleep, Western Montana Clinic, Missoula, MT, USA, [6]Psychiatry, Toronto Western Hospital, Toronto, ON, Canada, [7]Sleep, International Sleep Clinic, Parry Sound, ON, Canada

Introduction: Patients with chronic non-malignant pain taking high doses (greater than or equal to 100 MEQ Morphine equivalence) of opioid medications are at increased risk of respiratory depression, sustained hypoxemia, and airway instability during sleep. There have been conflicting study results on the effects of positive airway pressure therapy in this patient population. This study evaluates three different modes of positive airway pressure.
Methods: 5 patients (1 male, 4 females) with (mean ± SD) age (50.1 ± 9.3), BMI (30.7 ± 5.7), morphine equivalents (253.2 ± 153) underwent four full night in-lab PSG's including a diagnostic, CPAP titration, fully automated servo ventilation, servo ventilation with mandatory pressure support. Servo ventilation was provided by the BiPAP autoSV Advanced System One. The order of the therapy PSGS were randomized. PSG respiratory events during sleep were manually scored using 2007 AASM recommended criteria by a central scoring laboratory. Formal statistical analysis was not performed due to the small sample size. This study is ongoing.
Results: The AHI was lowest on the fully automated servo ventilation night [median (mean ± SD)] [(1.8 (3.1 ± 2.8)] compared to the servo ventilation with mandatory pressure support night [(4.9 (5.6 ± 6.2)] and the CPAP night [(16 (15.5 ± 10.8)]. The oxygen desaturation index was lowest on the fully automated servo ventilation night [2.6 (3.5 ± 2.9)] compared to the servo ventilation with mandatory pressure support night [(4.4(5.7 ± 6.4)] and the CPAP night [(7.6 (8.4 ± 6.6)].
Conclusion: Servo ventilation in either fully automated or with mandatory pressure support mode demonstrated lower AHI and oxygen desaturation index compared to CPAP in patients on high does of opioid therapy and sleep disordered breathing.

0520

SERUM FERRITIN LEVELS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA) BEFORE AND AFTER CPAP TREATMENT, COMPARED TO THE GENERAL POPULATION - THE ICELANDIC SLEEP APNEA COHORT (ISAC) STUDY

Thorarinsdottir E[1], Benedikstdottir B[1,2], Gislason T[1,2], Arnardottir ES[1,2], Olafsson I[3], Janson C[5], Pack A[4]
[1]Medical Faculity, University of Iceland, Reykjavik, Iceland, [2]Department of Allergy, Respiratory Medicine and Sleep, Landspitali University Hospital, Reykjavik, Iceland, [3]Department of Clinical Biochemistry, Landspitali University Hospital, Reykjavik, Iceland, [4]School of Medicine, University of Pennsylvania, Philadelphia, PA, USA, [5]Department of Medical Sciences: Respiratory Medicine and Allergology, Uppsala University, Uppsala, Sweden

Introduction: Ferritin is an intracellular iron storage protein but also a marker of acute and chronic inflammation. Previous studies have shown that subjects with sleep apnea (OSA) have higher levels of circulating pro-inflammatory cytokines but little is known about the association between ferritin, OSA and its comorbitities.The aim of the study was to evaluate S-ferritin levels in OSA patients before and after CPAP treat-

ment and compare it to S-ferritin levels in the general population. Also to study if there were correlation of S-ferritin levels to OSA comorbiditis.
Methods: The OSA subjects (n=822) were a part of the Icelandic Sleep Apnea Cohort. They were newly diagnosed with moderate or severe OSA (665 males,157 females). The control subjects (n=742) were randomly chosen Icelanders (394 males, 348 females) who participated in another epidemiological study (www.boldcopd.org). S-ferritin levels were measured , participants answeared a detailed questionnaire with questions about sleep, health and the Epworth Sleepiness scale. The OSA patients underwent a sleep study. The change with CPAP treatment was assessed after 2 years (n=538).
Results: S-ferritin was significantly higher in OSA patients than controls, both in men (p=0.007) and women (p=0.0006) but after adjusting for body mass index (BMI), age, smoking status and co-morbidities, S-ferritin was only found to be significantly elevated in OSA women (p=0.032). S-ferritin did not show significant correlation with OSA severity (AHI or ODI) or with sleepiness estimated with Epworth sleepiness scale . S-ferritin did not show significant correlation with level of CPAP usage at the two-year follow up.
Conclusion: Women with OSA had significantly higher S-ferritin levels than controls after adjusting for BMI, age, smoking status and co-morbidities. S-ferritin did not show any significant correlation with severity of OSA, daytime-sleepiness or level of CPAP usage at the two-year follow up.

0521

SLEEP/WAKE ACTIVITY AND ENERGY EXPENDITURE IN OVERWEIGHT AND OBESE OBSTRUCTIVE SLEEP APNEA PATIENTS: A PRE- AND POST-CPAP COMPARISON

McCullough PA[1,2], Speck BJ[2], Winslow DH[1,2], Mainous RO[4], Chlebowy DO[2], Myers J[3]
[1]Kentucky Research Group, Louisville, KY, USA, [2]School of Nursing, University of Louisville, Louisville, KY, USA, [3]School of Public Health, University of Louisville, Louisville, KY, USA, [4]College of Nursing and Health, Wright State University, Louisville, KY, USA

Introduction: Overweight and obesity is a major contributing factor in an estimated 70% of all obstructive sleep apnea (OSA) cases. Approximately five percent of the adult population has OSA, and the numbers continue to soar with the rising prevalence of obesity. As a primary therapy, continuous positive airway pressure (CPAP) has demonstrated improvement in many comorbities associated with both OSA and obesity. Although anecdotal and clinical references support increased energy, activity, and weight loss as a potential benefit of CPAP treatment, there remains little evidence to endorse CPAP as a significant weight-reduction measure for overweight and obese OSA patients. The purpose of this study was to examine sleep/wake activity and energy expenditure, pre- and post-CPAP treatment, in adult overweight and obese patients with OSA.
Methods: A prospective, observational, longitudinal study design was employed to assess 24-hour actigraphic measures of sleep/wake activity and energy expenditure while accounting for CPAP compliance. Analysis of variance (ANOVA) using repeated measures was performed to identify overall differences between pre-CPAP and one week post-CPAP and pre-CPAP and one month and post-CPAP sleep activity, wake activity, and 24-hour energy expenditure. Sixty-nine subjects were consented, with a total of 35 subjects completing the study.
Results: Data analyses revealed statistically significant mean differences in sleep activity, wake activity, and energy expenditure from pre-CPAP to post-CPAP at one week and one month. At baseline, and continuing through one week post-CPAP and one month post-CPAP, the CPAP compliant group demonstrated less sleep activity, more wake activity, and expended more energy than the CPAP noncompliant group. This study concluded that CPAP use is a statistically significant factor affecting sleep activity time, wake activity time, and energy expenditure. Regardless of CPAP compliance and length of use, the entire post-CPAP group demonstrated more sleep activity, had less wake activity, and burned fewer calories.
Conclusion: From a clinical perspective, the results of this study do not support the use of CPAP as a potential weight loss measure in overweight and obese OSA patients, and emphasize the need for the inclusion of behavioral weight management and weight loss strategies in an at-risk population for comorbid illnesses.

0522

SYSTEMATIC REVIEW COMPARING THE EFFICACY OF NASAL CONTINUOUS POSITIVE AIRWAY PRESSURE (NCPAP), NASAL EXPIRATORY POSITIVE AIRWAY PRESSURE (NEPAP), AND ORAL APPLIANCES

Diep L[1,2], Nguyen T[1], Vaughn A[1], Kwagyan J[1], Jayam-Trouth A[1], Khan RL[1]
[1]Neurology, Howard University, Washington, DC, USA, [2]Graduate Training Program in Clinical Investigation (GTPCI), Johns Hopkins Medical Institutions, Baltimore, MD, USA

Introduction: Preventing airway collapse, improving sleep continuity, and increasing compliance rates in patients with Obstructive Sleep Apnea (OSA) remains a challenge. We performed a systematic review of published studies to quantify the compliance rates, apnea hypopnea indices (AHI), nadir oxygen saturations, Epworth Sleepiness Scale scores (ESS), and demographic variables (age, sex, and BMI). We compared the efficacy of five different OSA treatments: One-piece oral appliance (OA), two-piece adjustable OA, two-piece non-adjustable OA, nasal continuous positive airway pressure (nCPAP), and nasal expiratory positive airway pressure (nEPAP).
Methods: A systematic literature search of MEDLINE and EMBASE (1984-2011) was performed. The mean difference, p-values, and 95% confidence intervals were used to assess the differences of each treatment outcome. Study-specific efficacy and outcome estimates were compared using ANOVA.
Results: 91 of 632 articles satisfied the inclusion criteria. nEPAP had the highest rate of compliance, but the lowest efficacy. There were greater differences between pre and post treatment values in AHI (p=0.011), ESS (p=0.037), and nadir oxygen saturation (p=0.004) when using nCPAP compared to the other four treatments, respectively. Nevertheless, the patients using nCPAP had lower compliance rates (p=0.036) and greater Body Mass Indices (p=0.0001) compared to the patients who used other treatments, respectively. There were no significant differences in age and sex among the treatments.
Conclusion: Results reveal that nCPAP is significantly better in improving AHI, ESS, and nadir oxygen saturation, but nCPAP has the lowest compliance rate compared to the other treatments. On the other hand, nEPAP has a significantly higher compliance rate compared to the other treatments, but the lowest improvement in efficacy values.

0523

UTILITY OF ACTIGRAPHY IN LONG TERM TRACKING OF SLEEP QUALITY IN PATIENTS TREATED WITH CPAP

Aksan N, Schall M, Dawson J, Zilli E, Tippin J, Rizzo M
Neurology, University of Iowa, Iowa City, IA, USA

Introduction: Studies on continuous positive airway pressure (CPAP) compliance in obstructive sleep apnea (OSA) typically rely on self-reported outcome measures of sleep quality. Limitations of self-report instruments make it difficult to track improvements in sleep quality over the longterm, underscoring the need for objective measure of sleep quality. This study examined systematic differences in sensitivity settings of wrist-worn actigraphy watches in relation to CPAP dosage, subjective ratings of sleep quality in patients with OSA and matched controls over a 3.5 month-period.
Methods: 19 patients with OSA and 7 controls in an ongoing study of real-world driving in OSA participated in the study (NIH R01 HL091917).

Actigraphy data were collected for two weeks before CPAP treatment, and during the first three months of CPAP treatment at three-levels of motion sensitivity: low, medium, and high. Participants completed Epworth Sleepiness, Pittsburgh Sleep Quality, Functional Outcomes of Sleep Questionnaire at pre-treatment, and monthly thereafter.
Results: Sensitivity settings produced large mean differences in sleep efficiency, wake minutes after sleep onset (WASO) and number of awakenings (all p's < .001). Among these parameters, number of awakenings was significantly inversely correlated with CPAP dosage only when they were obtained at low sensitivity settings (p <.05). Furthermore, only the low sensitivity settings identified improvements in number of awakenings after CPAP treatment (p < .05). Finally, subjective ratings of sleep significantly improved over the course of treatment but they were not related to objective actigraph-based measures of sleep.
Conclusion: Preliminary findings suggest that actigraphy may be useful in tracking improvements in sleep quality in OSA patients. Findings also suggest that sensitivity settings must be carefully considered particularly in low sample studies.
Support (If Any): NIH R01 HL091917.

0524

THE ROLE OF SEVERITY OF OBSTRUCTIVE SLEEP APNEA MEASURED BY APNEA HYPOPNEA INDEX IN PREDICTING COMPLIANCE WITH PRESSURE THERAPY, A META-ANALYSIS

Nida M[3], Madbouly EM[1], Nadeem R[1,2], Molnar J[2], Aggarwal S[1], Loomba R[4]
[1]Pulmonary and Sleep Medicine, James A Lovell Federal Health care center, North Chicago, IL, USA, [2]Medicine, Rosalind Franklin University of Medicine and Science, Chicago Medical School, North Chicago, IL, USA, [3]Medicine, SUNY Downstate Medical center, Brooklyn, NY, USA, [4]Pediatrics, Children's Hospital of Wisconsin/ Medical College of Wisconsin Affiliated Hospitals, Wauwatosa, WI, USA

Introduction: Obstructive sleep apnea (OSA) is associated with diabetes, hypertension, stroke, coronary artery disease and premature death. Positive airway pressure (PAP) is the mainstay of therapy. Despite its effective treatment with PAP therapy, noncompliance remains high. Many factors determine compliance. Role of severity of OSA measured by apnea hypopnea index (AHI) remains controversial. Meta-analysis of studies examining this role of AHI was performed.
Methods: Systematic review of medical literature was conducted using PubMed and Cochrane library by utilizing different combinations of key words; sleep apnea, AHI, compliance and non-adherence. Inclusion criteria were: English articles; Studies with adult population; with two groups of patients (compliant and non-compliant); Studies utilizing objective definition of compliance PAP usage of >4 hr per night for 70% of days or usage more than 5 days per week and for >4 hour per night. Studies were analyzed by standard methods of meta-analysis. The studies were heterogeneous for AHI, therefore the random effect model was used.
Results: 641 manuscripts were found. Of these, 230 were found to be appropriate for full text evaluation. 31 met inclusion criteria. 12 of these studies used objective criteria for PAP compliance, hence included in meta-analysis. All subjects had OSA determined by Polysomnography, for whom PAP was employed. Compliance to PAP therapy was evaluated after a period of time ranging from 4 weeks to 8 years. There were 1438 subjects included in the meta-analysis, 886 subjects were PAP compliant while 552 subjects were non-compliant. A greater AHI was found in PAP compliant patients. The mean difference between compliant and non-compliant groups was 5.9 (95% confidence interval: 0.19-11.67, p<0.05.
Conclusion: Patients with mild OSA are less likely to be compliant with PAP therapy. These patients should receive aggressive management particularly at the start of therapy with close follow up to increase compliance.

0525

THE EFFECT OF POSITIVE AIRWAY PRESSURE (PAP) ON SLEEP STATE PERCEPTION IN OBSTRUCTIVE SLEEP APNEA (OSA) PATIENTS

Barber AS, Reda F, Khan A, O'Brien LM, Kaplish N
MS Aldrich Sleep Disorder Laboratory, Department of Neurology, University of Michigan, Ann Arbor, MI, USA

Introduction: Sleep State Misperception (SSM) is typically seen in insomniacs; however, limited research has shown this phenomenon also occurs in obstructive sleep apnea (OSA) patients. The goal of this study was to investigate the effects of PAP therapy on SSM.
Methods: A retrospective review was performed between January 2010-April 2011 on patients (>18yo) who received PAP for the treatment of OSA. Both demographic and polysomnographic (PSG) variables were obtained. The ratio of subjective to objective total sleep time (TST) was calculated and SSM was defined as a deviation of >12.5% from the mean. This threshold was used based on the assumption that a misperception >1 out of 8 hours of sleep is clinically significant. SSM was calculated for baseline and PAP studies. Demographic and PSG variables were analyzed to identify subjects who remained under-perceivers during PAP.
Results: In total, 302 patients were identified: 64% were male, mean age 50.2 ± 13.2 years, and mean BMI 35.1 ± 9.1kg/m2. On baseline PSG: 47% had no misperception, 28% over-perceived and 25% of subjects under-perceived TST. Following PAP, TST perception improved in 58% of previous under-perceivers. Compared to others, the 32 subjects (43%) who remained under-perceivers after PAP were younger (42.9 ± 11.2 vs. 51.1 ± 13.2 years, p<0.001), had shorter sleep latency (14.6 ± 12.3 vs. 24.1 ± 23.3 mins, p=0.001), and lower Apnea/Hypopnea Index (AHI; 10.9 ± 5.2 vs. 14.1 ± 11.3, p=0.008). No difference was found in Epworth Sleepiness Scale (10.3 ± 5.0 vs. 9.7 ± 5.0, p=0.54). A regression model found that older age was independently associated with lower risk for remaining an under-perceiver of TST, OR=0.96 [95%CI=0.94-0.98).
Conclusion: Over half of the OSA patients who under-perceive TST on a diagnostic PSG will improve perception following PAP titration. Despite PAP titration, younger subjects are more likely to remain under-perceivers.

0526

THE ADEQUACY OF PAP TITRATIONS: A DESCRIPTIVE STUDY UTILIZING THE AASM CLINICAL GUIDELINES

Salem B, Kandasamy R, Krishnan S, Auckley D
Division of Pulmonary, Critical Care and Sleep Medicine, MetroHealth Medical Center, Case Western Reserve University, Cleveland, OH, USA

Introduction: Clinical guidelines for the manual titration of PAP therapy for OSA were published in 2008 by an AASM task force, recommending a grading scheme for the adequacy of a titration study. Studies are to be graded as optimal, good, adequate or unacceptable based upon the residual AHI and presence of supine REM sleep on the selected pressure. Currently, there is little data describing the frequency with which these different levels of PAP titration are achieved or factors associated with the adequacy of titration.
Methods: This retrospective study examined full night manual CPAP titrations performed on 249 individuals recently diagnosed with OSA by in-lab PSG. Each PSG was graded by the clinical guideline criteria to determine the adequacy of the PAP titration. In addition, patient characteristics, baseline PSG data, and titration PSG data were abstracted to determine predictors of good/optimal titrations vs. adequate/inadequate titrations. T-tests and chi square analysis were used where appropriate.

Results: Baseline characteristics of the 249 individuals: average age 53.6 +/- 16 yrs old, 39% male, average BMI 37.9 +/- 22 kg/m2, baseline AHI 35 +/-18. Grade of titrations: 31% optimal, 18% good, 41% adequate, 10% unacceptable. Good/optimal titrations were associated with younger age (50 vs. 56 yrs old, p< 0.01), higher total sleep time (302 vs. 246 minutes, p<0.01), more REM sleep (53 vs. 34 minutes, p<0.01) and a lower recommended CPAP pressure setting (10.1 vs. 12.2 cm H2O, p=0.03). There was no difference between titration categories in terms of BMI, baseline AHI, and use of a sleep aid on the night of the titration study.
Conclusion: While the number of unacceptable PAP titrations appears low (10%) in this study, a substantial number of patients achieve only adequate status (41%). Factors associated with good/optimal titrations warrant further investigation to determine potential areas for intervention to improve the quality of PAP titrations.

0527

CURRENT SITUATION OF NASAL CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY AFTER THE EAST JAPAN MEGAQUAKE DISASTER

Mitou F[1], Kizawa T[1], Hosokawa K[1,2], Takahashi S[1,2], Nishijima T[1], Suwabe A[2], Sakurai S[1]
[1]Division of Behavioral Sleep Medicine, Iwate Medical University School of Medicine, Morioka, Japan, [2]Division of Laboratory Medicine, Iwate Medical University School of Medicine, Morioka, Japan

Introduction: The Tohoku Region Pacific Coast Earthquake, which occurred at 14:46:18 on March 11, 2011 (Japan time) with the epicenter under the sea 130 km east southeast of the Oshika Peninsula of Miyagi Prefecture, was the strongest earthquake ever recorded in Japan, registering 9.0 on the Richter scale. The damage was also extensive in Iwate Prefecture and Hachinohe City in Aomori Prefecture, adjacent to Iwate, and disaster victims had to endure power failures, lives in evacuation centers, and other hardships. In these prefectures, approximately 2,000 patients with SAS had been receiving nCPAP therapy. This study assessed the situations of nCPAP therapy for patients with SAS right after the earthquake, in order to identify their problems and investigate countermeasures against potential future disasters.
Methods: This study involved 1,053 patients under nCPAP therapy in northern Japan including Iwate and Aomori Prefectures who consented to answer a questionnaire survey. The survey was conducted at 3 institutions including Iwate Medical University. Using the originally prepared questionnaire consisting of 8 items, the investigators interviewed the subjects during outpatient visits for sleep-disordered breathing.
Results: Out of 1,047 patients, 970 (91%) could not receive nCPAP therapy right after the earthquake or thereafter. In the coastal areas, 219 patients (82.1%) were unable to receive nCPAP for less than one week and 47 (17.5%) for more than one week. In the inland areas, 649 patients (92.5%) for less than one week and 51 (7.3%) for more than one week, respectively. Out of 44 patients who had to live in evacuation centers, 11 were able to continue nCPAP therapy and only one of them complained of ill health. On the other hand, 20 (60.6%) of 33 patients who had been unable to continue nCPAP complained of ill health. Especially, more than half of them (54.5%) complained of EDS and insomnia. Logistic regression analysis of factors affecting changes in physical conditions revealed the lack of internal batteries to be the most significant factor for onset of ill health ($p < 0.0001$, B [95% CI] 1.641 [2.262-3.877], Exp 2.962).
Conclusion: In this earthquake disaster, the main reason why SAS patients could not continue nCPAP therapy was power failure. Consequently, many patients demanded devices equipped with internal batteries. Discontinuation of nCPAP therapy may adversely affect physical conditions of patients living in evacuation centers.

0528

ROLE OF AN EDUCATION PROGRAM ON ADHERENCE TO POSITIVE AIRWAY PRESSURE (PAP) DEVICE USE IN NEWLY DIAGNOSED OBSTRUCTIVE SLEEP APNEA (OSA) INDIVIDUALS

Husain NF[1], King BJ[1,2], Carnes M[1,2]
[1]William S. Middleton VA Hospital, Madison, WI, USA, [2]Unversity of Wisconsin Madison, Madison, WI, USA

Introduction: For over two decades, Chronic Disease Self Management Programs have emerged to educate patients about diseases and disease management. OSA is also a chronic disorder affecting ~3-7% men and 2-5% women in the United States; however it's not being managed under chronic care model. Moreover, PAP therapy is the most effective treatment, yet 40-60% adhere to it. The VA Hospital has developed an education program for Veterans that involves educating newly diagnosed OSA patients by using audiovisual aids and hands-on training on their prescribed PAP devices. During the session, time is given to start the acclimatization process and to discuss nocturnal polysomnography reports individually. Patients were then scheduled for 1, 3, 6 and 12 month follow-up visits to establish continuity of care.
Methods: This study utilized a mixed methods design. Grounded/dimensional analysis (qualitative) was used to explore the effectiveness of how the information was conveyed; how it helped patients understand symptom cycle of the disorder; how education influenced commitment to continued use of the PAP; and to identify the role played by physician and technical staff during the clinical encounter. Quantitative design was used to describe subject demographics, Epworth Sleepiness Scores, and adherence/non-adherence patterns of use under Medicare guidelines.
Results: The patients' experience was explored to evaluate the overall efficacy and effectiveness of patient education program. Patients described several categories that influenced their adherence to PAP use. Three salient categories have emerged from the data: 1) Preconceived expectations about the education; 2) Factors influencing their decision; 3) Evaluating the learning processes from personal experiences.
Conclusion: This study will provide insight into adult learning principles regarding OSA & PAP usage. Information obtained will guide future improvement in patient education programs to ensure higher adherence patterns and to design Chronic Disease Self Management Program for OSA.
Support (If Any): Geriatric Research, Education, and Clinical Center Center for Women's Health Research.

0529

FREQUENT NOCTURNAL SWEATING - A SYMPTOM OF OBSTRUCTIVE SLEEP APNEA: THE ICELANDIC SLEEP APNEA COHORT STUDY

Arnardottir ES[1,2,3], Janson C[4], Benediktsdottir B[1,2], Juliusson S[5], Pack A[3], Gislason T[1,2]
[1]Department of Respiratory Medicine and Sleep, Landspitali - The National University Hospital of Iceland, Reykjavik, Iceland, [2]Faculty of Medicine, University of Iceland, Reykjavik, Iceland, [3]Center for Sleep and Respiratory Neurobiology, Division of Sleep Medicine/ Department of Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA, USA, [4]Department of Medical Sciences, Respiratory Medicine and Allergology, Uppsala Universitet, Uppsala, Sweden, [5]Department of Otolaryngology, Landspitali - The National University Hospital of Iceland, Reykjavik, Iceland

Introduction: To estimate the prevalence of reported nocturnal sweating in obstructive sleep apnea (OSA) subjects compared to the general population. To evaluate what characterizes those who report nocturnal sweating and whether it changes in OSA patients with continuous positive airway pressure (CPAP) treatment.
Methods: 826 newly diagnosed subjects with OSA (The Icelandic Sleep Apnea Cohort [ISAC]), referred for CPAP treatment. Of those, 623 sub-

jects have had a 2 year follow-up visit with objective CPAP compliance data collected (n=412 CPAP users, n=211 nonusers). The control group consisted of 939 subjects randomly selected from the general population (81% response rate). Both groups answered the same questionnaires, including reporting of nocturnal sweating, sleep and general health. A sleep study was performed in ISAC participants only.
Results: Frequent nocturnal sweating (≥3x a week) was reported in 31.1% of OSA subjects compared to 10.8% of controls ($p<0.001$). The OSA subjects were more obese on average (average±SD BMI 33.5±5.7 vs 27.8±4.9 kg/m^2) but the BMI range of the groups was similar. Nocturnal sweating was associated with a diagnosis of OSA, lower age, smoking history, and hypertension (adjusted for BMI and other covariates). In the general population only, an association was also found with increased BMI, not found for the ISAC group. Subjects (ISAC and controls) reporting nocturnal sweating were more likely to have sleep-related and respiratory complaints. In the ISAC group, nocturnal sweating was associated with a longer hypoxia time but not with the apnea-hypopnea index or oxygen desaturation index. A decrease was found in the prevalence of nocturnal sweating with CPAP treatment, from 34.1% to 13.6% ($p<0.001$), significantly greater than in nonusers ($p=0.004$) after 2 years.
Conclusion: Frequent nocturnal sweating is a distinct clinical symptom of OSA, affecting a subgroup of OSA patients. This symptom is responsive to treatment in a majority of patients.
Support (If Any): NIH grant HL72067 and HL94307, the Eimskip Fund of the University of Iceland and the Landspitali University Hospital Research Fund.

0530

HISTORY OF DREAM ENACTING BEHAVIOR IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: PREVALENCE AND RELATION WITH SEVERITY OF SLEEP APNEA

Gupta A, Shukla G, Mohammed A, Goyal V, Srivastava A, Behari M
Neurology, All India Institute of medical science, New Delhi, India

Introduction: Only few studies report abnormal sleep behavior mimicking symptoms of the REM sleep behavior disorder (RBD), in addition to typical symptoms of Obstructive sleep apnea and hypoapnea syndrome (OSAHS). Patients with severe OSAHS have been reported to demonstrate such behaviors usually in association with arousals. The aim of this study is to estimate the prevalence of dream enacting behavior simulating RBD (Pseudo-RBD) among patients with OSAHS.
Methods: We included patients who had undergone video-polysomnography for OSAHS during a one year period (Dec 2010- nov 2011). Clinical, polysomnographic (PSG) and video data were analyzed for patients with history of dream enacting behavior (Group 1) and compared with data from patients without history of dream enacting behavior (Group2) in sleep.
Results: Video PSG data was available for 52 patients with OSAHS, among which, a history of pseudo RBD was found in 29 patients (55.76%). On detailed video analysis, the same was found in 27 (50.98%) patients. Six patients who had < 5 events recorded overnight had a mean AHI of 36.16, 13 patients with 5-20 events overnight had a mean AHI of 61.85 and 8 patients with > 20 events recorded overnight had a mean AHI of 81.The events mainly consisted of sleep talking(93%), some dream enacting movements and gesturing of upper limbs(62.06%) and fondling with genitals(22.22%).No violent act was recorded. Both groups were clinically similar while on PSG significant differences were found in mean total AHI (58.50+33.5 v/s 29.9+24.7, p =0.003), AHI-NREM (57+35.8 v/s 27+26.9, p=0.003) and arousal index(55.6+29.7 v/s 34.7+25.1, p=0.01) between the two groups respectively.
Conclusion: Dream enacting behavior (pseudo-RBD) can be found in nearly half the patients with obstructive sleep apnea, most commonly among patients with severe sleep apnea.

0531

HYPERTENSION AND OBSTRUCTIVE SLEEP APNEA: INSTRUMENTAL-CLINICAL CORRELATION IN A GROUP OF PATIENTS FROM SOUTHERN ITALY

Gervasi G[2], Aricò I[1], Campolo L[1], Mento G[1], Silvestri R[1]
[1]Neurosciences, Sleep Medicine Center, Messina, Italy, [2]IRCCS Centro Neurolesi "Bonino Pulejo", Messina, Italy

Introduction: Sleep disordered breathing has been associated with hypertension. Obstructive sleep apnea (OSAS)is considered one of hypertension secondary causes. The OSASrelated intermittent hypoxia is associated with an increased sympathetic tone leading to hypertension. Aim of this study was to evaluate the clinical features of a cohort of patients presenting with OSAS and their eventual correlation with the degree of associated hypertension.
Methods: We have retrospectively studied 521patients referred to our Sleep Medicine Center in Messina (Italy) because of snoring and poor sleep quality. Each patient was clinically evaluated to detect BMI, neck and waist circumference. Blood pressure (BP) was detected at baseline in all patietns. 329/521 were suspected for OSAS and underwent Holter-PSG to detect the Apnea/Hypopnea index (AHI). They were subdivided into 4 groups according to the AHI: C (healthy patients), L (mild OSAS), M (moderate OSAS), S (severe OSAS). Statistical analysis was performed by means of SPSS with parametric and non-parametric tests; statistical significance was set at $p<0.05$.
Results: The clinical features of each groups were statistically different. Patients in Group S were older and had the highest BMI, neck and waist circumference. A prevalence of male was present in all groups, with an M/F ratio around 2:1 in group M and S. In group S both systolic and diastolic BP values had a trend toward an increase. Moreover we found a trend to a positive correlation between AHI and BP values, more for systolic (Spearman's R = 0.16) than for diastolic values (Sparman's R = 0.14). Higher BP values prevailed in males over females. However, no correlation between AHI, mean nocturnal SaO2, BMI and age was statistically associated with an increased risk for hypertension.
Conclusion: Our results confirm a higher prevalence of hypertension in elderly obese patients with the highest AHI, especially in male subjects. This male preponderance might be related to the overall higher prevalence of male patients in our population, rather than to a real statistical difference related to AHI. We were able to detect hypertension in patients with higher AHI despite no clear association of BP values to the OSAS severity degree.

0532

COMPARISON OF POLYSOMNOGRAPHIC AND CLINICAL PRESENTATIONS AND PREDICTORS FOR CARDIOVASCULAR-RELATED DISEASES BETWEEN REM-PREDOMINANT OBSTRUCTIVE SLEEP APNEA AND NOT-REM-PREDOMINANT OBSTRUCTIVE SLEEP APNEA

Teerapraipruk B[1,2,3], Chirakalwasan N[1,4], Simon R[5], Hirunwiwatkul P[1,3], Jaimchariyatam N[1,2], Desudchit T[1,6], Charakorn N[3], Wanlapkorn C[7]
[1]Excellence Center for Sleep Disorders, Chulalongkorn University, King Chulalongkorn Memorial Hospital/Thai Red Cross Society, Bangkok, Thailand, [2]Department of Otolaryngology and Opthalmology, Naresuan University, Phitsanulok, Thailand, [3]Department of Otolaryngology, Chulalongkorn University, Bangkok, Thailand, [4]Department of Medicine, Division of Pulmonary and Critical Care Medicine, Chulalongkorn University, Bangkok, Thailand, [5]Department of Otorhinolaryngology, Hospital Raja Permaisuri Bainun, Ipoh, Perak, Malaysia, [6]Department of Pediatrics,Division of Pediatric Neurology, Chulalongkorn University, Bangkok, Thailand, [7]Department of Medicine, Chulalongkorn University, Bangkok, Thailand

Introduction: REM-predominant obstructive sleep apnea (OSA) has been reported to be a unique clinical entity; however clinical signifi-

cance of its when compared to not-REM-predominant OSA has not been well investigated.
Methods: We reviewed polysomnographic studies which were performed in adult age>=18. We excluded the studies with REM time <10 minutes, total sleep time <100 minutes, and RDI<5. Criteria for REM-predominant OSA were REM RDI/NREM RDI ≥2 and total RDI≥5 and not-REM-predominant OSA were REM RDI/NREM RDI <2 and total RDI≥5. We investigated the clinical significance of REM-predominant OSA in terms of clinical manifestations and polysomnographic findings and also the predictors for cardiovascular-related disease including hypertension, diabetes mellitus, coronary artery disease and/or cerebrovascular disease.
Results: We found 151 patients with OSA (RDI≥5), in which 41 patients met criteria for REM-predominant OSA (27.2%) and 110 patients met criteria for not-REM-predominant OSA (72.8%). REM-predominant OSA was observed more in female, less history of habitual snoring (>3/4 times/week), lower BMI, and smaller neck size. Additionally, REM-predominant OSA group was noted to be less severe indicated by significantly lower supine, non-supine, NREM, and total RDIs; and obstructive apnea and hypopnea indexes. They were noted to have higher mean and nadir oxygen saturations and less disrupted sleep architecture (lower %NREM2 and NREM arousal index and higher %REM and REM time). In REM-predominant OSA group, frequent nocturia (>3-4 times/week) and total obstructive apnea index (OAI) ≥5 were noted to be significant predictors for cardiovascular-related disease after controlling for age, sex and RDI (OR= 2.42 and OR=6.17; respectively). In not-REM-predominant OSA group, only sleep efficiency<90% was a significant predictor (OR= 3.14).
Conclusion: REM-predominant OSA was observed more in non-obese, female and less snoring patients. They were also noted to have overall milder OSA. Predictors for cardiovascular-related disease in REM-predominant OSA were frequent nocturia and OAI ≥5.

0533

MORNING HEADACHES IN SNORERS AND THEIR BED PARTNERS - A PROSPECTIVE DIARY STUDY

Seidel S[1], Frantal S[2], Oberhofer P[1], Scheibel N[1], Bauer T[1], Pacher J[1], Albert F[1], Casjens T[1], Zeitlhofer J[1], Wöber C[1]
[1]Department of Neurology, Medical University of Vienna, VIenna, Austria, [2]Department of Medical Statistics, Medical University of Vienna, Vienna, Austria

Introduction: Up to now, studies have exclusively relied on retrospective assessment of morning headaches (MH) in habitual snorers with and without OSAS. Migraine, insomnia, psychosocial distress and obstructive sleep apnea syndrome (OSAS) have been identified as independent predictors for MH in habitual snorers. To date, prospective data on MH in habitual snorers and their bed partners are lacking.
Methods: Between January 2009 and May 2011 habitual snorers and their bed partners were recruited via newspaper articles. Headaches and objective sleep variables were prospectively documented by patients and their bed partners in a 90-day diary. The impact of headaches on daily life was assessed using the Headache Impact Test (HIT-6). Quality of sleep, daytime sleepiness and psychiatric comorbidities were assessed using the Pittsburgh Sleep Quality Index (PSQI), the Epworth Sleepiness Scale (ESS) the Self-rating Anxiety Scale (SAS) and the Self-rating Depression Scale (SDS).
Results: Patients were significantly older (49±11 vs. 43±12 years, p=0.0062) and showed a significantly higher BMI (28±4 vs. 26±4, p=0.011) than bed partners. Mean PSQI scores were significantly higher in bed partners than in patients (6.3±3.6 vs. 4.6±2.3, p=0.0076). Mean ESS scores were significantly higher in patients than in bed partners (9.0±3.5 vs. 7.4±3.6, p=0.03). Forty three (57%) patients documented a total of 454 days (7.2%) with MH, and 25 (61%) bed partners documented a total of 118 days (3.6%) with MH. The mean number of days with MH was 11 (range 1 to 83 days) in patients and 5 (range 1 to 28 days) in bed partners. During the 90-day diary period patients reported sleep disturbance due to coughing or loud snoring significantly more often than bed partners (p=0.02). Bed partners reported sleep disturbance due to "feeling to cold" significantly more often than patients (p=0.03). Bed partners rated their subjective sleep quality significantly worse than patients (p=0.0085).
Conclusion: This is the first study, which prospectively investigated the prevalence of morning headaches (MH) in habitual snorers and bed partners. Our study shows that MH was reported by more than 50% of snorers and bed partners, but was present only on 7.2% and 3.6% of days in snorers and bed partners, respectively.

0534

ALTERATION OF CEREBRAL BLOOD FLOW AND ARTERIAL PULSATILITY IN OBSTRUCTIVE SLEEP APNEA

Ramos AR, Cabral D, Lee DJ, Sacco R, Rundek T
Neurology-Sleep Medicine, Miller School of Medicine/University of Miami, Miami, FL, USA

Introduction: Obstructive sleep apnea (OSA) increases the risk of stroke independent of known vascular risk factors. Cerebral hemodynamic changes and increased arterial pulsatility measured with transcranial Doppler (TCD) have been associated to cerebral microangiopathy. The aim of our study is to determine the association between cerebral hemodynamic changes and arterial pulsatility with OSA.
Methods: We conducted a TCD study of 19 consecutive patients free of stroke and cardiovascular disease, referred for the evaluation of OSA. TCD was performed by a certified technologist according to the guidelines of the American Institute of Ultrasound in Medicine. Subsequent polysomnography (PSG) was performed according the practice parameters of the American Academy of Sleep Medicine. We evaluated the association between the apnea hypopnea index (AHI), hypoxemia, the flow velocities and the Gosling pulsatility index (PI), for the middle cerebral (MCA) and the basilar artery (BA). Linear regression was done to evaluate the relation between OSA and TCD variables.
Results: The median age was 50 ±11 years (range 37-83), 53% were men with a median BMI of 31±5 (range 25-40.4). The mean systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) recorded during the TCD's were 124±14 mm Hg, 79±7 mm Hg and 73±7 beats per minute, respectively. The median AHI was 22 ±18 (0.2-83). The MFV for the MCA's and BA were 49±13 and 34±10 cm/sec, respectively. When controlling for significant covariates (sex, BMI, SBP, HR), the AHI (estimate=0.28; p=0.0001) and hypoxemia (estimate=0.47; p=0.0001) where associated with MFV. The AHI was also associated to increased pulsatility (PI) at the MCA (estimate=0.06; p=0.048) and BA (estimate=0.16; p=0.01) with no relation to hypoxemia after controlling for covariates.
Conclusion: Our study shows alterations in cerebral blood flow parameters at the MCA and BA that may in part explain the increased risk of stroke in OSA.
Support (If Any): Supplements to R37 NS029993 (ARR).

0535

PREVALENCE OF SLEEP APNEA, ASSOCIATED SYMPTOMS AND CO-MORBIDITIES: RESULTS FROM THE HISPANIC COMMUNITY HEALTH STUDY / STUDY OF LATINOS (HCHS/SOL)

Redline S[1], Sortes-Alvarez D[2], Daviglus ML[3], Hall MH[6], Levine D[2], Loredo JS[4], Patel SR[1], Wohlgemuth WK[5], Youngblood M[2], Zee P[3]
[1]Department of Medicine and Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [2]Biostatistics, University of North Carolina, Chapel Hill, NC, USA, [3]Northwestern University, Chicago, IL, USA, [4]University of San Diego, San Diego, CA, USA, [5]University of Miami, Miami, FL, USA, [6]University of Pittsburgh, Pittsburgh, PA, USA

Introduction: The associations of sleep apnea (SA) with hypertension, diabetes and cardiovascular disease (CVD) vary by age, sex, and possibly ethnicity. Understanding the burden of SA and its presenting symptoms in groups at increased CVD risk may inform recognition and treatment strategies. This analysis aimed to: a) quantify SA prevalence and symptoms by Hispanic/Latino background and gender; and b) characterize the associations with obesity, diabetes, hypertension, and asthma.
Methods: The HCHS/SOL is a cohort study of 5 Hispanics/Latinos groups from diverse cultural and genetic origins living in 4 US communities. 14,105 participants had an in-home sleep apnea study with overnight measurement of oximetry, airfllow, position and snoring and answered a standardized sleep questionnaire. SA is defined as an Apnea Hypopnea Index > 15. Logistic regression analyses were performed to provide estimates of adjusted associations.
Results: Within each background, age and BMI-adjusted SA was approximately 2.0-fold more prevalent in men than women, varying from 5.3% in Central American women to 15.6% in Cuban men. Habitual snoring and excessive sleepiness also varied by background and gender. However, 30% of females and 25% of males were unable to report their snoring frequency. Multivariate-adjusted Odds Ratio for SA were 2.5 (1.9, 3.2) for habitual snoring, 1.9 (1.4, 2.5) for diabetes and 1.5 (1.2, 1.8) for hypertension. Excessive sleepiness and asthma were unassociated with SA.
Conclusion: SA is prevalent in Hispanic/Latino groups and associated with diabetes and hypertension independent of obesity. The high prevalence of participants who were unable to report on their snoring frequency and lack of association of SA with reported sleepiness suggest that SA may be less well recognized than in other populations. Thus while SA is associated with CVD risk factors in Hispanics/Latinos, potentially contributing to health disparities, traditional approaches for SA recognition using symptom-based screening may be inadequate.
Support (If Any): NIH: HHSN268200625233C/N01-HC-65233.

0536

THE EFFECT OF OBSTRUCTIVE SLEEP APNEA ON SLEEP-RELATED GASTROESOPHAGEAL REFLUX

Shepherd K, Wright S, Orr W
Lynn Health Science Institute, Oklahoma City, OK, USA

Introduction: Gastroesophageal reflux (GER) symptoms and events are extremely common in individuals with obstructive sleep apnea (OSA). The role of obesity *vs.* upper airway obstruction in the high prevalence of GER in OSA patients remains unclear. The present study investigated the additional risk of OSA on the presence and severity of GER in obese individuals.
Methods: Ten obese individuals with moderate to severe OSA (apnea-hypopnea index ≥ 15 events per hour) and 10 obese individuals without OSA (apnea-hypopnea index <5 events per hour) underwent 24-hour esophageal pH-impedance monitoring and polysomnography. Reflux events were classified as distal *vs.* proximal (migrating >15cm above the lower esophageal sphincter) or acidic (pH <4) *vs.* non-acidic. For analysis, the study was divided into a wake period, a sleep period (time after sleep onset) and the combined 24-hour period.
Results: There were no significant differences in age or BMI between the two groups; however there was a significantly greater proportion of males in the obese with OSA group (100% *vs.* 40%). There were no differences between groups in any pH or impedance variable, including acid contact time, during the sleep period. Over the 24-hour period, however, the number of GER events was significantly greater in the OSA group in the distal esophagus (55±21 *vs.* 38±13, p=0.05) and the proximal esophagus (32±17 *vs.* 17±12, p=0.03). Likewise the average duration of GER events was significantly longer in the OSA group (5±6 *vs.* 1±0.5min, p=0.02) during the 24-hour period.
Conclusion: There were no differences in GER measures between groups during the sleep period, arguing against a significant role of OSA in the occurrence of GER during sleep. GER during sleep in these subjects is most likely secondary to obesity. However, OSA was associated with an increase in number and duration of GER events over a 24-hour period.

0537

UNTREATED OBSTRUCTIVE SLEEP APNEA: A SYSTEMATIC REVIEW OF THE RISK FOR SERIOUS ADVERSE OUTCOMES

Kendzerska T[1], Mollayeva T[2], Gershon A[1,3], Leung R[3], Hawker G[1,3], Tomlinson G[1]
[1]Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, ON, Canada, [2]Department of Rehabilitation Science, University of Toronto, Toronto, ON, Canada, [3]Faculty of Medicine, University of Toronto, Toronto, ON, Canada

Introduction: Obstructive sleep apnea (OSA) affected 3.4% of Canadian adults in 2009. Reports on the association between OSA and risk of death, cardiovascular (CV) events, diabetes and depression have been inconsistent. We conducted a systematic review to evaluate the long-term risk for adverse outcomes in adults with untreated OSA and clinical and polysomnographic (PSG) markers of risk.
Methods: A comprehensive search strategy for prognosis studies, OSA, CV events, mortality, depression and diabetes was developed in collaboration with a medical information specialist. All English language studies, from 1999 to the present, with longitudinal design in adults with OSA diagnosed by PSG recording, found through MEDLINE, EMBASE and bibliographies of identified articles, were considered eligible. Quality was assessed using published guidelines.
Results: Of 2547 articles found, 48 were selected for full-text review. Of the 25 articles meeting quality and selection criteria, 10 evaluated the association of OSA with mortality, 8 with composite CV outcome, 4 with stroke, 2 with diabetes and 1 with depression. In studies controlling for potential confounders, there was consistent evidence for a relationship between OSA and risk of all-cause mortality or composite CV outcome for men. Evidence was lacking for diabetes, depression and the individual CV outcomes. The most common significant predictors were: apnea-hypopnea index (AHI) (18 of 25 studies), age (12/25) and baseline CV comorbidities (7/25). Contradictory relationships were reported for age.
Conclusion: Despite clear evidence for a relationship between OSA and all-cause mortality or CV events, associations between OSA and diabetes, depression or specific CV outcomes are still uncertain. There was inconsistency in the predictors and potential confounders examined. The roles of age and sex require clarification. AHI was not always associated with adverse outcomes. The predictive ability of the expanded set of factors including demographic, clinical patient characteristics and other PSG indexes must be tested.

0538

DOES OBSTRUCTIVE SLEEP APNEA, IN THE ABSENCE OF METABOLIC SYNDROME, CAUSE IMPAIRMENT IN INFLAMMATORY RESPONSE, OXIDATIVE STRESS AND ENDOTHELIAL DYSFUNCTION?

Andaku DK[1], D'Almeida V[1], Carneiro G[1,2], Hix S[1], Póvoa RM[2], Tufik S[1], Togeiro SM[1]
[1]Psychobiology, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [2]Medicine, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: Inflammation, oxidative stress and endothelial function have been studied in Obstructive Sleep Apnea (OSA),however these abnormalities could be related to the presence of Metabolic Syndrome (MS) in these patients. The aim of this study was to evaluate biochemical markers of inflammation, oxidative stress and endothelial function in OSA subjects in the absence of MS; and to analyze whether Glucose Intolerance (GI) and Insulin Resistance (IR) are additional mechanisms in promoting abnormalities in these parameters.
Methods: Thirty five patients were selected and distributed into three groups, 15 with OSA, 10 with OSA and GI and/or IR, and 10 control subjects. Serum measurements of high-sensitivity C-reactive protein (hs-PCR); homocysteine (Hcy), cysteine (Cys) and paraoxonase-1 (PON-1) activity were collected. Carotid-radial pulse wave velocity (PWV) was detected to evaluate the endothelial dysfunction.
Results: The hs-CRP, Hcy, Cys and, PON-1 activity mean values were in normal range in all three groups and there were no significant differences among them, except for plasma Hcy concentrations. PWV values were similar among the groups.
Conclusion: In the absence of MS, OSA does not cause impairment in inflammatory response, oxidative stress markers and endothelial dysfunction, even when associated with glucose intolerance or insulin resistance.
Support (If Any): FAPESP(CEPID #98/14303-3), CNPq and AFIP.

0539

THE EFFECT OF AGING IN COMBINATION WITH OBSTRUCTIVE SLEEP APNEA ON SLEEP-DEPENDENT MEMORY CONSOLIDATION

Matteis P[1,2,3], Carusona A[1,3], Isidro T[1,3], Guo M[1,2,3], Wamsley EJ[2,3], Stickgold R[2,3], Malhotra A[1,3], Djonlagic I[1,2,3]
[1]Division of Sleep Medicine, Brigham & Women's Hospital, Boston, MA, USA, [2]Center for Sleep and Cognition, Beth Israel Deaconess Medical Center, Boston, MA, USA, [3]Harvard Medical School, Boston, MA, USA

Introduction: Previous research has shown that healthy aging does not seem to affect offline sleep-related motor memory consolidation. The aim of this study was to examine the effect of aging in participants with and without obstructive sleep apnea on sleep-related offline improvement on a motor sequence learning task (MST).
Methods: We studied 43 subjects (19-67 years) in the evening prior to their clinical polysomnography evaluation and again the following morning. Overnight improvement on the MST was compared between subjects with OSA (n=20, AHI >10/h), and those who had a normal study (Controls n=23). PSG data were preprocessed and analyzed using BrainVision Analyzer 2.0 (BrainProducts, Munich Germany). Spindle analysis (number and density) was done manually and by using a wavelet-based algorithm.
Results: There was no significant group difference in age distribution between the OSA and Control group. OSA patients showed significantly less overnight improvement on the MST compared to controls (OSA 8.5%±3.7% vs. controls 20.8%±4.8%; p=0.03). Solely subjects with OSA showed a significant, negative correlation between overnight improvement and age (p=0.015, r-squared=0.3). Additionally, the total number of central sleep spindles (C3:p=0.040, C4:p=0.50) and central sleep spindle density (C3; p=0.018, C4: p=0.036) was associated with the amount of overnight improvement in apneics, an effect not observed in healthy controls.
Conclusion: Our findings illuminate that obstructive sleep apnea can incur a cognitive age-related decline, otherwise not present in aging individuals without OSA. Further research is needed to explore whether this neurocognitive decay may additionally lead to ties between OSA and neurodegenerative disorders.
Support (If Any): NIH-NHLBI National Heart, Lung, and Blood Institute - K23 HL103850-01 American Sleep Medicine Foundation - #54-JF-10.

0540

MORNING BLOOD PRESSURE SURGE IN CHINESE PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Wang M
Respiratory Department, West China Hospital SiChuan University, ChengDu, China

Introduction: Certain groups of patients with obstructive sleep apnea (OSA) may be more likely to suffer morning blood pressure (BP) surge and these patients may with a high risk of future cardiovascular events. This study aims to identify the morning blood pressure surge in patients with OSA, and to exam the relationship between morning BP surge with common demographic and clinical factors.
Methods: The BP of 306 consecutive adult patients with newly diagnosed OSA was examined (270 men and 36 women). Among them 23.70% of men and 33.33% women were hypertensive. Morning BP surge was calculated as the difference between the BP manually taken before sleep and in the morning. The relationships between morning BP surge with gender, age, body mass index (BMI), apnea hypopnea index (AHI), oxygen desaturation and excessive daytime sleepiness (evaluated by Epworth Sleepiness Scale) were examined by linear regression analyses.
Results: The average morning BP surge was 0.91±6.63 mmHg, with 50% of patients having increased morning BP. The difference in the BPs was significantly associated with the ESS score ($r = 0.191$, $R2 = 0.036$, $p = 0.001$), AHI ($r = 0.323$, $R2= 0.104$, $p= 0.000$), the nadir SaO2 ($r = 0.248$, $R2 = 0.061$, $p = 0.000$), the time of SaO2 less than 90% ($r = 0.233$, $R2 = 0.054$, $p = 0.000$).
Conclusion: The degree of morning BP surge may be related to the daytime sleepiness and severity of OSA. These results may have practical relevance in screening for patients with OSA and may have prognostic clinical value in predicting future cardiovascular events.

0541

TO DOCUMENT THE NEED FOR MEDICAL THERAPY IN SLEEP APNEA PATIENTS WITH EXCESSIVE DAYTIME SLEEPINESS

Thommi G, Shehan JC, Meyers P, Mcleay MT
Pulmonary/ Sleep medicine, Creighton University/Midwest Pulmonary and Critical Care, Omaha, NE, USA

Introduction: Excessive daytime sleepiness is not uncommon In patients with Obstructive Sleep Apnea (OSA) and patients are initiated on stimulants without any objective data.
Methods: A prospective study was performed over a period of 3 years. Patients with moderate to severe excessive daytime sleepiness (EDS) on continuous positive airway pressure (CPAP) and patients with mild OSA not on CPAP were evaluated. CPAP titration was performed followed by Mean Sleep Latency time (MSLT) the following day. Patients were discarded if their sleep efficiency was less than 80% on CPAP titration or if they did not respond to CPAP/BiPAP.
Results: Forty-eight patients were evaluated of which sixteen were mild (Sleepiness index (SI) below50; MSLT above 10 minutes), fifteen were of moderate severity (SI between 50 and 75; MSLT between 5 and 10 minutes) and 17 were severe (SI above 75; MSLT below 5 minutes).

Seven patients had narcolepsy and 4 patients had inadequate response to CPAP (AHI > 5 but below 10/hr). Only two patients needed medical therapy with mild SI compared to 9 of the 15 patients with moderate SI. All patients with severe SI and patients diagnosed with narcolepsy needed medical therapy.
Conclusion: We conclude that patients with sleep apnea that continue to have persistent EDS be titrated with CPAP followed by an MSLT the next day to diagnose the severity of their SI and/or narcolepsy. Patients with Mild SI need good sleep hygiene techniques and very seldom need medications. Some patients with Moderate SI and most patients with severe SI will need medications to control their symptoms.

0542

OBSTRUCTIVE SLEEP APNEA AND RACIAL DIFFERENCES IN HYPERTENSION: DETERMINING RISK OF VASCULAR EVENTS BY APNEA MONITORING ("DREAM") STUDY

Teba CV[1], Bernardo S[6], Strohl KP[4], Ferguson J[2], Jimenez W[5], Qin L[1], Bennett A[6], Doctor K[5], Sands M[3], Yaggi H[6]
[1]Pulmonary and Critical Care, Yale University School of Medicine, New Haven, CT, USA, [2]Center of Excellence on Implementing Evidence Based Practice, Richard L. Roudebush VA Medical Center, Indianapolis, IN, USA, [3]Public Health, Brown University, Providence, RI, USA, [4]Pulmonary, Critical Care, and Sleep, Louis Stokes Cleveland VA Medical Center, Cleveland, OH, USA, [5]Pulmonary, Critical Care, and Sleep, VA Connecticut Healthcare System, West Haven, CT, USA, [6]Pulmonary, Critical Care, and Sleep, Yale University School of Medicine, New Haven, CT, USA

Introduction: Hypertension is a major public health concern and disproportionately affects African Americans (AA). Obstructive sleep apnea has been identified as a risk factor for hypertension, but limited literature exists on racial differences in sleep apnea as it relates to hypertension. The objective of this study is to examine racial differences in sleep apnea among a veteran population with open access to care, and determine if differences exist in the magnitude of risk, conferred by sleep apnea for hypertension.
Methods: This is a cross-sectional analysis of 1,779 patients who underwent attended polysomnography at three Veterans Affairs (VA) sleep centers. Diagnosis of obstructive sleep apnea was based on apnea-hypopnea index ≥ 5. Hypertension was defined as: 1) history of hypertension; or 2) patients without diabetes, SBP≥ 140 mmHg or DBP ≥ 90 mmHg; or 3) patients with diabetes, SBP ≥ 130 mmHg or DBP ≥ 80 mmHg. Logistic regression models were constructed to determine the association of race and obstructive sleep apnea with hypertension.
Results: AA comprised 14% of the total population, were younger, had higher rates of current alcohol use, smoked less, and had significantly higher rates of hypertension (p=0.02). Comparing AA to Caucasians there were no differences in BMI, nor prevalence or severity of sleep apnea. Patients with obstructive sleep apnea had significantly higher risk of hypertension (OR=1.58; CI 1.16-2.14). Importantly, the magnitude of risk conferred by sleep apnea for hypertension was significantly higher among African Americans (OR=4.68; CI 1.64-13.4) compared to Caucasians (OR=1.44; CI 1.04-1.99).
Conclusion: Among a population which controls for access to care, no differences in sleep apnea prevalence or severity were observed among African Americans compared to Caucasians. However, sleep apnea may be a potent risk factor for hypertension among African Americans, and therefore, may contribute to racial differences in hypertension.
Support (If Any): Agency: VA CSR&D Merit Review Program, I.D.# IIR Resp S07-27.

0543

ANALYSIS OF CORTICAL THICKNESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

Joo E[1], Jeon S[2], Lee S[3], Hong S[1]
[1]Neurology, Sleep Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea, [2]Computational NeuroImage Analysis Laboratory, Department of Biomedical Engineering, Hanyang University, Seoul, Republic of Korea, [3]Neurology, Inam Neuroscience Research Center, Wonkwang University College of Medicine, Sanbon Hospital, Gunpo, Republic of Korea

Introduction: To investigate differences in cortical thickness in patients with obstructive sleep apnea syndrome (OSA) and control subjects, cortical thickness was measured using a 3-D surface-based method that enables more accurate measurement in deep sulci and localized regional mapping.
Methods: We enrolled 38 male patients with untreated OSA (mean AHI 55.7/hr) and 36 age-matched controls. Cortical thickness was measured using a direct method for calculating the distance between corresponding vertices from inner and outer cortical surfaces. Cortical surfaces was normalized by using 2-D surface registration and performed diffusion smoothing to reduce the variability of folding patterns and to increase the power of the statistical analysis.
Results: Localized cortical thinning in OSA patients was found in rectal gyri, superior frontal and medial frontal gyri, pericentral gyri, inferior parietal lobule, uncus, superior and inferior temporal gyri, and fusiform gyrus in left or right hemispheres at corrected $p < 0.05$. No significant local increases in cortical thickness were observed in OSA patients. A significant correlation was observed between respiratory arousal (%) in polysomnography and the cortical thinning of the left dorsolateral prefrontal cortices and right parietal cortex and the longer apnea maximum duration was definitely related to the thinner thickness of right parietal cortex.
Conclusion: Severe OSA patients showed definitely reduced cortical thickness compared to normal subjects. Cortical thinning in localized anatomic brain regions may explain close relationship between the disturbances in attention, memory, emotion, and sleepiness and sleep apnea induced hypoxia in untreated OSA patients.

0544

DO OSAS PATIENTS SHOW MORE RISKY BEHAVIOR WHILE DRIVING IN REALISTIC ROAD ENVIRONMENTS?

Diaz-Piedra C[1], Di Stasi LL[2], Catena A[2], Buela-Casal G[1]
[1]Laboratory of Psychophysiology, University of Granada, Granada, Spain, [2]Experimental Psychology, University of Granada, Granada, Spain

Introduction: Several studies have suggested a relation between sleep apnea and vehicle accidents. Many authors have used several simulators to measure driving performance in subjects with sleep apnea. The complexities of these tests vary largely and, although results have been generally congruent, performance between patients and controls vary considerably. Can these results be extrapolated to predict real world, on-road driving? If some patients do not perform well on simulators, it would stand to reason that they would be more prone to having on-road collisions. However, previous research does not confirm this; many patients have never had collisions and several studies have shown that this assumption is not always true. The aim of this study was to evaluate risk-taking behaviors during driving in a group of apnea patients and in a group of controls.
Methods: Twelve patients (age 52.3 ± 8.9 years, body mass index 32.1 ± 5.9 kg/m2, 9 males) and 12 matched healthy controls (age 53.7 ± 9.7 years, body mass index 26.8 ± 2.6 kg/m2, 9 males) were recruited to be assessed by the Honda Riding Trainer simulator. The driving scenarios were designed to train dynamic and complex time-critical driving skills

such as risk-taking assessment. Subjective diurnal sleepiness, mental fatigue, and activation levels during the simulation were also assessed by questionnaires.
Results: Although apnea patients exhibited a great degree of diurnal sleepiness, risk-taking behaviors were similar between groups. There were no differences in mental fatigue or activation levels during the simulation.
Conclusion: Contrary to previous findings, performance of apnea patients do not differ from matched controls when realistic road environments are used in the evaluation process. These results seem to warrant the use of CPAP, and suggest the inclusion of virtual simulation tests in order to obtain or extend the driving license, especially in populations at risk.
Support (If Any): This study was supported in part by Excellence Projects P05-CTS-918, PB09-SEJ4752, PSI2009-12217, funded by the Andalusian Government, and by FPU AP2007-2965 Spanish national grant (C. Diaz-Piedra). We wish to thank D. Montalban, N. Galiano, and R. Quevedo for his help collecting data.

0545

CLINICAL IMPLICATIONS OF UNDIAGNOSED OBSTRUCTIVE SLEEP APNEA IN PATIENTS UNDERGOING CONSCIOUS SEDATION FOR BRONCHOSCOPY

Cantu J[1], Abraham V[2], Velamuri K[1], Sharafkhaneh A[1]
[1]Pulmonary, Critical Care and Sleep Medicine, Baylor, Houston, TX, USA, [2]Pulmonary, Taranaki District Health Board, New Plymouth, New Zealand

Introduction: The use of conscious sedation during bronchoscopy may increase morbidity in patients with obstructive sleep apnea (OSA). However, OSA is frequently undiagnosed at the time of presentation. We aimed to determine if adult patients with undiagnosed OSA have a longer post-procedural recovery time when compared to those without OSA.
Methods: We screened all patients referred for outpatient bronchoscopy. Exclusion criteria included pre-existing sleep disorders and the inability to perform a home sleep study. Following informed consent, patients had an unattended home sleep test (HST). Sleep apnea was defined as an apnea-hypopnea index greater than 5. Bronchoscopy was performed in usual fashion with HST results not provided to the bronchoscopist. Post-procedural recovery from conscious sedation was assessed using the Modified Aldrete Scoring System. Data is presented as mean±standard deviation and compared using Student's unpaired t-test.
Results: A total of 29 patients completed the full study protocol. All patients were male with an average age of 65±11 years and a body mass index of 26.2±5.2 kg/m2. No statistically significant demographic differences were noted between patients with and without OSA. Forty-four percent (13/29) were diagnosed with an average AHI of 14.3 (range of 5-42). Pre-operative and intra-operative oxygen saturation, end tidal CO2 and total bronchoscopy times were not statistically different between groups. Administered dosages of midazolam and fentanyl were statistically similar. Recovery times showed no statistical difference, averaging 4.1±2.4 minutes to reach recovery criteria for both groups (p=0.5). There were no operative complications necessitating hospital admission.
Conclusion: Patients with undiagnosed OSA undergoing conscious sedation did not have statistically different recovery times when compared to a similar control population. In addition, no differences in intra-operative respiratory variables and no operative complications requiring hospital admission were noted. It is safe to perform procedures requiring conscious sedation in patients that may have undiagnosed OSA.

0546

HYPOXIA AND SLEEPINESS IN PATIENTS WITH OSA

Uysal A[2,1], Paxson C[2,1], Liendo C[1,2], Chesson AL[2,1], McCarty DE[2,1], Jenks C[2], Batra H[2], Wang L[2], Kim Y[2], Marino AA[2,1]
[1]Department of Pulmonary,Critical Care and Sleep, VA Overton Brooks Medical Center, Shreveport, LA, USA, [2]Department of Neurology/Sleep, Louisiana State University, Shreveport, LA, USA

Introduction: Patients with obstructive sleep apnea (OSA) exhibit varying degrees of sleepiness. Our goal was to determine whether sleepiness in patients with moderate-to-severe OSA was correlated with common measures of hypoxia, taken either alone or in combination.
Methods: Computer-based chart reviews identified a consecutive series of OSA patients with AHI≥15 during a cardiopulmonary sleep study (Embletta) which we evaluated (N=114). The measures used were: desaturation index; P90 (minutes below 90% saturation); average %-desaturation; lowest %-desaturation; and AHI. To score hypopneas, a desaturation criteria of ≥4% was used. Sleepiness was assessed using the Epworth Sleepiness Scale (ESS). Correlations between ESS score and these measures were determined using the Pearson correlation coefficient (PCC). The PCC was calculated for each measure and for all possible combination (31 cases). For each combination we determined the PCC between a biomarker formed by principal components analysis and the ESS score.
Results: None of the individual measures correlated with the ESS score. Of the 10 possible pair-wise combinations, half correlated with ESS score; the highest significant PCC (0.3) was the biomarker formed using average %-desaturation and P90. Of the 10 combinations involving three measures, 4 were significant; the highest significant PCC was the one formed by the addition of the AHI. Addition of desaturation index and lowest %-desaturation either individually or together (six cases) did not further increase the PCC.
Conclusion: Individual measures studied do not capture enough of the complex physiological relationship between OSA and sleepiness to yield a statistically significant correlation between the two conditions. Biomarkers formed by linear combinations of 2-3 measures were correlated with sleepiness, indicating that the relationship can be characterized more effectively by combining measures. Nevertheless the PCCs were low, suggesting that individual these measures alone (however combined) are unlikely to explain sleepiness well in patients with moderate-to-severe OSA.

0547

FACTORS ASSOCIATED WITH EXCESSIVE DAYTIME SLEEPINESS IN PATIENTS WITH SEVERE OBSTRUCTIVE SLEEP APNEA (OSA)

Shi L[1], Jacobsen J[1], Mokhlesi B[2]
[1]Neurology, The University of Chicago Medical Center, Chicago, IL, USA, [2]Medicine, The University of Chicago Medical Center, Chicago, IL, USA

Introduction: Although excessive daytime sleepiness (EDS) is regarded as one of the key symptoms of OSA, associations between OSA and EDS have been inconsistent. The Sleep Heart Health Study investigators have reported that only 35% of patients with severe OSA develop EDS. The explanation for this phenomenon is unclear. To that end, our goal was to investigate factors associated with EDS based on the Epworth Sleepiness Scale (ESS) score in a large clinical population with severe OSA.
Methods: This cross-sectional study included 1126 adult patients referred for their first in-laboratory polysomnography. All patients completed a questionnaire including demographics, race, co-morbidities, sleep history, ESS, short-form quality of life questionnaire-12 (SF-12), the center for epidemiologic studies depression (CES-D) scale, and medications used. 498 patients had severe OSA (apnea hypopnea index [AHI] ≥ 30). After excluding patients taking narcotics, hypnotics, ben-

zodiazepines, antidepressants or with diagnosis of depression, 355 patients remained in the final analysis. Patients were divided into quartiles based on ESS and comparisons were made between the lowest quartile (ESS ≤ 6; N = 105) and highest quartile (ESS ≥ 13; N = 97).
Results: Compared to the ESS ≤ 6 group, patients in the ESS ≥ 13 group had a significantly lower oxygen saturation nadir and a significantly higher 3% oxygen desaturation index ($p < 0.05$). Moreover, patients with severe OSA in the highest quartile of ESS had higher depressive symptomatology.
Conclusion: In this subset of patients with severe OSA, the present study suggests that intermittent nocturnal hypoxemia and depressive symptoms, but not arousal index or overall AHI, are important contributing factors to EDS. To our knowledge, this is the first study of a large cohort of patients with severe OSA to examine a wide variety of demographic, polysomnographic, and co-morbid factors for possible association with EDS.

0548

IMPAIRED CEREBRAL AND PERIPHERAL VASCULAR RESPONSES TO THE VALSALVA WITH HYPERTENSION IN OSA

Macey PM[1], Kumar R[2], Richardson HL[2], Ogren JA[1], Woo MA[1], Harper RM[2]
[1]School of Nursing, UCLA, Los Angeles, CA, USA, [2]Neurobiology, UCLA, Los Angeles, CA, USA

Introduction: Obstructive sleep apnea (OSA) is an independent risk factor for hypertension, which likely leads to the high incidence of cardiovascular morbidity and mortality in the sleep disorder. Hypertension in OSA is difficult to treat, possibly due to neural injury in autonomic areas, resulting in impaired central sympathetic and parasympathetic regulation, with consequences for vascular control. We assessed whether hypertensive OSA patients showed greater autonomic impairment than normotensive patients with heart rate (HR) and insular cortex functional magnetic resonance imaging (fMRI) responses to an autonomic challenge.
Methods: We studied 30 recently-diagnosed, untreated, moderate-to-severe OSA patients and 59 healthy control subjects, with no history of mental illness. Based on a blood pressure threshold of 140/90 mmHg, we classified 10 OSA subjects as hypertensive (age 50.5±8.0, AHI 46.3±25.2, 3 female) and 20 subjects as normotensive (age 46.6±9.0, AHI 40.3±18.5, 3 female). All controls were normotensive (age 46.7±8.8, 22 female). We measured fMRI and HR signals while subjects performed four Valsalva maneuvers, an 18 s forcible exhalation against a closed glottis, which normally elicits large transient blood pressure and HR changes. Neural responses were calculated from fMRI signals in the insular cortex, as identified from anatomical scans. We assessed between-group differences by repeated-measures ANOVA.
Results: Group differences ($p < 0.05$) in HR appeared, with normotensive OSA showing smaller increases than controls, and a further reduced response emerging in the hypertensive OSA. Insular fMRI responses were altered in hypertensive OSA relative to the other groups. All groups showed signal decreases in the first 4 s, but only the hypertensive OSA failed to return to baseline during the strain period (4-18 s). At 6-10 s after release, the hypertensive OSA showed an exaggerated overshoot before returning to baseline. The differences were most pronounced in anterior insular regions.
Conclusion: Hypertensive OSA patients show reductions in heart rate responses, and a time lag in undampened neural responses to a strong autonomic stimulus. The source of the impaired regulation likely includes neural injury in autonomic regulatory brain regions, including the insular cortex. The findings suggest a limitation in dynamic range of cardiovascular responses available to hypertensive OSA patients, which may contribute to further pathology and difficult-to-treat hypertension associated with OSA.
Support (If Any): National Institutes of Health NR-011230 (PMM) and HL-60296 (RMH).

0549

MILD COGNITIVE IMPAIRMENT IN OBSTRUCTIVE SLEEP APNEA: A PILOT STUDY

Gagnon K[1,2], Gosselin N[2,3], Mathieu A[1,4], Montplaisir J[2,3], Gaudreault P[2,5], Décary A[1,3], Gagnon J[1,2]
[1]Departement of Psychology, Unisersité du Québec à Montréal, Montreal, QC, Canada, [2]Center for Advanced Research in Sleep Medicine, Hôpital du Sacré-Coeur de Montréal, Montreal, QC, Canada, [3]Departement of Psychiatry, Université de Montréal, Montreal, QC, Canada, [4]Hôpital Hôtel-Dieu, Centre Hospitalier de l'Université de Montréal, Montreal, QC, Canada, [5]Departement of Psychology, Université de Montréal, Montreal, QC, Canada

Introduction: Obstructive sleep apnea (OSA) causes sleep disruption and intermittent nocturnal hypoxemia, which can lead to daytime sleepiness and cognitive deficits. The cognitive deficits reported in OSA can sometimes be severe enough to warrant a diagnosis of mild cognitive impairment (MCI). However, the frequency of diagnosed MCI in OSA is still unknown. Objective: We sought to determine the proportion and subtypes of MCI in OSA.
Methods: Twenty-four patients with OSA (AHI ≥ 15; mean age, 56.4 ± 9.0 yrs) and 33 healthy controls (mean age, 59.3 ± 9.7 yrs), matched for age, sex and education, underwent overnight polysomnography and a comprehensive neuropsychological evaluation. Three cognitive domains were defined: attention and executive functions, verbal learning and memory, and visuospatial abilities. MCI was defined as: 1) objective evidence of cognitive decline (performance ≥1.5 standard deviation below the standardized mean on at least two variables in a cognitive domain); and 2) no major impact of cognitive deficits in daily living activities. MCI subtypes were categorized as nonamnestic single domain, amnestic single domain, nonamnestic multiple domains and amnestic multiple domains. The between-group difference in the proportion of MCI was assessed using a χ^2 test.
Results: MCI was found in 38% (9/24) of OSA patients. In contrast, only 15% (5/33) of controls had MCI ($\chi^2 = 3.75$, dl = 1, $p = 0.05$). Four (44%) of the 9 patients with comorbid MCI-OSA met the criteria for nonamnestic single domain (2 with impaired attention and executive functions and 2 with impaired visuospatial abilities), two (22%) for amnestic single domain, one (11%) for nonamnestic multiple domain and two (22%) for amnestic multiple domain.
Conclusion: We found that MCI is frequent in OSA patients. The study of a larger cohort is needed to better characterize the predominant MCI subtypes and specific domains impaired in OSA.
Support (If Any): Supported by the Canadian Institutes of Health Research.

0550

INFLUENCE OF AUTONOMIC FUNCTION AND EXERCISE TRAINING ON C-REACTIVE PROTEIN LEVELS IN OBSTRUCTIVE SLEEP APNEA

Kline CE[1], Crowley E[2], Ewing GB[3], Burch JB[4], Blair SN[2,4], Durstine J[2], Davis J[2], Youngstedt SD[2,5]
[1]Department of Psychiatry, University of PIttsburgh School of Medicine, Pittsburgh, PA, USA, [2]Department of Exercise Science, University of South Carolina, Columbia, SC, USA, [3]School of Medicine, University of South Carolina, Columbia, SC, USA, [4]Department of Epidemiology & Biostatistics, University of South Carolina, Columbia, SC, USA, [5]WJB Dorn VA Medical Center, Columbia, SC, USA

Introduction: There is emerging evidence demonstrating a relationship between autonomic function and inflammation, but little is known regarding this association in obstructive sleep apnea (OSA). Furthermore,

it is unknown whether improvement in autonomic function is associated with reduced inflammation. The purpose of this study was to evaluate the association between C-reactive protein (CRP, a marker of systemic inflammation) and post-exercise heart rate recovery (HRR, a marker of vagal tone) in adults with OSA, and to examine the impact of exercise on CRP.
Methods: 43 overweight/obese (BMI >25) adults with at least moderate-severity OSA (apnea-hypopnea index [AHI] ≥15) were randomized to 12 wk of exercise training (EX; n=27) or stretching control (STR; n=16). At pre- and post-intervention, CRP was measured from plasma, body composition was assessed with dual x-ray absorptiometry (DXA), and cardiorespiratory fitness (VO2peak) and HRR were assessed with a maximal exercise test.
Results: Of 37 participants with baseline CRP available (5.08±0.78 mg/L), 17 had values associated with elevated cardiovascular risk (i.e., >3.0 mg/L). Baseline CRP was correlated with DXA fat (r=.71, P<.01), VO2peak (r=-.55, P<.01), and HRR (r=-.34, P=.03), but not OSA severity. Compared with participants with low CRP (n=20), those with elevated CRP had a significantly blunted HRR (20.45±1.61 vs. 13.59±1.50; P=.02) independent of age, sex, body fat, fitness, and AHI. Following completion of the intervention (n=32), there was a trend (P=.09) for CRP reduction following EX (-1.18±0.52 mg/L; n=21) versus STR (+0.32±0.71 mg/L; n=11). CRP reduction was not correlated with change in body fat, VO2peak, HRR, or OSA severity. However, VO2peak change was greater among those with the greatest CRP reduction (P=.04; n=16).
Conclusion: CRP was independently associated with impaired autonomic function in adults with OSA. Larger trials are needed to examine whether exercise can reduce CRP in OSA and the mechanisms by which this may occur.
Support (If Any): CDC Public Health Dissertation Grant (1R36CD000695-1), NIH T32 HL082610-04.

0551

RELATIONS BETWEEN MAINTENANCE WAKEFULNESS TEST (MWT) AND OBSTRUCTIVE SLEEP APNEA (OSA): DOES THE MWT IS A VALID TEST FOR THE ASSESSMENT OF DRIVERS WITH OSA?

Ben Mair EL, Opachevsky M, Shechter-Amir D
Institute for Sleep Medicine & Fatigue, Sheba Medical Center, Tel Hashomer, Affiliated to the Tel-Aviv University, Sackler School of Medicine, Ramat Gan, Israel

Introduction: Drivers with Obstructive Sleep Apnea (OSA) are at increased risk for road accidents than drivers without OSA due to excessive daytime sleepiness. The Maintenance of Wakefulness Test (MWT) is a useful test for the assessment of the ability to stay awake in sleepy patients. In Israel, the test is indicated for drivers with OSA. In the current study we tested the relations between the MWT score and OSA severity as measured by the Apnea Hypopnea Index (AHI) as well as other relevant measures in drivers that were referred to our sleep clinic.
Methods: The study population included 141 subjects who were referred with a clinical suspicion of OSA, or patient with OSA that were not compliant with CPAP treatment or drivers who were candidates to operate trucks and public transportation vehicles and complained of excessive daytime sleepiness. Women and patients with other sleep disorders were excluded. MWT score (mean of 4 trials, 40 min protocol) was correlated with AHI, body mass index (BMI), age, Epworth Sleepiness Scale (ESS), Total Sleep Time (TST) in the PSG, and the reported hours of sleep in the night before the test (Sleep before PSG).
Results: Only 20.5% of the subjects failed the test (mean MWT score <31 min). Mean MWT score was not correlated with AHI severity. A weak correlation between MWT score and Sleep before PSG was found (r=0.2, p<0.05). No significant correlations between MWT score and each of the other indexes were found. Additionally, a multiple regression test for all measures was also insignificant.
Conclusion: Our results showed no relations between the MWT mean score and OSA severity but showed a weak correlation with the hours of sleep before the sleep study. Thus, the validity of this test for the evaluation of drivers with OSA is questioned.

0552

SMOKING AFFECTS THE NEURORECOGNITIVE FUNCTION OF PATIENTS WITH MODERATE-TO-SEVERE OBSTRUCTIVE SLEEP APNEA HYPOPNEA SYNDROME

Lin Y, Li Q, Zhang X
Department of Pulmonary Medicine, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, Shanghai, China

Introduction: Obstructive sleep apnea hypopnea syndrome (OSAHS) is an important risk factor for cognitive dysfunction and so is cigarette smoking.If smoking affects the neurorecognitive function of patients with moderate-to-severe obstructive sleep apnea hypopnea syndrome is not still well studied. We investigated the cognitive function of smokers and nonsmokers with OSAHS.
Methods: Twenty-three moderate-to-severe OSAHS patients who smoked for at least 5 years and another seventeen patients who never smoked or had quited smoking for at least 6 months were recruited in this study. Polysomnography was performed and neuropsychological tests were carried out in all patients.
Results: Non-smokers got significantly higher scores in Clock Drawing Task than smokers did (13.94±0.97 Vs 12.57±1.97, P=0.0064). In Montreal Cognitive Assessment, non-smokers tended to get higher scores and the scores of the two groups both dropped below the normal level (25.41±2.67 Vs 24.68±2.93). Also non-smokers seemed to perform better in Verbal Fluency Task (24.53±4.82 Vs 21.61±6.08). Correlation analysis showed that smoking index, defined as the number of cigarette-years, had a negative relationship with the scores of VFT (r=-0.55,P<0.05).
Conclusion: These initial findings suggested that smoking might increase the risk of executive dysfunction and semantic memory impairment in OSAHS patients.
Support (If Any): The study was supported by Pfizer China Tobacco Control Competitive Grant (WS766932).

0553

SLEEPINESS, SLEEP QUALITY AND MENTAL HEALTH IN REM-PREDOMINANT OSA

Jan Y[1,2], Kang J[2,3], Chen C[2], Yang C[1,4], Lee H[2,5]
[1]Psychology, National Cheng-Chi University, Taipei, Taiwan, [2]Sleep Center, Taipei Medical University Hospital, Taipei, Taiwan, [3]Department of Physical Medicine and Rehabilitation, Taipei Medical University Hospital, Taipei, Taiwan, [4]The Research Center for Mind Brain and Learning, National Cheng-Chi University, Taipei, Taiwan, [5]Department of Psychiatry, Taipei Medical University-Shuang Ho Hospital, Taipei, Taiwan

Introduction: Obstructive sleep apnea (OSA) has been associated with excessive daytime sleepiness, sleep quality, and emotional disturbances. Apnea tends to be more severe in REM sleep and may result in more fragmentation or deprivation of REM sleep. Clinical practice tends to treat REM-related apnea and NREM apnea equally and may overlook possible impact of severe apnea during REM sleep in patients with low overall AHI. This study therefore compared subjective daytime sleepiness, sleep quality, and emotional disturbances in mild OSA patients with and without REM-predominant OSA in order to investigate whether REM-predominant OSA may lead to more negative consequences.
Methods: Data collected from 5100 patients referred for sleep evaluation at Sleep Center of general hospital between 2005 and 2011 were considered for this analysis, including one night of clinical PSG and self-rating scales for daytime sleepiness (Epworth Sleepiness Scale; ESS),

sleep quality (Pittsburgh Sleep Quality Index; PSQI), and mental-health (Chinese Health Questionnaire; CHQ). Data from 488 patients with mild OSA (AHI ≥ 5 and < 15) were included for final analyses. Subjects were categorized into REM-predominant OSA group (AHIREM≧30) and control group (AHIREM< 15). Independent samples t-tests were conducted to compare the differences in daytime sleepiness, sleep quality, and mental health between the two groups.

Results: Among the patients with mild OSA 132 patients (32.9%) were found to have REM-predominant apnea. There were no significant differences in age, gender distribution, overall AHI, and AHINREM between two groups; body mass index was significant higher in REM-predominant OSA group than control group (27.4 vs 25.6). REM-predominant OSA group also showed higher level of daytime sleepiness than control group (ESS: 9.04 vs 7.74; t=-2.328, p=.020). Nevertheless, the CHQ (t=-.137, p=.891) and PSQI (t=-1.565, p=.119) showed no significant difference between two groups.

Conclusion: Mild OSA patients with predominantly REM-related events may go through severe breathing disturbances during REM sleep. Although REM sleep accounts for less than 1/4 of total sleep time, our results show that REM-predominant OSA leads to higher daytime sleepiness, suggesting that they may require more clinical attention. Also, the higher BMI in this group indicates possible etiological mechanisms that require investigation in future studies.

0554

HEART RATE CHANGES ASSOCIATED WITH MICROAROUSAL IN PATIENTS WITH DIFFERENT SEVERITY OF OBSTRUCTIVE SLEEP APNEA

Zhu S, Li X, Lei F, Du L, Zhang L, Tang X
West China Hospital of Sichuan University, Chengdu, China

Introduction: The events of sleep apnea often trigger the microarousal (MA) and the changes of the heart rate in patients with obstructive sleep apnea (OSA). This may lead to increased autonomic activity and is possibly as the early changes in the development of cardiac diseases in OSA. The aim of the present study was to assess whether there are differences in the heart rate changes associated with MA in patients with different severity of OSA.

Methods: Six male patients (they all were 46 years old) were included in each group of mild (AHI 5-15), moderate (AHI 15-30) and severe (AHI > 30) OSA. Heart rate changes were calculated for 10 R-R intervals of heart beats prior to and 20 after the onset of MA. We randomly selected 10 artifact-free MA at the termination of apnea (apnea related MA), and 10 spontaneous MA, during sleep state 2 in each subject. Repeated measures analysis of variance were used in data analysis ($p<0.05$).

Results: The increased patterns were obtained in approximately 14 intervals of heart beats after the onset of MA compared to those prior to MA in three groups. The increased amplitude of heart rate changes associated with apnea related MA was greater than that associated with spontaneous MA in three groups. The significant rankings of increased amplitude of heart rate changes associated MA were severe > mild and moderate > mild in both spontaneous and apnea related MA, and no differences were obtained between severe and moderate groups.

Conclusion: The finding demonstrated that the amplitude of increase in apnea related heart changes were greater compared to that in spontaneous and there was a linear relationship between the increase of heart rate changes associated with MA and severity of OSA in terms of AHI level.

Support (If Any): Chinese National Science Foundation 30870891.

0555

EXPIRATORY APNEAS WITH AND WITHOUT CATATHRENIA PRESENTING AS CENTRAL APNEAS

Sehgal Kapur S, Park SY
Albert Einstein Medical Center, New York, NY, USA

Introduction: Expiratory apneas during wakefulness are largely considered voluntary breath holding. We present 4 cases with expiratory apneas during sleep with central apnea component. Catathrenia is considered a REM parasomnia. There is no conclusive evidence published that catathrenia results from sleep apnea. Adults presenting with prolonged expiratory apneas with or without catathrenia might have implications for control of breathing.

Methods: Case series and review of literature.

Results: We observed 4 patients with expiratory apneas during wakefulness and sleep including one with a diagnosis of catathrenia. Expiratory apneas were noted to mostly occur between 3-5 AM, lasting 5 to 15 seconds during mid-exhalation, then a sudden exhalation followed by few deep breaths or an arousal. There were no significant oxygen desaturations. Two of our patients had both obstructive and central events. One of the patients underwent modified uvulopalatopharyngoplasty, radiofrequency partial glossectomy, septoplasty and turbinoplasty and reported improvement but continued to have central apneas on a postoperative polysomnogram. Another patient also had a history of catathrenia. He had central apneas associated with expiratory pauses with and without catathrenia on polysomnogram. One of the patients had obstructive events with expiratory apneas. The last patient had these symptoms during her third trimester of pregnancy. This raises the question if prolonged expiratory apneas were a result of a central breathing disorder versus obstructive sleep apnea.

Conclusion: Apneas are generally considered an inspiratory phenomenon. A combination of inspiratory and expiratory muscles and their sensory feedback is known to play an important role in rate of breathing. Although some degree of irregular breathing is normal, prolonged expiratory apneas are possibly due to failure of central control of breathing. Further studies need to be done to evaluate the association between expiratory apneas and central control of breathing. Also, further studies need to investigate catathrenia being a disorder of central breathing.

0556

OSA AND RISK FACTORS IN ACHONDROPLASIA

Collop NA[1], Alade Y[2,3], Henry B[3], Koerner C[3], Schultze K[2,4], McGready J[2,4], Germain-Lee E[2,3,5], Silber H[3], Hoover-Fong J[2,3]
[1]Emory Sleep Center, Emory University, Atlanta, GA, USA, [2]Greenberg Center for Skeletal Dysplasias, Johns Hopkins University, Baltimore, MD, USA, [3]Johns Hopkins University, Baltimore, MD, USA, [4]Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA, [5]Kennedy Kreiger Institute, Johns Hopkins University, Baltimore, MD, USA

Introduction: Achondroplasia is the most common short stature skeletal dysplasia. Obstructive sleep apnea (OSA) is common due to small airways, large tonsils/adenoids, and hypotonia though rarely studied in skeletal dysplasia adults. General population obesity trends are mirrored in achondroplasia, collectively worsening OSA and cardiovascular disease risk.

Methods: Recruited achondroplasia adults were generally healthy though pre-existing medical conditions were allowed (e.g. OSA, hypertension). Study activities included in-hospital polysomnography (PSG), portable (ARES©) sleep study, anthropometry, questionnaires, laboratory studies, and echocardiography.

Results: 20 adults (9 F, 11M) enrolled (mean 36.6 ± 8.7 yrs). 2 subjects presented with OSA. By PSG, 6 additional subjects (1 F, 5 M) had OSA; 4 of the most severe were detected by ARES. Bland-Altman comparison of PSG AHI to ARES AHI (n=15) was -0.04 (95%CI -10.8, 10.9). Of the 8 OSA subjects, 4 had positive Berlin screening score and 3

had abnormal Epworth Sleepiness Scale score (>10). Echocardiography was normal in all. At study outset, 1/20 reported hypertension and hypercholesterolemia, none were diabetic. After study completion, 6 were hypertensive (4 with OSA), 12 pre-hypertensive (4 with OSA) and 8 hypercholesterolemic (6 with OSA); none diabetic. By BMI category, all 8 with OSA were obese (>30); by body fat, 7 subjects were.
Conclusion: Though the prevalence of co-morbidities in achondroplasia populations cannot be concluded from this pilot, this study suggests many unrecognized medical conditions may exist. The portable ARES equipment detected the most severe OSA by PSG. Future research is needed to diagnose and study OSA and other cardiopulmonary risk factors.

0557

OXYGEN SATURATION AND PRESENCE OF CONGESTIVE HEART FAILURE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Kumar S[1], Cruz E[2], Subramanian M[3]
[1]Pulmonary and Critical care, Loyola University medical Center, Maywod, IL, USA, [2]Internal Medicine, Loyola University Medical Center, Maywood, IL, USA, [3]Psychiatry, Institute of Mental Health, Singapore, Singapore

Introduction: Obstructive sleep apnea (OSA) is a highly prevalent condition that is associated with significant cardiovascular morbidity including congestive heart failure (CHF). Studies on atrial fibrillation and OSA indicated that the risk of recurrence of atrial fibrillation in patients with OSA following successful cardioversion suggest that both the duration and extent of oxygen desaturation may play a role in causing cardiovascular comorbidity. The aim of our study was to determine which correlated better with presence and severity of CHF: the apnea-hypopnea index (AHI) or the degree of desaturation.
Methods: Retrospective chart review of patients who underwent both a sleep study and echocardiography since 2008. We abstracted demographic, sleep study and ECHO data and used chi-square to compare proportions and Anova and independent sample t-tests to compare sample means.
Results: Results were available for 779 patients aged 58.8± 13.5 years, BMI 38.1 ±9.2 kg/m2. 116 patients (14.9%) had CHF (ejection fraction of less than 40%). OSA was present in 102 (79.1%) patients with CHF. There was a significant correlation between apnea-hypopneas index (AHI) and presence of CHF (chi square = 9.1, p = 0.01. There was no correlation between the severity of oxygen desaturation either in terms of nadir of oxygen saturation (p = 0.70) or duration of sleep time with oxygen saturation less than 90% (p = 0.65), with CHF. Patients with severe OSA had a significantly lower ejection fraction as compared to patients with mild OSA ($p < 0.008$).
Conclusion: Our study suggests a high prevalence of OSA in patients with CHF, emphasising the importance of screening patients with CHF for OSA. It showed a correlation between presence of CHF and severity of OSA as determined by AHI and not by duration or degree of oxygen desaturation. This implies that the decision to treat patients with CHF and OSA should take into account severity of OSA as determined by AHI only.

0558

PREVALENCE OF SLEEP-DISORDERED BREATHING IN ADULTS WITH DOWN'S SYNDROME IN SCOTLAND

Hill EA[1], Fairley D[1], Van Putten S[2], Cooper S[3], Forbes JF[4], Williams L[4], Riha RL[1]
[1]Department of Sleep Medicine, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom, [2]Down's Syndrome Scotland, Edinburgh, United Kingdom, [3]Department of Mental Health & Wellbeing, University of Glasgow, Glasgow, United Kingdom, [4]Division of Community Health Sciences, University of Edinburgh, Edinburgh, United Kingdom

Introduction: Adults with Down's syndrome (DS) are predisposed to sleep disordered breathing (SDB), which can manifest as behavioural and emotional disturbances. We measured the prevalence of SDB, sleepiness, and behavioural and emotional disturbances in adults with DS in Scotland.
Methods: A sleep questionnaire, including the pictorial Epworth Sleepiness Scale (pESS) and subscales of the Developmental Behaviour Checklist for Adults (DBC-A), was sent to 637 adults (age ≥16yrs) with DS and their families/carers. Standard statistical analysis was undertaken using SPSS 17 (Chicago, IL). All tests were two-tailed, with $p<0.05$ significance. Level 2 limited cardio-respiratory sleep studies (Embletta® Gold, Embla Systems LLC) were offered to all questionnaire responders.
Results: Of 268 responses (42.1%), 243 were valid for analysis. 15 respondents were already diagnosed with sleep apnoea, with 10 receiving treatment. Mean age was 31±11 years (no significant gender difference). BMI was 29.7±7.4 kg/m2, with females significantly heavier (p=0.004). Mean pESS score was 7±5, with males significantly sleepier (p=0.017). 180 participants reported snoring, with 89 snoring often or frequently. 65 reported breathing pauses, with 34 often or frequently. To date, 10 patients (5 males; 5 females) have undergone sleep studies. Mean age was 24±6 years. Mean BMI was 31.6±7.5 kg/m2, with females being heavier (p=0.031). Median AH (number of apnoeas+hypopnoeas per hour in bed) was 25.5 (IQR 11.8-42.9). Median ODI (number of oxygen desaturations ≥4% per hour in bed) was 12.3 (IQR 5.0-31.4). Mean minimum oxygen saturation was 76.6±10.4%. Two-thirds of patients had an AH≥15. Snorers scored higher on pESS ($\rho=0.866$; p=0.001) and the disruptive subscale of DBC-A ($\rho=0.803$, p=0.005). Total AH correlated significantly with ODI ($\rho=0.917$, p=0.001).
Conclusion: This is the first population survey of SDB in adults with DS. Females were less sleepy than males, despite being heavier. Snoring was associated with sleepiness and disruptive behaviour. This study is ongoing.
Support (If Any): This study was funded by the Chief Scientist Office, Scotland and Fondation Jérôme Lejeune, France.

0559

SLEEP APNEA AND VISCERAL ADIPOSITY IN NON-OBESE MEN AND WOMEN: A SEXUALLY DIMORPHIC EFFECT

Kritikou I[1], Basta M[1], Tappouni R[3], Pejovic S[1], Nazir R[1], Shaffer M[2], Liao D[2], Bixler EO[1], Chrousos G[4], Vgontzas AN[1]
[1]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA, [3]Radiology, Gastrointestinal and Abdominal Imaging, Penn State College of Medicine, Hershey, PA, USA, [4]First Department of Pediatrics, National Capodistrian University of Athens, Athens, Greece

Introduction: In obese men excessive visceral adiposity has been associated with obstructive sleep apnea (OSA), while studies in non-obese men and women are limited. Thus, in the current study our aim was to examine the association between OSA and visceral fat in a predominantly non-obese population and to assess the effects of CPAP treatment on body fat composition in such subjects.

Methods: Eighty-one subjects, twenty-two middle-aged apneic men and 19 controls and 20 postmenopausal women with OSA and 20 controls. 2-month periods of CPAP and sham-CPAP treatment in a counterbalanced order.Sleep was recorded by polysomnography for four consecutive nights. Abdominal fat deposits (visceral-VAT, subcutaneous-SAT) measured with computed tomography were assessed at baseline. Data were analyzed by gender.
Results: Apneic men had significantly higher VAT than controls and a VAT/SAT ratio>1. In contrast, apneic women had significantly higher SAT than controls. In men, apnea severity was associated with VAT whereas in women it was associated with total fat. CPAP treatment improved significantly sleep and respiratory indices but did not change body fat composition.
Conclusion: In non-obese men, visceral obesity seems to be the risk factor for sleep apnea whereas in women general adiposity appears to be the most important predictor suggesting different pathogenetic mechanisms for the two genders. It appears that in apneic men the goal should be to reduce visceral adiposity and its metabolic correlates, whereas in women weight loss may be sufficient. Short-term CPAP treatment does not seem to affect obesity or abdominal fat distribution.

0560

COMPARISON OF POLYSOMNOGRAPHIC AND CLINICAL PRESENTATIONS AND PREDICTORS FOR CARDIOVASCULAR-RELATED DISEASES BETWEEN NON-OBESE AND OBESE OBSTRUCTIVE SLEEP APNEA PATIENTS AMONG ASIANS

Chirakalwasan N[1,2], Teerapraipruk B[3,1,5], Simon R[4], Hirunwiwatkul P[1,5], Jaimchariyatam N[1,2], Desudchit T[1,6], Charakorn N[5], Wanlapkorn C[7]
[1]Excellence Center for Sleep Disorders, King Chulalongkorn Memorial Hospital/Thai Red Cross Society, Bangkok, Thailand, [2]Department of Medicine, Division of Pulmonary and Critical Care Medicine, Chulalongkorn University, Bangkok, Thailand, [3]Department of Otolaryngology and Opthalmology, Naresuan University, Phitsanulok, Thailand, [4]Department of Otorhinolaryngology, Hospital Raja Permaisuri Bainun, Ipoh, Perak, Malaysia, [5]Department of Otolaryngology, Chulalongkorn University, Bangkok, Thailand, [6]Department of Pediatrics,Division of Pediatric Neurology, Chulalongkorn University, Bangkok, Thailand, [7]Department of Medicine, Chulalongkorn University, Bangkok, Thailand

Introduction: Contrarily to Caucasians, many Asians with obstructive sleep apnea (OSA) are non-obese due to predisposing craniofacial structure. Non-obese and obese OSA may represent different entity as well as different risk factors for developing cardiovascular-related diseases.
Methods: We reviewed polysomnographic studies which were performed in adult age>=18 who were diagnosed with OSA (respiratory disturbance index (RDI) ≥ 5). We divided the patients into obese (body mass index (BMI) ≥25) and non-obese (BMI<25). We aim to determine the differences between these two groups in terms of clinical presentations, polysomnographic findings, and predictors for developing cardiovascular- related diseases including hypertension, diabetes mellitus, coronary artery disease and/or cerebrovascular disease.
Results: Among 194 patients with OSA (RDI ≥ 5), 63.4% were non-obese and 36.6% were obese. When compared with obese OSA, non-obese OSA patients were noted to have smaller neck size, less incidence of hypertension and less history of frequent nocturia (>3-4/week) with equal incidence of excessive daytime sleepiness. Overall, non-obese OSA patients were noted to have milder disease indicated by lower total, supine, non-supine, NREM RDIs and higher mean and nadir oxygen saturations. In the non-obese group, only total obstructive apnea index (OAI) was noted to be a predictor for developing any of the cardiovascular-related diseases after controlling for age, sex and RDI (odd ratio=9.7). Contrarily to obese OSA group in which frequent snoring (>50% of total sleep time), low sleep efficiency (≤90%), and low mean oxygen saturation (<95%) were noted to be significant predictors (odd ratio=12.3, 4.2, and 5.2; respectively).
Conclusion: Among Asians, most OSA patients were not obese. Comparing to obese OSA patients, non-obese OSA patients were noted to have less incidence of hypertension and less history of nocturia. They were also noted to have overall milder OSA. Only OAI was noted to be a significant predictor for cardiovascular-related disease in the non-obese OSA group.

0561

PERIOPERATIVE COMPLICATIONS IN OSA PATIENTS UNDERGOING SURGERY: A REVIEW OF THE LEGAL LITERATURE

Fouladpour N[1], Jesudoss R[1], Bolden N[2], Auckley D[3]
[1]Medicine, MetroHealth Medical Center, Case Western Reserve University, Cleveland, OH, USA, [2]Anesthesiology, MetroHealth Medical Center, Case Western Reserve University, Cleveland, OH, USA, [3]Division of Pulmonary, Critical Care and Sleep Medicine, MetroHealth Medical Center, Case Western Reserve University, Cleveland, OH, USA

Introduction: OSA is an independent risk factor for perioperative complications. This study reviewed the legal literature to describe the potential ramifications of perioperative complications in patients with OSA.
Methods: A retrospective review of the legal literature was performed. The legal databases Westlaw Next, Westlaw, Lexis and Lexis Academic were searched using the following search terms; "obstructive sleep apnea and medical malpractice," "post operative medical complications and sleep apnea," and "obstructive sleep apnea and medical negligence." Inclusion criteria: adults (> 18 y/o), known or suspected OSA, had a surgical procedure with an adverse perioperative outcome, and this resulted in a lawsuit adjudicated in a court of law. OSA had to be directly implicated in the outcome. Strictly surgical mishaps and cases settled prior to going to court were excluded.
Results: Twenty four cases from 1991-2010 met our criteria. Demographics: age 41.7 years (+/- 9.8 years), 62% male, known diagnosis of OSA in 96%. 58% of cases were general procedures and 42% were ENT procedures. Complication location: intraoperatively (12%), PACU (33%), ward (54%). Adverse outcomes: death (71%), anoxic brain injury (ABI) (21%), upper airway complications (8%). Six of 17 (35%) who died suffered ABI prior to death. Narcotics were implicated in 38% and anesthetics in 58% of cases. Verdicts: 58% in favor of the plaintiff. Average financial penalty was $2.5 million (+/- $2.3 million). Plaintiff verdicts correlated with cases from Medicare Region 2 (Midwest), non-ENT surgery, implication of narcotics, and death as the reason for the lawsuit.
Conclusion: The majority of malpractice suits that reach court involving perioperative complications in OSA patients result from early postoperative complications. The adverse complications are frequently catastrophic and can carry serious financial penalties. These cases probably significantly underestimate the actual medical-legal burden resulting from perioperative complications in OSA patients as many of malpractice suits are settled outside of trial court.

0562

SNORING IS NOT ASSOCIATED WITH ALL-CAUSE MORTALITY, INCIDENT CARDIOVASCULAR DISEASE OR STROKE IN THE BUSSELTON HEALTH STUDY

Marshall NS[1], Wong KK[1,4], Cullen SR[2], Knuiman MW[3], Grunstein RR[1,4]
[1]University of Sydney, Sydney, NSW, Australia, [2]Western Australian Sleep Disorders Research Institute, Perth, WA, Australia, [3]School of Population Health, University of Western Australia, Perth, WA, Australia, [4]Sleep and Respiratory Failure, Royal Prince Alfred Hospital, Sydney, NSW, Australia

Introduction: Sleep apnea is an independent risk factor for premature mortality and cardiovascular disease, including stroke. More recently, snoring induced vibration injury to the carotid vascular bed has been implicated as a mechanism by which snoring may increase cardiovascular disease (CVD), stroke in particular, independently of the effects of obstructive sleep apnea.
Methods: In a community-based cohort of 400 residents of the Western Australian town of Busselton Snoring and OSA were quantified via the percentage of the night spent snoring and the respiratory disturbance index (RDI) as measured by a single night recording in November-December 1990 by the MESAM IV device, along with a range of cardiovascular disease risk factors. Follow-up for deaths and cardiovascular hospitalisations was ascertained via record linkage to the end of 2007.
Results: Snoring was observed for a mean/median of 32.0/27.4% of the night (SD=23.9% range 0-97.2%). There were 46 deaths, 68 cardiovascular events and 24 strokes during follow-up of the 380 participants without a history of stroke or heart attack at baseline. Snoring as either a categorical or continuous variable was not significantly associated with death, incident CVD or stroke in both unadjusted Cox regression models and in models that adjusted for obstructive sleep apnea and other risk factors.
Conclusion: No measure of snoring was associated with all-cause mortality, or incident cardiovascular disease or stroke over 17 years in this community-based sample.
Support (If Any): National Health and Medical Research Council of Australia (NHMRC).

0563

THE ASSOCIATION OF SLEEP-DISORDERED BREATHING WITH RISK OF FALLS IN WISCONSIN SLEEP COHORT STUDY PARTICIPANTS

Teodorescu M[1], Barnet JH[2], Young T[2], Hla KM[1], Barczi SR[1], Peppard PE[2]
[1]Medicine, University of Wisconsin School of Medicine and Public Health, Madison, WI, USA, [2]Population Health Sciences, University of Wisconsin School of Medicine and Public Health, Madison, WI, USA

Introduction: Sleep-disordered breathing (SDB) is associated with decrements in cognitive function. Recent data demonstrates that impairments in cognition impact the risk of falls. We sought to determine if the presence of SDB affects the risk of falling as assessed by gait tasks in Wisconsin Sleep Cohort Study participants.
Methods: 280 adult subjects, selected from an employed-population sample in 1988, were polysomnographically-assessed for SDB and also had gait evaluations. Gait was assessed with Timed Up and Go (TUG) and with dual-tasks Timed Up and Go, which included Counting Backwards by 3's (TUG-CB). To test whether SDB was associated with prolonged times of gait tasks indicating an increased risk of falling, linear models regressed gait tasks times on SDB categories (apnea-hypopnea index [AHI]<5 events/hr; 5≤AHI<15; 15≤AHI<30; AHI≥30) with adjustments for age, gender, body mass index (BMI).
Results: 280 subjects had an opportunity to complete the Balance and Gait Tasks; eleven subjects used an assistive device to complete the tasks and were excluded from the analysis. The 269 remaining subjects included 133 females (49%) and were 64.0 ± 7.4 (45-81.5) years old at the time of balance and gait testing. Both baseline TUG (mean 11.3 ± 2.5 s) and TUG-CB (mean 13.2 ± 6.7s) demonstrated gradual prolongations of times to completion with age, BMI and AHI. After adjusting for the number of correct subtractions and errors committed, age, gender and BMI, there was a statistically significant relationship between the AHI>30 (vs. AHI<5) and TUG-CB time to completion (p= 0.02). In addition, the difference in seconds between the time to complete TUG-CB and baseline TUG (mean 5.1 ± 16.6s) was significantly associated with the AHI>30 category after multivariable adjustments (p=0.017).
Conclusion: More severe SDB is associated with decrements in gait tasks performance, particularly the dual-task Timed Up and Go Counting Backwards. SDB-related lower cognitive reserve may lead to worse gait performance and, implicitly, a higher risk for falls.
Support (If Any): Funding support from NIH grants R01HL62252, 1R01AG036838-01A1, and 1UL1RR025011.

0564

SLEEP DISORDERED BREATHING IN CHIARI MALFORMATION

Losurdo A, Dittoni S, Testani E, Gnoni V, Colicchio S, Vollono C, Mariotti P, Di Rocco C, Massimi L, Della Marca G
Neurosciences, Catholic University, Rome, Italy

Introduction: Chiari Malformation (CM) is defined as a downward herniation of the caudal part of the cerebellum and/or medulla oblongata into the spinal canal. CM is classified into distinct types according to the degree of herniation. CM type II is associated with severe malformations, particularly with Myelomeningocele. An association has been reported between CM and sleep disordered breathing, either central or obstructive. The aim of the study was to evaluate the prevalence of sleep disordered breathing (SDB, both of central and obstructive origin) in CM.
Methods: Thirty-five consecutive patients (18 girls and 17 boys, mean age 9.4 ±4.3, range 4-20 years) affected by CM underwent a full neurological examination, neuroimaging (brain MRI), somatosensory evoked potentials, EEG and polysomnography (PSG).
Results: The mean length of the herniation was 10.3±10.5 mm. Two patients had CM type II. Eight patients had synringomiely and three had hydrocephalus. Oxygen Desaturation Index (ODI) was > 5 in 7 patients; Central Apnea-Hypopnea Index (CAHI) was > 2 in 11 patients; Obstructive Apnea-Hypopnea Index (OAHI) was > 2 in 3 patients (two of whom had CM type II). Statistical comparison performed with a non-parametric test (Mann-Whitney U-test) showed a significantly higher ODI in patients with syrinx or hydrocephalus ($p<0.05$). No significant correlation were observed between size of the herniation and PSG respiratory parameters.
Conclusion: Our data do not confirm the high prevalence of SDB in CM reported in literature. The present findings suggest that abnormalities in cerebro-spinal fluid dynamics (syrinx and hydrocephalus) may play a major role in the pathogenesis of SDB in CM. It is likely that hydrocephalus can worsen the neuronal dysfunction in subtentorial structures, caused by the deep herniation of cerebellar tonsils. Alternatively, raised intracranial pressure and ventricle dilation may impair some brain hemispheric functions essential for the maintenance of upper airways patency during sleep.

0565

DIFFERENCES IN CIRCULATION TIME IN PATIENTS WITH CHEYNE-STOKES RESPIRATION: SYSTOLIC VERSUS DIASTOLIC HEART FAILURE

Gupta A, Tallavajhula S, Allen E, Majid R
Pulmonary, Critical Care and Sleep Medicine, University of Texas, Houston., Houston, TX, USA

Introduction: Congestive Heart failure (CHF) afflicts greater than 5 million individuals in the United States. Systolic and diastolic heart

failure can be associated with a subtype of central sleep apnea (CSA) called Cheyne-Stokes respiration (CSR-CSA). This is characterized by recurrent episodes of central apneas or hypopneas, alternating with hyperpneas, during which there is a crescendo-decrescendo pattern of tidal volume. CSA-CSB is also associated with an increase in circulation time (normally <20 seconds). Hypothesizing that patients with systolic heart failure may have longer circulation times when compared to patients with diastolic dysfunction, we looked at the circulation times in both these patient populations. This may be implemented to predicting subtype of cardiac dysfunction based on polysomnographic findings.

Methods: We performed a retrospective chart review of patients evaluated with a nocturnal polysomnogram (NPSG) that were found to have a diagnosis of Cheyne-Stokes breathing. We then looked at the 'circulation time' calculated as the time (in seconds) between the termination of an apnea or hypopnea and the following oxygen desaturation nadir. We reviewed 2D-echocardiograms performed within 4 months of the NPSG to distinguish patients with systolic from those with diastolic dysfunction. We used a two-tailed student's t test to compare the circulation times.

Results: We reviewed a total of 19 cases, 9 with diastolic and 10 with systolic heart failure. The mean age (66 years SD ±13) and body mass index (32.7 kg/m2 SD ± 6.9) in each group were comparable. There was however a clear predominance of males in each group (M:F ratio 9:1). Subjects with systolic heart failure (ejection fraction ranging 20-35%) had a mean circulation time of 41.8 seconds (SD ±15) versus 26.6 seconds (SD ± 7) in patients with diastolic dysfunction (ejection fraction ranging 55-65%). When comparing the circulation times we found a significant statistical difference (p=0.04).

Conclusion: Cheyne-Stokes respiration is often found as an incidental finding on a polysomnographic study. The presence of CSR-CSA has adverse prognostic implications. Hence, identifying and characterizing the heart failure early is of upmost importance. We found that there appears to be a significant difference in circulation time in patients with systolic and diastolic heart failure. We therefore argue that not only can we detect the presence of cardiac dysfunction but also characterize the subtype (systolic versus diastolic).

0566

OBSTRUCTIVE SLEEP APNEA SEVERITY AND THE HYPOTHALAMIC-PITUITARY-ADRENAL AXIS IN MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA

Peterson EG, Mehra R, Arafah B, Male M, Thomas C
Case University Hospitals of Cleveland, South Euclid, OH, USA

Introduction: The hypothalamic-pituitary-adrenal (HPA) axis controls inflammation which may link obstructive sleep apnea (OSA) to heart disease. We hypothesize that evening cortisol will increase with increasing OSA severity due to repeated stimulation of the HPA axis.

Methods: Individuals with moderate to severe OSA participating in the baseline examination of the Sleep Apnea Stress Study, a randomized controlled trial to examine OSA treatment effects on intermediate cardiovascular measures, were included. Participants underwent full polysomnography (PSG) and in tandem collection of two consecutive (home and research visit) evening salivary cortisol specimens using standardized procedures. Linear regression models were fit using apnea-hypopnea index (AHI) (primary) and secondary OSA severity indices (oxygen desaturation index (4%), % time less than 90% oxygen saturation and arousal index) and evening salivary cortisol (average of 2 values) (micrograms/dL).

Results: 137 of 150 individuals with age (51±11 years), 55% male, race (52% Caucasian), body mass index (36.7 ± 7.6 kg/m2), evening salivary cortisol (0.11±0.10 micrograms/dL), AHI (25.6±19.5) with complete data comprised the analytic sample. 32% of the subjects had cortisol levels over the upper limit of normal. Linear regression models showed no statistically significant relationship between the AHI and secondary measures of OSA severity (hypoxia and arousals) with salivary cortisol.

Conclusion: OSA severity was not associated with evening salivary cortisol levels in individuals with untreated moderate to severe OSA. These findings may reflect a blunted cortisol response and desensitization of the HPA axis due to repeated OSA pathophysiologic insults resulting in potential increased cardiovascular risk via potential mechanisms of plaque destabilization, insulin resistance and unchecked systemic inflammation. Given the moderate to severe OSA level considered, it is possible that a threshold effect was realized such that further stress beyond this level did not result in further increases in HPA activation.

Support (If Any): NIH/NHLBI HL079114 K23 Mentored Patient-Oriented Clinical Research Career Development Award, Clinical Translational Science Collaborative Small Pilot Grant, Central Society of Clinical Research Career Development Award.

0567

OBSTRUCTIVE SLEEP APNEA AND OBESITY HYPOVENTILATION SYNDROME: ANAEMIC OR POLYCYTHAEMIC PATIENTS?

Ziherl K, Sarc I, Flezar M, Kosnik M, Gabrijelcic J
University Clinic of Respiratory and Allergic Diseases Golnik, Golnik, Slovenia

Introduction: Intermittent hypoxia is a cardinal feature in patients with sleep disordered breathing (SDB) and is commonly thought to lead to polycythaemia. Recent studies suggest that it may lead to anaemia, since intermittent hypoxia drives chronic inflammation. Data on prevalence of anaemia and polycythaemia in patients with SDB are scarce.

Methods: Medical records of all patients who underwent diagnostic polysomnography in University Clinic Golnik between 2005 and 2010 were retrospectively reviewed for diagnosis of SDB, comorbidities and laboratory data. Patients were divided into 5 groups: controls (apnea-hypopnea index - AHI <5), obstructive sleep apnea (OSA)(3 groups according to severity), and obesity hypoventilation syndrome (OHS).

Results: Final sample of 1020 patients (age 52±11y, men 79%) consisted of 167 (16%) controls, 152 (15%) mild OSA, 169 (17%) moderate OSA, 422(41%) severe OSA and 110(11%) OHS patients. Anaemia was present in 61 (6.5%) patients with SDB. Prevalence in controls, OSA subgroups and OHS was 4.8%, 6.9%, 5.7%, 7.4%, 6.5%, respectively ($p>0.05$). Polycythaemia was present in 9 (1%) patients with SDB; 2 (1.5%) patients with mild OSA and 7 (6.5%) patients with OHS ($p<0.0001$). Haemoglobin correlated with AHI (R2 0.152, $p<0.0001$) and minimal oxygen saturation (R2 -0.111, $p=0.001$). In multivariate logistic regression model adjusted for age, sex, heart failure, body mass index (BMI), hypercapnia and AHI, age (OR 1.07 CI 1.04-1.1), BMI (OR 1.05 CI 1.01-1.09), and heart failure (OR 2.28 CI 1.06-4.9) significantly predicted anaemia. In the same model age (OR 0.93 CI 0.87-0.99), male sex (OR 0.18 CI 0.4-0.86), heart failure (OR 8.71 CI 1.54-46.15), hypercapnia (OR 25.0 CI 2.9-214.6) significantly predicted polycythaemia.

Conclusion: Although intermittent hypoxia increased haemoglobin levels, anaemia was more common in SBD than polycythaemia, but the prevalence was not higher than in control group. Polycythaemia was more prevalent in OHS than in OSA and control group.

0568

OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITH INSOMNIA

Huang L[1,2], Zhou J[1], Lei F[1], Zhu S[1], Liu H[1], Tang X[1]
[1]West China Hospital of Sichuan University, Chengdu, China,
[2]Heilongjiang University of Chinese Medicine, Harbin, China

Introduction: Obstructive sleep apnea (OSA) and insomnia can be clinically associated. OSA patients with insomnia may be characterized by higher prevalence in the elderly, greater presences in females than in males, and less severity of hypoxia than OSA patients with no subjective insomnia.

Methods: The subjects included a total of 1161 patients (male 43%, age 44±12, BMI 22.5±3.1) with a chief complaint of insomnia. The overnight polysomnographic examination and medical history were collected.
Results: Among total reviewed patients with insomnia, 26% patients had AHI>5, 16% had AHI>15, and 7% had AHI>30. Prevalent rates of OSA were approximately 2-, 4- and 5 folds more in males than in females for AHI>5, 15 and 30, respectively. Compared to insomnia with no OSA (AHI<5), insomnia with OSA group exhibited significant increases in age, BMI, male proportion and ESS scores. Stepwise logistic regression analysis revealed that advancing age (age >59 years old), snoring and overweight (BMI>23) were predictors of OSA occurring in male patients with insomnia. But in female patients, diabetes and nasal inflammation were predictors of the presence of OSA besides advancing age (age>45years old) and snoring.
Conclusion: These findings confirmed that the presences of OSA in insomnia patients are associated with male, snoring, advancing age and increased BMI. OSA in female insomnia patients may have higher rates of comorbidity with the other types of physical illness.
Support (If Any): Chinese National Science Foundation 30870891 and 30801528.

0569

SLEEP STATE MISPERCEPTION IN OBSTRUCTIVE SLEEP APNEA

Khan A, Barber AS, Reda F, O'Brien LM, Kaplish N
University of Michigan Sleep Disorders Center, University of Michigan, Ann Arbor, MI, USA

Introduction: Clinical observations and small studies suggest that sleep state misperception (SSM) occurs in patients with obstructive sleep apnea (OSA). However, the frequency of SSM is unknown. The primary goal of this study was to investigate the frequency of SSM in OSA and specifically the proportion of those who under-perceive sleep time.
Methods: A retrospective review was performed on patients attending a sleep laboratory, January 1, 2010 through April 15, 2011. OSA was considered present if the apnea/hypopnea index (AHI) ≥5. The ratio of subjective to objective total sleep time (TST), sleep-onset latency (SOL), and sleep efficiency (SE) was calculated and SSM was defined as any value ±12.5% of the mean value for each parameter. The threshold of 12.5% was based upon an assumption that >1 hour of discrepancy per 8 hours of sleep is clinically significant. Three subgroups were defined for each sleep parameter: under-perception, no misperception and over-perception.
Results: The population included 302 subjects (64% male). Mean age was 50.2 ± 13.2 years and mean BMI was 35.1±9.1 kg/m2. SSM was noted in 89.8%, 52.9% and 49.5% as measured by SOL, TST and SE respectively. For TST, 142 (47%) patients showed no misperception, 75 (24.8%) had under-perception, and 85 (28.2%) exhibited over-perception. For SE, frequencies were similar. Considering SOL, over-perception was found in 68%, and under-perception was found in 22%. Subjects with under-perception of TST, compared to those without, were significantly younger (44.4 ± 12.5 vs. 52.2 ± 12.9 years, p<0.001), had higher sleep efficiency (81.6 ± 78.6, p=0.021), fewer arousals/hr (15.1 ± 9.5 vs. 18.8 ± 13.5, p=0.012) and a shorter latency to sleep (19.3±16.6 vs. 24.4±24.1, p=0.047). In a regression model, age was the only independent variable associated with under-perceiver (OR=0.956, CI=0.935-0.976).
Conclusion: SSM is common in OSA. Younger subjects are more likely to under-perceive TST.

0570

CORRELATES OF RESPIRATORY EVENTS WITH AND WITHOUT ASSOCIATED LEG MOVEMENTS IN OBSTRUCTIVE SLEEP APNEA

Deak MC[1,2,3], Platt S[1], Winkelman J[2,1,3]
[1]Sleep HealthCenters, Brighton, MA, USA, [2]Brigham and Women's Hospital, Boston, MA, USA, [3]Harvard Medical School, Boston, MA, USA

Introduction: Obstructive sleep apnea is associated with several negative health outcomes including increased risk of cardiovascular disease. Apneas and hypopneas terminate with sympathetic activation, hypoxemia, arousal from sleep, and, in some cases, with leg movements. Previous studies have shown that cardiac activation is greater in respiratory events associated with leg movements. Periodic limb movements of sleep are also associated with sleep fragmentation and sympathetic activation.
Methods: We performed a retrospective chart review of 44 patients who underwent split night polysomnography, scored by the same technician. Apneas and hypopneas during the baseline portion of the study were manually reviewed for the presence of leg movements at termination. We examined the relationship between the percent of respiratory events associated with leg movements scored by AASM criteria other than periodicity (kick percentage) and a variety of demographic and polysomnographic variables.
Results: Kick percentage correlated with apnea hypopnea index (r=0.32, p=0.031) and periodic limb movement index (PLMI) (r=0.40, p=0.009), but did not correlate with age, body mass index, Epworth Sleepiness Scale, or PSG-derived sleep efficiency, PLM arousal index, arousal index, or wake after sleep onset. Subjects who reported difficulty maintaining sleep had a significantly higher kick percentage (median 51 versus 22, p=0.006) than those without this complaint. There was no difference in kick percentage based on whether patients complained of trouble falling asleep, pain or fatigue upon awakening in the morning, or sleep symptoms interfering with daytime functioning. There was no difference in kick percentage based on symptoms of restless legs syndrome or history of cardiovascular disease.
Conclusion: Preliminary data from this small exploratory study indicates that respiratory events associated with leg movements occur more commonly in patients with more severe obstructive sleep apnea and higher PLMI. Respiratory events associated with leg movements may be associated with subjective, though not objective, trouble staying asleep.

0571

INCIDENCE OF SLEEP APNEA IN ISCHEMIC HEART DISEASE

Mozafari A, Farzam S
Internal Medicine, Islamic Azad University, Qom, Islamic Republic of Iran

Introduction: Obstructive sleep apnea (OSA), a common form of SDB, is highly prevalent in adults with approximately 20% adults having at least mild OSA (1). One of The most associated consequences is cardiovascular sequel (2). In the 2 largest case series of patients with HF undergoing PSG, OSA was detected in 37% and 11% of subjects studied, with the prevalence of OSA greater in men (38%) than in women (31%)(3). Treatment of OSA leads to improvements in many of these adverse outcomes and may reduce healthcare costs (4). This study aimed to assess the incidence of sleep apnea in IHD patients and whether pulse oximetry can predict apnea in this group of patients.
Methods: A randomized sample of 60 adult patients referred to Post CCU of Shahid Beheshti Hospital of Qom city in Iran was selected. Patients with respiratory and CNS problem and using of sedative drugs were excluded. All participants including post AMI, CHF and acute coronary syndrome underwent the portable device (a small recording unit to monitor the change in nasal pressure with respiration) and pulse

oximetry. AHI, ODI, ESS and Anthropometric parameters were evaluated. Data were analyzed and compared using SPSS version 15 software.
Results: From April through September 2011, we randomly performed 60 tests with nasal cannula and pulse oximetry. Of these, mean age was 61±11, 61.7% were female, neck circumference 39.3±3.3, and BMI 29± 6kg/m2. Patients with Epworth Sleepiness Scale>10 were in 45%, snoring in 73% and finally mean Apean-Hypopnea Index(AHI) was 21.9±17, AHI over than 15 in 61.7% and AHI>30 in 18.3% . There were no relationship between AHI>15 and ESS>10 (p value 0.471), AHI>15 and ESS>16 (p value 0.106), AHI>15 and BMI (p value 0.602) and AHI and sex (p value o.725). There were significant correlation between AHI more than 15 and (ODI) >10(p value 0.0001, OR: 9.180, CI 2.67-31.50) and AHI>30 and ODI>10 (P value 0.042, OR: 4.89 CI 0.95-25).
Conclusion: in according to this data, incidence of AHI>15 were 61.7% in IHD patients. There were no significant correlations among AHI>15 and sex, BMI and ESS in IHD patients, but significant relationship between AHI>15 and ODI>10. Sensitivity and Specificity of ODI>10 for detection of AHI>15 were only 27.02% and 22.7% respectively.

0572

OBSTRUCTIVE SLEEP APNEA IS ASSOCIATED WITH URINARY ALBUMIN EXCRETION IN JAPANESE PATIENTS

Hokari S[1], Ohshima Y[1], Nakayama H[1], Takada T[1], Suzuki E[2], Narita I[1]
[1]Department of Homeostatic Regulation and Development, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan, [2]Department of General Medicine, Niigata University Medical and Dental Hospital, Niigata, Japan

Introduction: Obstructive sleep apnea (OSA) is identified as a risk factor of cardiovascular disease (CVD). Increased urinary albumin excretion (UAE) is also associated with CVD since it reflects a state of endothelial dysfunction. We investigated the relationship between the severity of OSA and UAE and evaluated the effect of continuous positive airway pressure (CPAP) retrospectively.
Methods: 155 adults (110men, 53.3±15 years) underwent overnight polysomnography (PSG) in our hospital. The patients with history of renal, cardiac, neurological, or collagen vascular disease were excluded. We assessed apnea-hypopnea index (AHI), blood pressure (BP), urinary albumin-creatinine ratio (ACR) and hemoglobin A1c. ACR was measured from a morning spot urine sample. Out of them, 46 patients who received CPAP therapy were reassessed at the follow-up PSG.
Results: Their mean AHI was 31.5±24 per hour, and 112 patients (72%) had AHI with 15 or greater per hour. 58 patients (37%) had increased UAE (ACR≧10mg/g). In a univariable analysis, age, AHI, hypertension, and diabetes mellitus were associated with increased UAE. In a multivariable logistic model among these factors, AHI was the only independent predictor of ACR elevation (Odds ratio=1.025, 95%CI 1.008-1.042). With CPAP therapy, ACR and diastolic BP significantly decreased (13.5±14 mg/g→10.4±8.7 mg/g, 84±13 mmHg→78±13 mmHg, respectively).
Conclusion: OSA is significantly correlated with UAE in Japanese patients. UAE may be a reflection of OSA-related risk of CVD. CPAP therapy has possibility to decrease UAE together with the reduction of diastolic BP.

0573

VALIDATION OF IMPORTANT SIGNS AND SYMPTOMS OF SLEEP DISORDERED BREATHING (SDB) IN PATIENTS WITH TEMPOROMANDIBULAR JOINT DISEASE (TMD)

Prehn RS[1,4], Simmons JH[2,3,4], Gray M[1]
[1]1. Center for Facial Pain and Dental Sleep Medicine, PC, The Woodlands, TX, USA, [2]2. Sadler Clinic Sleep Disorders Center, The Woodlands, TX, United States., The Woodlands, TX, USA, [3]3. Comprehensive Sleep Medicine Associates, Houston, TX, USA, [4]4. Sleep Education Consortium, Houston, TX, USA

Introduction: The purpose of this study is to validate which S&S of SDB in the exam and history of a TMD patient are true indicators of SDB.
Methods: We reviewed all 580 cases referred to Facial Pain Clinic for evaluation during 2009. Patients not presenting with TMD as a chief complaint were excluded. Signs and Symptoms of SDB were assessed and those patients who had two or more were referred for NPSG testing.
Results: There were 429 patients with TMD of which 359 (84%) met criteria for NPSG referral. Of the 359 patients, signs and symptoms of SDB occurred with the following frequency. TOTAL REFERRED 359 TOTAL PSG 67 Frequent arousals 272 76% Frequent arousals 40 60% Bruxism 155 43% Morning headaches 36 54% Morning headaches 154 43% Bruxism 33 50% Takes or desires naps 119 33% Takes or desires naps 32 48% GERD 86 24% GERD 18 27% HBP 73 20% HBP 12 18% Witnessed apnea 44 12% Blood sugar concerns 8 12% Blood sugar concerns 20 6% Witnessed apnea 7 10% Of the 359 that were referred only 67 had NPSG studies completed, however, all of these were with the addition of the Pes (Pressure within the esophagus) to enhance testing sensitivity. All 67 of these studies were positive, confirming the presence of SDB. We independently assessed the frequency of the signs and symptoms of the NPSG group to compare with the entire group of patients. We found these to be present as shown above.
Conclusion: The high occurrence of signs and symptoms of SDB in the TMD population clearly suggests a significant relationship between these conditions. Our population of NPSG confirmed SDB patients had a similar occurrence of symptoms as the entire group suggesting that even though we did not obtain NPSG's on the entire group the frequency of symptoms is still valid. Clearly, it would be difficult to fully treat the entire clinical range of TMD without addressing SDB. It is therefore recommended that if patients present with TMD, one should screen for SDB and treat that as well in order to treat the entire clinical range of this disorder.

0574

THE PREVALENCE OF ERECTILE DYSFUNCTION AND IMPACT OF CPAP THERAPY: A PROSPECTIVE ANALYSIS

Dombrowsky JW, Lettieri CJ, McCarthy JG, Shah A, Holley A
Walter Reed Military Medical Center Bethesda, Bethesda, MD, USA

Introduction: Erectile dysfunction (ED) is common in patients with obstructive sleep apnea (OSA). However, both conditions are more frequent with advanced age and diabetes, which may confound the true relationship between OSA and ED. We sought to determine the prevalence of ED and decreased libido among non-diabetic men under 60 years old with OSA and assess the impact of CPAP on sexual function and desire.
Methods: Prospective analysis of 92 men with newly diagnosed OSA initiating CPAP therapy. Results from the international index of erectile function (IIEF) and functional outcomes of sleep questionnaire (FOSQ), as well as subjective measures of fatigue and sleepiness, were recorded at baseline and after 1, 3 and 6 months of CPAP therapy. Changes in these metrics were correlated with objective measures of CPAP use.
Results: Among the cohort, mean age was 45.8±8.2 years, mean AHI was 38.2±27.6 events/hour and mean BMI was 29±4.5Kg/m^2. At baseline, ED was present in 45.6% and 27.2% had diminished libido. CPAP therapy improved Epworth sleepiness scale (-13.8%, p<0.001) and

fatigue (-15.1% p<0.001). CPAP also improved sexual function and satisfaction in both those with and without ED, with greater improvements from baseline in those with ED. Specifically, improvements in IIEF function (+7.8, p=0.28), IIEF satisfaction (+8.9%, p=0.07), FOSQ (+8.8%, p=0.02), and FOSQ sexual domain (+8.4%, p=0.18) scores were observed. Of those with ED, regular use of CPAP was associated with an 88.3% improvement in FOSQ sexual domain, 71.7% improvement in IIEF function and normalization of IIEF function occurred in 41.2%.

Conclusion: ED and decreased libido are common in OSA. CPAP therapy improves sexual function and satisfaction in the majority of subjects, regardless of baseline erectile function. Those with ED had more robust improvements, which correlated with CPAP adherence. Like other forms of OSA-related end organ dysfunction, ED improves, but may not resolve despite adequate treatment.

0575

REGULATION OF CIRCULATING MICRORNAS IN OBSTRUCTIVE SLEEP APNEA PATIENTS WITH PULMONARY HYPERTENSION

Yuan H[2], Wang H[1], Hu A[1], Nino G[3], Hua S[2], Peng L[2]

[1]Pulmonary, CHOP, Philadelphia, PA, USA, [2]Department of Respiratory Medicine, The First Hospital of Jilin University, Changchun, China, [3]Division of Pediatric Pulmonology and Sleep Research and Treatment Center, Penn State College of Medicine, Hershey, PA, USA

Introduction: MicroRNAs have been implicated in inflammation and various cardiovascular diseases. Blood circulating microRNAs have been proposed as biomarkers for the diagnosis and prognosis of both cardiovascular diseases and cancer. The purpose of this study was to examine whether the circulating microRNAs play a role in the development of Pulmonary Hypertension in patients with Obstructive Sleep Apnea (OSA).

Methods: A total of 96 patients participated in this study, including: 38 patients with OSA, 32 patients with OSA as well as pulmonary hypertension, and 26 controls. All the participants were monitored overnight with laboratory-based polysomnography and high-quality echocardiography, and blood samples were collected. Quantitative reverse transcription-polymerase chain reaction (qRT-PCR) was used to measure the levels of microRNAs in the serum of each subject, including vascular muscle-enriched miR21, miR-145, and miR126; inflammation-associated miR155, miR2, miR223, miR126, and miR125; and hypoxia-related miR22, miR322, let-7, and miR133.

Results: In patients with OSA, compared to the control subjects, miR21, miR126, miR22, and let-7 levels were significantly lower, whereas miR155 and miR2 levels were significantly higher ($P < 0.05$). These changes became even more substantial in OSA patients with pulmonary hypertension. Interestingly, while the inflammation-repressing miR126 was reduced in OSA patient with pulmonary hypertension, the inflammation-stimulating miR125 was increased.

Conclusion: Circulating microRNAs are regulated during the development of pulmonary hypertension in OSA patients, suggesting that microRNAs may be a contributing factor in the pathogenesis of pulmonary hypertension in OSA patients. This result potentially presents a novel tool for the early detection as well as therapeutic intervention of pulmonary hypertension in OSA patients.

0576

SELECTING OSA PATIENTS FOR ORAL APPLIANCE THERAPY BY MANDIBULAR PROTRUSIVE TITRATION: EFFECT OF HYPOPNEA SCORING CRITERIA ON PREDICTIVE ACCURACY

Remmers J[1,2], Charkhandeh S[3,2], Topor Z[1,2], Grosse J[2], Santosham P[2], Bruehlmann S[2]

[1]Medicine, University of Calgary, Calgary, AB, Canada, [2]Zephyr Sleep Technologies, Calgary, AB, Canada, [3]Edmonton Dental Studio Groups, Edmonton, NS, Canada

Introduction: We have developed a mandibular protrusion titration test (MATRx, Zephyr Sleep Technologies), carried out during polysomnographically monitored sleep, to select candidates for oral appliance therapy. A patient is prospectively predicted to be a favorable candidate if mandibular protrusion reduces the AHI during REM while supine to12 hr.-1 or less. The present investigation examined the effect of two different hypopnea criteria on predictive accuracy.

Methods: OSA patients (n=58) underwent the test and received a mandibular protruder (SomnoDent, SomnoMed) set at a target position determined from the study. RDI was measured by a portable monitor (Snoresat, Sagatech) at baseline and while wearing the appliance. Therapeutic success was considered to be an RDI≤10 hr-1 with the appliance. Both PSG interpreter and dentist were appropriately blinded. Patients who were therapeutic failures at target received additional mandibular protrusion and were retested. The PSG was scored using two secondary criteria for hypopnea: 1) a desaturation ≥ 4% (rule 4a), or 2) a desaturation ≥ 3% or an arousal (rule 4b).

Results: Values for 4a target, 4b target, 4a final, and 4b final, respectively, are as follows: Sensitivity: 0.78*, 0.66, 0.75*, 0.62; Specificity: 0.90*, 0.95*, 1.00*, 1.00*; Pos. Pred. Value: 0.93*, 0.96*, 1.00*, 1.00*; Neg. Pred. Value: 0.70, 0.59, 0.63, 0.50 (*= P<.05). These values indicate that with either hypopnea scoring rule, the test predicts therapeutic success with high accuracy. However, the negative predictive power is lower, particularly in mild OSA and when rule 4b is used. Addition of a prediction rule to the 4a criteria that liberalizes prediction of therapeutic success in mild patients by including REM lateral, significantly improved the accuracy of negative predictions without compromising positive predictive accuracy (Sensitivity:0.83*; Specificity:1.00*; Pos. Pred. Value:1.00*; Neg. Pred. Value:0.71).

Conclusion: Our results indicate that the mandibular protrusion titration test has adequate predictive accuracy to select patients for oral appliance therapy.

Support (If Any): Supported by a grant from Alberta Innovation.

0577

ROLE OF PUBERTY IN RECURRENCE OF SLEEP APNEA

Sato R[1], Huang Y[2], Lin C[2], Quo S[3], Guilleminault C[1]

[1]Div Sleep Medicine, Stanford Univ-Sleep Medicine Division, Redwood City, CA, USA, [2]Sleep Medicine and Plastic Surgery, Chang-Guang University Hospital, Taipei, Taiwan, [3]Orthodontics, University of California at San Francisco, Dental School, San Francisco, CA, USA

Introduction: Limited studies suggest pubertal development may lead to recurrence of sleep disordered breathing despite previously curative surgery. We evaluated adolescents previously cured of obstructive sleep apnea following adenotonsillectomy for recurrence of sleep apnea following puberty.

Methods: Retrospective analysis of 29 adolescents (Tanner stage III-IV) with obstructive sleep apnea previously treated by adenotonsillectomy. Clinical evaluation and sleep-related complaints were assessed annually from pediatric sleep questionnaire (PSQ) during orthodontic follow up. Systematic cephalometric xray or 3-dimensional cat scan of subjects were performed by orthodontists between 12-15 years of age. Polysomnography at the time of obstructive sleep apnea diagnosis, following adenotonsillectomy, and after puberty were compared.

Results: Twenty-nine subjects were studied; 20 boys, 9 girls. At initial obstructive sleep apnea diagnosis, mean age 7.6 ± 1.7 years, mean apnea hypopnea index 9 ± 5, mean respiratory disturbance index 15 ± 6.4, and lowest oxygen saturation (%) 91 ± 2.5. Following adenotonsillectomy, mean age 8.1 ± 2.4 years, mean apnea hypopnea index 0.4 ± 4.4, mean respiratory disturbance index 0.6 ± 0.5, and lowest oxygen saturation (%) 96.5 ± 1.0. Pubertal evaluations occurred at mean age of 14 years. Complaints obtained from pediatric sleep questionnaire included snoring (N=4), difficulty getting up in morning/going to school (N=12), inattention or poor school performance within last year (N=13), fatigue (N=10), napping on school bus or ride home (N=8), and signs of sleep phase delay (N=16). Nine subjects were asymptomatic, most of whom were girls (N=7). Cephalometric comparison of subjects (N=20) performed at mean age 11 years versus mean age 14 years, showed a reduction of posterior airway space of 2.3 ± 0.4 mm. Polysomnography of asymptomatic subjects showed mean apnea hypopnea index 1.1, mean respiratory disturbance index 1.8, and lowest oxygen saturation (%) 97.5 versus symptomatic subjects that showed mean apnea hypopnea index 3.1, mean respiratory disturbance index 5.6 ± 1.2, and lowest oxygen saturation (%) 92.5 ± 1.5.
Conclusion: Cephalometric investigation indicates a reduction of posterior airway space in symptomatic pubertal adolescents following previously curative adenotonsillectomy. Puberty may be a risk factor for the recurrence of obstructive sleep apnea due to enlargement of the tongue in boys and less frequently, abnormal decent of the hyoid bone in girls.

0578

DEAD SPACE MASK ELIMINATES PERIODIC CENTRAL APNEAS AT HIGH ALTITUDE

Patz D[1,2,3], Hackett P[2,4], Spoon M[3], Steiner G[3]
[1]Medicine, St. Mary's Hospital, Grand Junction, CO, USA, [2]Medicine, University of Colorado Health Sciences Center, Denver, CO, USA, [3]Western Colorado Sleep Institute, Grand Junction, CO, USA, [4]Institute for Altitude Medicine, Telluride, CO, USA

Introduction: Travelers to altitude may have disturbed sleep due to periodic breathing during sleep with frequent central apneas. This may contribute to daytime sleepiness, though not clearly to acute mountain sickness. Masks with enhanced rebreathing space (dead space), without any CPAP machinery, have been used successfully for patients with Cheyne Stokes breathing from congestive heart failure, and also for patients with idiopathic central sleep apnea. We tested whether a mask with added dead space, could eliminate or reduce the central apneas of altitude.
Methods: 16 subects were recruited, age 18-35, residing at 4600 ft. They each slept one night with full polysomnographic monitoring including end tidal C02, in a normobaric hypoxia tent simulating an altitude of 12,000 ft. Those who had a central apnea index (CAI) >20/hr. returned for a night in the tent for dead space titration during which they slept first with a Quatro mask, and increasing amounts of dead space amounts, aiming for a CAI <5/hr. Then each subject slept another full night with the titrated amount of dead space. One subject went through the titration process a second night, with a pneumotachometer in-line, to help us determine the mechanism by which the mask reduced central apneas.
Results: Of the 16 subjects, 5 had a central apnea index >20/hr. , mean 49.1 (SD 46.6). In each of the 5, the dead space mask reduced the CAI by at least 88% to mean 3.06, (SD 3.06) p=0.03. 3 subjects required 500ccs or less. One subject required 750ccs, and one required 2L . Dead space did not increase the C02 reserve, (mean decreased 3.5 to 2.3mmHg), thus it likely stabilized breathing by dampening the hypocarbia during post arousal hyperventilation.
Conclusion: At 12,000 ft., central apneas can be effectively reduced with a dead space mask, but utility will require further evaluation.
Support (If Any): Institute for Altitude Medicine Western Colorado Sleep Institute.

0579

UPPER AIRWAY SURGERY FOR OBSTRUCTIVE SLEEP APNEA: SLEEP ENDOSCOPY DETERMINANTS OF OUTCOME

Koutsourelakis I, Safiruddin F, Ravesloot M, de Vries N
Ear Nose and Throat Department, Sint Lucas Andreas Ziekenhuis, Amsterdam, Netherlands

Introduction: Although drug-induced sleep endoscopy is often employed in order to determine the site of obstruction in patients with obstructive sleep apnea (OSA) who will undergo upper airway surgery, it remains unknown whether its findings are associated with surgical outcome. This study tested the hypothesis that drug-induced sleep endoscopy variables can predict the outcome of upper airway surgery in OSA patients.
Methods: Thirty OSA patients (25 men; mean apnea-hypopnea index-AHI- 30.2±18.2 events/h) underwent at first propofol-induced sleep endoscopy scored according to VOTE classification, secondly upper airway surgery (palatal surgery, radiofrequency ablation of the tongue base, hyoid suspension), and thirdly follow-up polysomnography to assess surgical response.
Results: Thirteen patients (43%) were responders and seventeen non-responders (57%). Responders had a higher occurrence of partial lateral collapse at oropharynx and a lower occurrence of antero-posterior collapse at tongue base and of complete circumferential collapse at velum in comparison with non-responders. In addition, multivariate logistic regression analysis revealed that the absence of complete collapse at the tongue base, and of circumferential collapse at the velum were independently associated with the response to upper airway surgery. Furthermore, AHI at baseline ($R^2 = 0.33$) along with the degree of tongue base collapse ($R^2 = 0.24$) were independent contributors of the postoperative change in AHI.
Conclusion: In conclusion, propofol-induced sleep endoscopy findings are predictors of upper airway surgery outcome and along with OSA severity can explain a significant part of the variance of postoperative change in AHI.

0580

THE IMPACT OF LIFESTYLE INTERVENTIONS AND DIETARY WEIGHT LOSS ON OBSTRUCTIVE SLEEP APNOEA (OSA): A META-ANALYSIS

Hosseini Araghi M[1], Chen Y[1], Jenkinson D[1], Choudhury S[1], Cartwright A[1], Banerjee D[2], Thomas G[1], Taheri S[1]
[1]School of Health and Population Sciences, University of Birmingham, Birmingham, United Kingdom, [2]Sleep and Ventilation Academic Department, Birmingham Heartlands Hospital, Birmingham, United Kingdom

Introduction: Weight loss is frequently recommended to improve obstructive sleep apnoea (OSA) among obese patients, yet the empirical support for this recommendation is weak. We conducted a meta-analysis assessing the effects of weight loss through diet and physical activity on the apnoea-hypopnoea index (AHI) and oxygen desaturation index (ODI).
Methods: A systematic search was performed to identify publications using Medline (1948-2011), EMBASE (from 1988), and CINAHL (from 1982). The review included randomised controlled trials (RCTs) and uncontrolled before-and-after studies. RCTs were assessed using the rapid critical appraisal of RCTs checklist, and uncontrolled before-and-after studies were assessed using the STROBE checklist. Data were extracted using a standardised data extraction form that captured details of study design, population, intervention, and outcomes. The inverse variance method was used to weight studies and the random effects model was used to analyse data.
Results: Three RCTs of fair quality with 386 participants showed that weight reduction programmes were associated with a decrease in AHI

(-11.46 /hr [95% confidence interval -1.69 to -21.23] compared to controls. Seven uncontrolled before-and-after studies with 172 participants also showed significant decrease in AHI (-5.17/ hr [95% confidence interval -2.05, -8.28] post intervention. In addition, uncontrolled before-and-after studies with 86 participants showed a significant decrease in ODI4 (-19.16 /hr [95% confidence interval -14.23 to -24.09]).
Conclusion: Physicians and their patients can expect that weight loss will result in significant and clinically relevant improvements in OSA among obese patients. These promising preliminary results need confirmation with large randomized studies.

0581

NASAL EPAP THERAPY FOR OSA: OBSERVATIONS FROM A CLINICALLY BASED SLEEP CENTER

Hwang D[1,2], Becker K[1], Chang NS[1], Chang JW[1], Gonzalez L[1], Vega DT[1], Shah N[1]
[1]Sleep Medicine, Kaiser Permanente, Fontana, CA, USA, [2]Pulmonary, Critical Care, Sleep Medicine, NYU School of Medicine, New York, NY, USA

Introduction: Nasal EPAP (PROVENT Sleep Apnea Therapy®, Ventus Medical, Inc) is a novel OSA therapy incorporated as a major therapeutic option into our clinically based sleep center. We report real-world experience utilizing nEPAP which includes assessment of treatment efficacy, predictors of response, and acceptance of therapy. We additionally provide extended follow-up information regarding long-term use of nEPAP.
Methods: OSA patients were eligible for a nEPAP trial: clinic orientation, in-home acclimation period, and polysomnography (primarily portable monitoring) to evaluate effectiveness (nEPAP "post-test"). Treatment response was defined as ≥50% AHI4% improvement and AHI4%<15. Other OSA indices and demographic data were compared between responders and non-responders. Prescription for nEPAP therapy (an out-of-pocket expense at Kaiser Permanente) was offered to responders. Those accepting nEPAP prescriptions were followed-up by telephone.
Results: 146 OSA patients underwent nEPAP orientation; 133 (91%) proceeded with home acclimation; 78 (59%) returned for nEPAP post-test. Among this group, OSA improved (AHI4% 26.3 vs 10.2; p<0.01). 54 (69%) patients met response criteria with a mean nEPAP AHI4% of 4.0, median improvement of 86%. Response rate was similar for mild, moderate, severe OSA. No baseline characteristics emerged as predictive of response. 45 of 54 (83%) of responders accepted nEPAP prescriptions. Additional 7 prescriptions were given for nEPAP combined with positional therapy. 42 (81%) were able to be contacted for follow-up. At time of follow-up (mean 431±306 days after prescription date), 19 (50%) were still using nEPAP. Reasons for discontinuing nEPAP varied (lack of symptomatic improvement, discomfort, cost). Duration of use until discontinuing was similarly distributed between "days", "weeks", "months", "years". 13 patients were currently on no therapy, 3 CPAP, 2 oral appliance, 1 positional therapy.
Conclusion: Nasal EPAP therapy can be successfully used as a major therapeutic option with high rates of efficacy and initial acceptance. Follow-up is necessary to address patients non-adherent to long-term therapy.

0582

PERCENT OF WEIGHT CHANGE AFTER BARIATRIC SURGERY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Mashaqi S[1], Bae C[1], Chand B[2], Schauer P[2]
[1]Neurological Institute, Cleveland Clinic, Cleveland, OH, USA, [2]Bariatric and Metabolic Institute, Cleveland Clinic, Cleveland, OH, USA

Introduction: Obesity is an important risk factor for obstructive sleep apnea (OSA). Among the severely obese, the prevalence of OSA ranges between 55%-91%. There is an increasing awareness about the importance of identifying OSA before surgery, but there have been no studies looking at the potential impact of OSA on the rate of weight loss after bariatric surgery.
Methods: Hypothesis: patients with OSA who have bariatric surgery will lose weight slower compared to patients who do not have OSA. Data were analyzed from patients who had bariatric surgery between 2009-2010, along with a polysomnogram before surgery and a follow-up visit 4-11 months after surgery. 150 patient charts were reviewed (26 were excluded due to absence of a follow-up). Primary outcome variable was percent weight loss after surgery stratified by Apnea-Hypopnea index (AHI) and type of surgery (Sleeve gastrectomy-SG, Gastric bypass-GB, Gastric restrictive surgery with bypass-GRS+GB, Gastric banding-GB). For patients with an AHI<15, the numbers for GB and SG were too low to be analyzed.
Results: Patients with AHI <5 (n=9, 89% female, mean age 26, percent weight loss 26.1%, mean postop BMI 33.9). Patients with AHI 5-15 (n=33, 70% female, mean age 39.5, percent weight loss 26.3%, mean postop BMI 35.8). Patients with AHI >15 (n=77, 56% female, mean age 53.5, percent weight loss 25.6%, mean post operative BMI 37.8). The mean follow up visit took place between 6-7 weeks. Percent weight loss for OSA patients who underwent gastric restrictive surgery with gastric bypass were 27.2%, 29.7%, 26.6%.
Conclusion: Percent weight loss after bariatric surgery in OSA patients does not seem to be affected by the AHI, but is affected more by the type of surgery. In our study, the patients who had the highest percent of weight loss were those who had AHI 5-15 and underwent gastric restrictive surgery with gastric bypass.

0583

IMPACT OF CONTROL TYPE ON BLOOD PRESSURE OUTCOMES IN OBSTRUCTIVE SLEEP APNEA: A META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

Bertisch SM[1], Thompson AM[2], Bazzano LA[2], Patel SR[1,3], Kaptchuk TJ[1], Smetana GW[1]
[1]Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Epidemiology, Tulane University School of Public Health and Tropical Medicine, New Orleans, LA, USA, [3]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA

Introduction: There is a need for randomized controlled trials examining the efficacy of continuous positive airway pressure (CPAP) for cardiovascular disease reduction in patients with obstructive sleep apnea (OSA). Debate exists regarding the ideal control. In this context, we compared the effects of two controls, sham-CPAP and conservative management (CM), upon blood pressure.
Methods: We systematically searched six databases from January 1980 to August 2011. From 1023 potential publications, 15 randomized controlled trials evaluating therapeutic CPAP fulfilled our predefined inclusion and exclusion criteria and were included for meta-analysis. We extracted information on participant characteristics, trial design and duration, type of control, and blood pressure (BP) measurements using a standardized protocol.
Results: From 15 studies, 864 patients with OSA randomized to either sham-CPAP or conservative treatment (CM) were included. Overall, pa-

tients in these control groups had no change in systolic BP (0.27 mmHg, 95% CI -0.91 to 1.44, p-value=0.66) and a small increase in diastolic BP (0.63 mmHg, 95% CI 0.12 to 1.14, p-value=0.02). In prespecified subgroup analysis, we found no change in systolic BP (-0.11 mmHg, 95% CI -1.03 to 0.80, p-value=0.81) or diastolic BP (0.44 mmHg, 95% CI -0.11 to 0.99, p-value=0.11) among patients using sham-CPAP (n=11 studies). Among patients randomized to CM (n=4 studies), diastolic BP increased (1.87 mmHg, 95% CI 0.48 to 3.26, p-value<0.01) and there was a trend towards increased systolic BP (2.46 mmHg, 95% CI -0.59 to 5.51, p-value=0.11); however these results should be interpreted cautiously as few studies used CM.

Conclusion: Among patients with OSA randomized to a control intervention, we found sham-CPAP had no effect on blood pressure and CM possibly increased blood pressure. The magnitude of effect seen with CM is similar, but in opposite direction to that reported with therapeutic CPAP, suggesting CM may have limitations as a control in cardiovascular trials evaluating CPAP.

Support (If Any): NIH 1K23AT005104.

0584

EVALUATION OF A NEW SIMPLE TREATMENT FOR POSITIONAL SLEEP APNEA PATIENTS

van Maanen P[1,2], Richard W[1,2], van Kesteren E[3], Ravesloot MJ[1,2], Laman M[3], Hilgevoord A[3], de Vries N[1]

[1]Otorhinolaryngology, Head and Neck Surgery, Sint Lucas Andreas hospital, Amsterdam, Netherlands, [2]Otorhinolaryngology, Head and Neck Surgery, Academic Medical Center, Amsterdam, Netherlands, [3]Clinical Neurophysiology, Sint Lucas Andreas hospital, Amsterdam, Netherlands

Introduction: 60% of obstructive sleep apnea patients suffer from positional obstructive sleep apnea (POSA). POSA was defined as an apnea hypopnea index (AHI) at least two times higher in supine position than the average AHI in the other positions . This study aimed to analyse the effect of a novel, neckworn, electronic device to treat positional sleep apnea.

Methods: Patients with polysomnographically proven positional sleep apnea were asked to participate in this study. These patients would undergo two additional polysomnographies, one with the device attached, but in OFF mode, and one with the device attached in ON mode.

Results: Thirty patients with positional sleep apnea were included in this study. No side effects were reported. The mean apnea hypopnea index dropped from 27.7±2.4 to 12.8±2.2. Seven patients developed an overall apnea hypopnea index below 5 when using the device in ON modus.

Conclusion: We expect that positional therapy with such a device can be applied as single treatment in many patients with mild to moderate position dependent obstructive sleep apnea, while in patients with a more severe obstructive sleep apnea such a device could be used in combination with other treatment modalities.

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POSITIONAL TRAINER: PRELIMINARY RESULTS OF A NEW TREATMENT FOR POSITIONAL OBSTRUCTIVE SLEEP APNEA

Dun L, Meester K, Koutsourelakis Y, Laman M, Hilgevoord A, de Vries N

Saint Lucas Andreas Hospital, Amsterdam, Netherlands

Introduction: Obstructive sleep apnea (OSA) is a prevalent disorder which appears to be positional dependent (apnoea hypopnoea index-AHI- in supine position ≥ twice the AHI in other positions) in 56% of patients. The possible effect of positional therapy with other techniques than the 'tennis ball technique' has not been investigated thoroughly so far. The aim of this study was to determine the effectiveness of the Sleep Position Trainer (SPT) in treating positional OSA without disturbance of the sleep quality.

Methods: 18 patients (15 men; mean age 52.6±9.6 years; mean body mass index 26.9±3.7 kg/m2) with positional OSA (mean AHI 17.4±6.8 events/h; mean AHI in supine position 37.1±14.3 events/h) underwent a 29±2 days of treatment at home with the SPT. The SPT is a sensor positioned in an elastic band attached around the body. The SPT measured the body position and vibrated when the patient lied in supine position. Subsequently, a polysomnography was repeated.

Results: Average use of the positional trainer was 27.2±2.8 days. The average proportion of supine position during the last 5 days of therapy (including the polysomnography night) was 3.3±10.8% of total sleep time, in comparison with 42.6±18.4% (p<0.001) at baseline. AHI at follow-up was 7.3±4.8 events/h (p<0.001). Sleeping efficiency at follow-up was 82.8±10.7, whereas at baseline it was 87.1±7.8% (p<0.05).

Conclusion: The SPT appears to have good compliance and can significantly reduce the proportion of supine sleep position and the AHI in patients with positional OSA.

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LONG TERM CLINICAL EFFECTIVENESS OF MAXILLOMANDIBULAR ADVANCEMENT FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

Boyd S[1], Walters A[1], Song Y[2]

[1]Neurology, Vanderbilt University, Nashville, TN, USA, [2]Biostatistics, Vanderbilt University, Nashville, TN, USA

Introduction: Short term results suggest that maxillomandibular advancement (MMA) may be a clinically effective alternative therapy for patients with obstructive sleep apnea (OSA) who are unable to adhere to CPAP therapy. However, little is known about the long term effectiveness of MMA, as measured by changes in the apnea-hypopnea index (AHI), sleepiness and quality of life. This study was performed to determine the long term clinical effectiveness of MMA.

Methods: We evaluated 20 patients who were primarily middle age (mean age = 48.0 ± 7.9 years) males (75%) with moderate to severe OSA (baseline AHI = 51.6 ± 22.8). No patient in the study group was adherent to CPAP therapy, and all individuals subsequently underwent maxillomandibular advancement surgery (MMA). Each patient had polysomnography performed at baseline, 3-6 months following MMA, and >3 years after surgery (mean follow-up 8.0 ± 2.3 years). Patients also completed the Epworth Sleepiness Scale (ESS) and Sleep Apnea Quality of Life Index (SAQLI) at the long term evaluation.

Results: Surgical treatment resulted in a significant short term reduction in AHI (51.6 ± 22.8 to 9.9 ± 9.1, P <0.0001) that was maintained on a long term basis (9.9 ± 9.1 to 8.6 ± 11.3 p = .4144). These changes in AHI occurred despite a significant increase in weight from baseline (BMI: 28.4 ± 2.8 to 30.8 ±3.5, p = <0.0001). The patients also demonstrated a significant reduction in sleepiness from baseline (ESS: 11.9 ± 4.3 to 5.6 ± 2.9, p= 0.0078), and on the SAQLI reported an extremely large improvement in quality of life (9.0 ± 1.2).

Conclusion: The results of this study indicate that MMA may be a clinically effective long term treatment—as measured by changes in AHI, sleepiness and quality of life—for patients who are unable to adhere to CPAP therapy.

Support (If Any): This investigation was supported in part by the Vanderbilt CTSA grant UL1 RR024975 from the National Center for Research Resources, National Institutes of Health and in part by a Research Support Grant Award from the Oral and Maxillofacial Surgery Foundation.

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PLACEBO EFFECTS ON SLEEPINESS IN OBSTRUCTIVE SLEEP APNEA: A META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

Bertisch SM[1], Thompson AM[2], Bazzano LA[2], Patel SR[1,3], Kaptchuk TJ[1], Smetana GW[1]
[1]Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Epidemiology, Tulane University School of Public Health and Tropical Medicine, New Orleans, LA, USA, [3]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA

Introduction: Research indicates that placebo treatment influences subjective symptoms. Clinical assessment and research outcomes in patients with obstructive sleep apnea (OSA) rely heavily upon self-reported sleepiness. In this context, we examined the placebo response to two common control groups: sham-CPAP and conservative management (CM).
Methods: We systematically searched six databases from January 1980 to August 2011. From 1023 potentially relevant publications, 23 randomized controlled trials evaluating therapeutic CPAP fulfilled our predefined inclusion and exclusion criteria and were included for meta-analysis. We extracted information on participant characteristics, trial design and duration, type of control, and Epworth Sleepiness Scale (ESS) scores using a standardized protocol.
Results: From 23 studies, 1255 OSA patients randomized to either sham-CPAP or CM were included. Study duration ranged from 2 to 52 weeks. Mean age of participants ranged from 45-63 years, 85% were male, and mean ESS at baseline was 11.5 (95% confidence interval [CI] 9.4 to 13.6). Overall, patients receiving control intervention had a decrease in ESS score of 1.27 (95% CI 0.71 to 1.84, p-value<0.001). After stratifying by control type, the mean decrease in ESS score was 1.51 (95% CI 0.73 to 2.28, p-value<0.001) in studies using sham CPAP (n=17) and 0.65 (95% CI -0.11 to 1.38, p=0.10) in studies using CM (n=6). Using meta-regression, control type was not found to be a significant predictor of ESS (p=0.27).
Conclusion: Among patients with OSA, sham-CPAP resulted in a larger reduction in subjective sleepiness than conservative management CM, suggesting enhanced placebo effects with use of a sham device. In contrast, lack of improvement with CM may suggest Hawthorne effects and regression to the mean are not major contributors to placebo effects in OSA. Differential effects of these common control groups should be accounted for in future clinical trials and acknowledged in clinical assessments.
Support (If Any): NIH 1K23AT005104.

0588

FINAL DISPOSITION OF PATIENTS SEEN IN THE ALTERNATIVES TO CPAP CLINIC: A 13 YEAR EXPERIENCE

Kumar M, Stanley JJ
Michael S Aldrich Sleep Disorders Center, University of Michigan, Ann Arbor, MI, USA

Introduction: Although treatment of obstructive sleep apnea (OSA) with continuous positive airway pressure (CPAP) is the gold standard, compliance remains problematic. An estimated 46-83% of patients use CPAP for less than an average of 4 hours/night. The goal of a multispecialty alternatives clinic is to offer CPAP intolerant patients other treatments for OSA.
Methods: 1739 patients with a documented history of OSA and CPAP intolerance, who were interested in alternative treatments, were seen in the Alternatives to CPAP Clinic between December 1997 and December 2011. All patients underwent a same day evaluation by a Sleep Medicine Physician, Otolaryngologist, Oral Maxillofacial Surgeon and Prosthodontist. Evaluation of each patient included a comprehensive medical and sleep history, review of polysomnography and PAP treatment parameters, head and neck examination (with flexible nasopharyngoscopy - Muller's maneuver), cone beam computed tomography or cephalometric analysis, and dental evaluation.
Results: Alternative treatments were recommended by group consensus, and patient preference was incorporated in the final treatment plan. Alternative treatments were chosen by 27% of patients. Of this group, 24% underwent surgery and 3% (n= 54) received an oral appliance. 70% of patients (n=291) who elected to undergo surgery underwent oropharyngeal and/or hypopharyngeal procedures and 30% (n=125) underwent maxillomandibular advancement. Over 50% of patients seen decided to make additional supervised attempts at positive airway pressure therapy and the remainder decided to abandon additional attempts at treatment.
Conclusion: A multidisciplinary alternatives to CPAP clinic can facilitate the treatment of CPAP intolerant patients and improve communication between sleep physicians, otolaryngologists, oral surgeons, and prosthodontists. Although labor intense and time consuming, such a clinic provides an effective means to treat a subset of CPAP intolerant patients and plays a key role in the management of this challenging patient population.

0589

AN ANALYSIS OF RESPONDERS TO NASAL EXPIRATORY POSITIVE AIRWAY PRESSURE (EPAP) THERAPY DURING LONG-TERM FOLLOW-UP

Massie C
Chicago Sleep Group, Elk Grove Village, IL, USA

Introduction: A nasal expiratory positive airway pressure (EPAP) device (Provent® Therapy, Ventus Medical, Inc.) is a safe and effective treatment option for patients with obstructive sleep apnea (OSA). A previously published 12-month long term use study compared outcome measures at week 1 and month 12 in patients who had a positive clinical response to EPAP at the conclusion of a sham-controlled randomized study. This analysis provides additional data showing the progression of outcome at intermediate time points between week 1 and month 12.
Methods: Patients in the EPAP arm of the randomized study who met adherence and efficacy criteria at month 3 were enrolled in the 12 month follow-up study. Device-on and device-off polysomnograms (PSG) were completed at week 1 and month 3, and a device-on PSG was completed at month 12. Subjective sleepiness was evaluated with the Epworth Sleepiness Scale (ESS) at baseline, and months 3, 6, 9, and 12.
Results: There were 41 patients enrolled in the 12-month follow-up study; 31 had an AHI > 5 at baseline. In these 31 subjects, median AHI was reduced from 17.5 (device-off) to 5.0 (device-on) at week 1, 18.1 (device-off) to 5.1 (device-on) at month 3, and 17.5 (device-off at week 1) to 5.0 (device-on) at month 12. Similarly, the median oxygen desaturation index (ODI) was reduced from 13.7 to 6.6 at week 1, from 11.5 to 5.6 at month 3 and from 13.7 to 8.2 at month 12. The mean ESS at baseline was 10.6 compared to 7.6 at month 3, 6.9 at month 6, 6.3 at month 9 and 5.9 at month 12 (p<0.01 at each time point compared to baseline).
Conclusion: Nasal EPAP reduced the AHI and ODI, and progressively improved daytime sleepiness at multiple time points throughout a 12 month follow-up period.

0590

A LONGITUDINAL STUDY OF ADENOTONSILLECTOMY EFFECTS TO OSA CHILDREN

Jin H[1,2], Chung S[1,2], Sun S[1,2], Li M[1,2]
[1]Applied Psychology, Harbin Engineering University, Harbin, China, [2]Sleep Laboratory, Harbin Engineering University, Harbin, China

Introduction: Obstructive sleep apnoea syndrome (OSAs) is often occurred among children. Adenotonsillectomy is recommended for children who have severe OSA combined with large tonsil size. Studies show the significant improve on OSA severity, neuro-cognition impairment, behavior problems, and quality of life after surgery. This study investigated the long-term effect of surgery with longitudinal data.

Methods: Eighteen children with OSAs were recruited in south China. Based on overnight PSG and tonsil size, twelve children were diagnosed as severe OSAs and conducted adenotonsillectomy and six children without surgery as control group. The PSG was performed before surgery, as well as 6 months, one year and two years after surgery. AHI, SaO2, and SE% were used to evaluate the effects of treatment.
Results: There was a significant drop after six months, the mean AHI of adenotonsillectomy group was significant decreased (F=16.28, P<.000) from 11.20 (±6.64) to 1.03 (±1.33). AHI of control group had also decreased from 6.38(±4.73) to 1.50(±0.92). However, one year later, the AHI of both groups exhibited a rise treatment group arrived at 1.9(±2.60) and 1.63(±1.54) of control. As two years follow up, AHI reached approximated 3 in both groups (2.833±2.79 vs. 2.78±3.36).
Conclusion: Compared with the control group, the AHI of the children with adenotonsillectomy had a distinct decline at the first six months. However, two years later, there was no difference. But this results worth further consideration. First, the sample size remains small. Second, we did not conduct neuro-cognitive assessment so could not investigated function change. Third, we did not control BMI as covariance and it seems affect results significantly. Therefore, more factors should be took into account while treat the child OSAs.

0591

EFFECT OF ADENOTONSILLECTOMY ON CORTICAL PROCESSING OF RESPIRATORY AND AUDITORY AFFERENT STIMULI DURING WAKEFULNESS IN CHILDREN WITH THE OBSTRUCTIVE SLEEP APNEA SYNDROME

Huang J[1], Colrain IM[2], Tapia IE[1], Padilla ML[2], Yuan H[1], Mcdonough J[1], Samuel J[1], Bradford R[1], Cornaglia MA[1], Marcus CL[1]
[1]Children's Hospital of Philadelphia, Philadelphia, PA, USA, [2]SRI International, Menlo Park, CA, USA

Introduction: Impaired cortical processing of respiratory afferent stimuli during sleep, manifested by blunted respiratory-related evoked potentials (RREP), may contribute to the pathogenesis of obstructive sleep apnea syndrome (OSAS) in children. However, most children with OSAS breathe normally during wakefulness. The cortical processing of afferent stimuli during wakefulness in that group is unknown. We hypothesized that 1) children with OSAS have abnormal cortical processing of respiratory and non-respiratory (auditory) stimuli during wakefulness, manifested by abnormal RREP and auditory evoked potentials (AEP), respectively; 2) Awake RREP and AEP in children with OSAS improve after adenotonsillectomy.
Methods: Children with OSAS and controls aged 5-16 years old were studied. Five children whose apnea hypopnea indices (AHI) were normalized by surgery were reevaluated (ages 8 ± 1 years; body mass index z-scores 1.0 ± 1.2; AHI before and after surgery 16.6 ± 12/hr and 1.3 ± 1.5/hr, respectively). The ages, BMI z-scores and AHI of the five controls were 8.0 ± 1.5 years, 0.8 ± 1.3 and 0.4 ± 0.2/hr, respectively. During wakefulness, multiple 400 ms inspiratory occlusions were performed. After RREP, 90 dB tones were presented in an oddball series. The occlusions and rare tones were designed as targets to which the subjects were instructed to press a button in response. Surface EEG activity was averaged, and then RREP and AEP peak amplitudes and latencies were analyzed.
Results: No changes in RREP and AEP responses were found between OSAS and controls. Nevertheless, the latency of the RREP early component Nf decreased after adenotonsillectomy in OSAS (from 47 ± 13 ms to 38 ± 12 ms, P < 0.05).
Conclusion: We conclude that children with OSAS have normal cortical processing of respiratory and non-respiratory stimuli during wakefulness. We speculate that adenotonsillectomy changes upper airway properties, resulting in a better transduction of respiratory stimuli into afferent signals during wakefulness.

Support (If Any): This study was supported by American Heart Association grant 0825666D and NIH grants U54-RR023567 and R01-HL58585.

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NASAL EXPIRATORY POSITIVE AIRWAY PRESSURE (EPAP) DEVICE TO TREAT OBSTRUCTIVE SLEEP APNEA IN PATIENTS AGE 65 AND OVER

Adams G
[1]Sleep Medicine Specialists, PLLC, Sarasota, FL, USA, [2]Sleep Disorders Center, Sarasota Memorial Hospital, Sarasota, FL, USA, [3]Florida State University Medical School, Sarasota, FL, USA

Introduction: Prior studies have reported that a nasal expiratory positive airway pressure (EPAP) device (PROVENT® Therapy, Ventus Medical, Inc) significantly reduced the apnea-hypopnea index (AHI) and improved oxygenation and subjective daytime sleepiness. A retrospective analysis was conducted to evaluate real-world patient acceptance and outcomes of nasal EPAP among patients ≥65 years of age in a private practice clinical setting.
Methods: Patients with a diagnosis of obstructive sleep apnea (AHI > 10/hour or AHI>5 with excessive daytime sleepiness or other comorbidities) were offered a trial of nasal EPAP. Patients received a prescription for 10 nights of nasal EPAP therapy for in-home acclimation trial. Patients that self-reported success in acclimation were asked to return for efficacy confirmation using standard in-lab polysomnography (PSG). During the PSG, adjunctive therapy (e.g. chin straps, positional therapy) was employed, when necessary, to achieve optimal efficacy. Patients with demonstrated effectiveness were prescribed nasal EPAP for ongoing usage.
Results: Ninety-one patients, ≥ 65 years of age, trialed nasal EPAP of which 73/91 (80.2%) acclimated to the device within 10 nights of use. Data from baseline and follow-up PSGs was available for 72 patients. Median AHI (25th, 75th quartiles) was reduced from 26.3 (15.8, 43.5) to 4.6 (2.3, 8.1) (P<0.0001). There were statistically significant reductions in median AHI across all OSA severities: in mild OSA from 11.5 (10.1, 12.9) to 5.5 (1.9, 7.3); in moderate OSA from 22.9 (18.2, 27.2) to 4.1 (3.1, 6.8); in severe OSA from 50.5 (42.2, 58.8) to 5.6 (2.5, 10.7). Effectiveness (AHI <10) was achieved in 59/72 (81.9%) of patients. AHI was reduced to <5 in 39/73 (54.2%) of patients.
Conclusion: The nasal EPAP device provided a statistically significant and clinically meaningful reduction in AHI in a group of clinical practice patients ≥ 65 years of age. Acceptance of the therapy was excellent.

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MAXILLAE AND MANDIBLE LENGTH MAY BE PREDICTIVE FOR OSAS ORAL APPLIANCE TREATMENT OUTCOMES

Juliano M, Machado MA, Balsalobre R, Carvalho LB, Prado LF, Prado GF
Department of Neurology, Federal University of Sao Paulo, Sao Paulo, Brazil

Introduction: Oral appliance therapy has been indicated for patients who have mild and moderate Obstructive Sleep Apnea Syndrome (OSAS). Lateral radiography is a common approach to assess craniofacial morphology for these patients. According to American Academy of Sleep Medicine, treated patients should have AHI<5 per hour after OSAS therapy with oral appliances. We hypothesized if cephalometric variables can predict the success of OSAS treatment with ARMIO™.
Methods: We analyzed cephalograms of 17 OSAS patients before treatment with ARMIO™. Polysomnography was performed in a standardized fashion. Complete response to treatment was defined as a resolution of OSA symptoms and a reduction in AHI to less than 5 events per hour. Two groups were studied according to AHI achieved at the end of ARMIO™ titration protocol: the group who had AHI<5 per hour (group

1) and the group who had AHI>5 per hour (group 2). The cephalometric variables were: SNA, SNB, ANB, NSPlO, NSGoGn, 1.NA, 1.NB, SPAS, PAS, MPH, C3H, Length of Soft Palate, Length of Maxillae and Length of Mandible. The T-test was used to determine statistical significance ($p<0.05$).
Results: Two cephalometric variables showed statistical significance: the length of maxillae was greater in the group who had AHI<5 per hour and the length of mandible was greater in the group who had AHI>5 per hour. No other variable showed difference between the two groups. Length of maxillae, group 1 - mean 101.5±9.8; group 2 - mean 93.7±4.7 ($p=0.04$); length of mandible, group 1 - mean 118.3±6.1; group 2 - 125.4±5.9 ($p=0.03$).
Conclusion: Oral appliance therapy seems to be more effective in OSAS patients with greater maxillae, probably because they show larger intra-oral space, as well as patients with greater length of mandible, as was found in group 2, who do not get enough mandible advancement to achieve AHI<5per hour.
Support (If Any): Supported by FAPESP # 00/07513-3) Supported by FAPESP # 1999/08189-6).

0594

LONG-TERM EFFECTS AND SIDE-EFFECTS OF UVULOPALATOPHARYNGOPLASTY FOR OBSTRUCTIVE SLEEP APNEA

Chao C[1], Lin C[2,3], Lin W[2], Wu H[2], Liu Y[2], Wu J[4]
[1]Department of Otolaryngology, Tainan Municipal Hospital, Tainan, Taiwan, [2]Department of Otolaryngology, Tainan Hospital, Department of Health, Tainan, Taiwan, [3]Department of Occupational and Environmental Medicine, Medical College and Hospital, National Cheng Kung University, Tainan, Taiwan, [4]Department of Otolaryngology, Medical College and Hospital, National Cheng Kung University, Tainan, Taiwan

Introduction: An attractive treatment for obstructive sleep apnea (OSA) is uvulopalatopharyngoplasty (UPPP). The efficacy and safety of this procedure have not been clearly established. Our aim was to assess long-term effects and side-effects of UPPP for OSA.
Methods: We reported the results of routine pre-/post-operative OSA-related assessments in patients undergoing UPPP from January 1, 2003 to June 30, 2011. All these participants received overnight polysomnography (PSG) and questionnaires regarding daytime sleepiness, snoring severity, and sleep quality before and after the treatment (6 months, 1, 2, 3, 5, 7 years). In addition, snoring and functional parameters such as speech, taste, swallowing and pharyngeal irritation were assessed using standard 10-cm visual analogue scales (VAS). Surgical success was defined as > 50% reduction in the apnea-hypopnea index (AHI) and a postoperative AHI of < 20/hour.
Results: Fifty patients (49.5%) completed the study. Forty-two (80%) were male subjects. The average age was 30.7 years. The body mass index (BMI) was 28.9. The mean of preoperative AHI was 38.7/hour. The difference of pre-/post-op AHI was reduced after UPPP treatment (6 months: -24.0; 1 year: -17.4; 2 year: -14.0; 3 year: -12.1; 5 year: -19.0; 7 years: -21.2). The levels of pharyngeal irritation were limited and persistent (6 months: 1.8; 1 year: 1.4; 2 year: 1.3; 3 year: 1.0; 5 year: 0.0; 7 years: 0.0). All the other functional parameters were not complained post-operative 1 year. Complications did not occur. The success rate for UPPP was decreased with time (6 months: 81.8%; 1 year: 44.4%; 2 year: 33.3%; 3 year: 33.3%; 5 year: 42.9%; 7 years: 40.0%).
Conclusion: This study indicated that UPPP treatment for patients with OSA might have a limited effect up to a 7-year follow-up. Except for pharyngeal irritation, the long-term side-effects such as speech, taste and swallowing were rated as rather minor.

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TIME DEPENDENT AMELIORATION OF OBSTRUCTIVE SLEEP APNEA BY DRONABINOL

Carley DW[1,2,3], Prasad B[3,1], Radulovacki M[4,3]
[1]CNSHR, University of Illinois at Chicago, Chicago, IL, USA, [2]Biobehavioral Health Science, University of Illinois at Chicago, Chicago, IL, USA, [3]Medicine, University of Illinois at Chicago, Chicago, IL, USA, [4]Pharmacology, University of Illinois at Chicago, Chicago, IL, USA

Introduction: We previously showed that cannabimimetic agents reduced sleep disordered breathing in an animal model, and that the cannabinoid agonist dronabinol lowered the apnea/hypopnea index (AHI) in patients with obstructive sleep apnea (OSA). Here, we further examine the time-dependent versus dose-dependent effects of dronabinol on AHI.
Methods: After confirmatory diagnostic polysomnography, 14 subjects with AHI between 15 and 75 completed a three-week course of dronabinol treatment, with repeat polysomnography every 7th night. All subjects received an initial dose of 2.5 mg QD dronabinol 30 minutes before bedtime. This dose was escalated to 5 mg QD and 10 mg QD on days 8 and 15, as tolerated. Eight subjects fully escalated to the 10 mg dose, 4 subjects escalated to the 5 mg dose and 2 subjects remained at the 2.5 mg dose throughout.
Results: Average AHI was reduced from 41.0±5.1 (SE) to 33.3±7.3 ($p = 0.08$; paired t-test) after one week of treatment with 2.5 mg dronabinol and was further reduced to 26.0±5.2 after three weeks of treatment (all doses; $p = 0.008$; paired t-test). Final on-treatment AHI did not differ according to final dose ($F = 0.001$; $p = 0.99$): 25.9±9.0 (10 mg); 26.5±4.3 (5 mg); 25.9±9.4 (2.5 mg). Further, the change in AHI from baseline to final on-treatment value was equivalent for all three final doses ($F = 1.03$; $p = 0.39$).
Conclusion: These findings suggest that cannabimimetic agents such as dronabinol may be useful in ameliorating obstructive sleep apnea severity. Further, they demonstrate that the impact of dronabinol on AHI severity increases with time-on-treatment for a period of at least several weeks, pointing to the potential importance of neural plasticity in the treatment response. We speculate that even lower doses of dronabinol may have beneficial effects with longer treatment durations.
Support (If Any): This study was supported by a grant from Pier Pharmaceuticals.

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TOPIRAMATE IMPROVES CENTRAL SLEEP APNEA: A CASE SERIES

Westwood A, Montouris G, Auerbach S
Neurology, Boston University School of Medicine, Boston, MA, USA

Introduction: Central sleep apnea includes Cheynes-Strokes breathing. Pharmacological therapy for central sleep apnea includes acetazolamide. The introduction of topiramate into a patient's medical regimen appeared to show a reduction in the incidence central sleep apneas. This report is currently in press. Topiramate is a partial carbonic anhydrase inhibitor and may work in a similar way to acetazolamide.
Methods: A search for "topiramate" and "Topamax" was implemented in the electronic sleep database at Boston Medical Center from 2004-2010. The medical record numbers of these studies were obtained and cross-referenced to the outpatient database. Those with more than one sleep study that included one without topiramate listed in current medication were analyzed.
Results: A retrospective chart analysis found 34 patients had sleep studies while performed on topiramate. 12 of these patients had multiple sleep studies. 9 of the 12 patients had one sleep study while not taking topiramate. Amongst patients with central apneas 67% patients improved and 33% worsened during the interval between studies.
Conclusion: Given the limited sample size conclusions cannot be drawn at this time. Using medication that is multi-effective for several co-mor-

bidities provides cost-effectiveness and improves patient compliance. Larger studies should be undertaken to investigate the effects of these medications further.

0597

THE EFFECT OF ACETAZOLAMIDE ON CARDIO-RESPIRATORY VARIABLES FOLLOWING SPONTANEOUS AROUSAL

Connolly JG, Campana LM, Sands SS, Wellman A, Malhotra A, Edwards BA
Division of Sleep Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA

Introduction: In individuals with obstructive sleep apnea (OSA), the magnitude of the ventilatory overshoot following arousal is likely to perpetuate subsequent respiratory events, potentially contributing to the disorder's severity. Given the limitations of CPAP, the main therapeutic intervention for OSA, an alternative approach for non-adherent patients may be pharmacotherapy. Recent work from our laboratory examined the utility of acetazolamide to improve the physiological traits responsible for OSA. Specifically, the aim of the current study was to assess the effect of acetazolamide on the magnitude of the ventilatory response to spontaneous arousal.
Methods: We retrospectively analysed data from twelve OSA subjects who underwent 4 nights of polysomnography to assess the effect of acetazolamide (500mg twice daily) on the traits effecting OSA. A researcher, blinded to treatment, identified spontaneous arousals with durations between 3-15s and were preceded and followed by at least 1-minute of stable NREM sleep. Minute ventilation (V_I), end-tidal CO_2, tidal volume (V_T), expiratory-time, inspiratory-time, total breath duration and heart rate (HR) were analyzed. Breath-by-breath measurements of all respiratory variables were interpolated using 4s (1s for beat-to-beat HR) intervals 32s prior and 60s following each arousal.
Results: Acetazolamide did not alter the peak V_I following arousal (8.8±0.4 versus 8.9±0.1L/min). However, when compared relative to the pre-arousal V_I, acetazolamide significantly reduced the magnitude of the peak breath following arousal (122.0±4.4 versus 108.7±3.5%; $p<0.05$); a change driven predominantly by V_T. Interestingly, the magnitude of V_I (% of pre-arousal levels) was positively correlated ($r=0.43$; $p=0.04$) with the apnea-hypopnea index. Following arousal, acetazolamide did not alter the other variables studied.
Conclusion: Our data indicate that acetazolamide markedly attenuates the rise in ventilation that occurs in response to spontaneous arousal from sleep in subjects with OSA. This finding suggests that that the magnitude of V_I to spontaneous arousal is dependent upon resting ventilatory drive.
Support (If Any): 5R01HL048531-16, 1R01HL090897-01A2.

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EFFICACY OF MAXILLOMANDIBULAR ADVANCEMENT IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME: A SYSTEMATIC REVIEW AND META-ANALYSIS

Balsalobre RA, Machado MA, Juliano M, Bizari L, Prado LB, Prado G
Neuro-Sono Sleep Center, Department of Neurology, Universidade Federal de São Paulo, São Paulo, Brazil

Introduction: Maxillomandibular advancement (MMA) surgery has been indicated in the treatment of obstructive sleep apnea syndrome (OSAS) in patients with severe apnea and maxillomandibular deficiency or in those who did not fit or did not show improvement with other treatment modalities. MMA anteriorizes the maxilla and mandible, thus enlarging the upper airway (UA).This systematic review aimed to assess the efficacy of MMA for OSAS in patients with no history of any surgical procedure other than MMA for treatment of this condition.
Methods: Due to a scarcity of clinical trials about the theme, we conducted a systematic review of the literature based on a search of the main bibliographic databases with no restrictions on study design. The criteria for inclusion were assessment of adult patients with apnea who had undergone MMA as the sole modality for surgical treatment of OSAS. The primary outcome was the number of apnea-hypopnea index (AHI) events per hour (AHI/h) before and after MMA, and the secondary outcomes were excessive daytime sleepiness (EDS) as measured by the Epworth Sleepiness Scale, satisfaction with changes in facial appearance, and treatment-related complications and adverse effects.
Results: After the search and selection of studies, only five could be include in the review: four series of cases and a clinical trial. Considering the outcomes of each study, two meta-analysis could be performed, one evaluating the primary outcome, the AHI / h found before and after the AMM surgery (n = 61) and another considering the secondary outcome, the excessive daytime sleepiness assessed through Epworth Sleepiness Scale (n = 40).
Conclusion: This systematic review suggests that MMA is an effective treatment for OSAS, if proper indications are respected. However, further studies with higher levels of evidence, larger sample sizes, and longer follow-up are required.

0599

CIRCADIAN RHYTHM PERIOD LENGTH IN DELAYED SLEEP PHASE DISORDER

Lack LC, Micic G, De Bruyn A, Wright H, Lovato N
Psychology, Flinders University, Adelaide, SA, Australia

Introduction: Delayed Sleep Phase Disorder (DSPD) is defined as an abnormally late sleep period (e.g. 3am - 12 noon). DSPD is prevalent in the adolescent and young adult population and is associated with significant morbidity. Attempts to establish an earlier sleep period usually fail due to sleep onset insomnia and insufficient sleep. DSPD is presumed to be caused by a delayed circadian rhythm. However, the strong tendency in DSPD to phase delay may arise from a longer endogenous circadian rhythm period length, tau, and/or longer period lengths of subjective and objective sleepiness rhythms.
Methods: Six DSPD participants and seven normal controls had period lengths determined from a three-day laboratory ultradian routine. One hour "days" (40 min wake alternating with 20 min sleep opportunities) were carried out in a time free, constant bed rest, dim light conditions. Core body temperature as well as objective sleepiness (sleep latency) and subjective sleepiness were measured hourly across the 78 hours. Best fit, two component (24hr plus 12hr harmonic) cosine curves were derived for each participant on the three measures.
Results: The mean period lengths for the sleepiness rhythms of both groups did not vary significantly from 24 hours. However, both groups had longer than 24-hour core body temperature tau at 24.6 (0.27) hours for the good sleepers and significantly longer ($p<0.01$) at 25.2 (0.47) hours for the DSPD participants.
Conclusion: The longer DSPD core body temperature tau found in this study is consistent with the only previous but sparse data on DSPD. Because the period lengths of the objective and subjective sleepiness rhythms remained at 24 hours, an abnormally long circadian tau is most likely to be a cause of DSPD and make it particularly difficult to shift to an earlier, more conventional sleep time. Successful treatment of DSPD would, therefore, require aggressive and persistent chronobiologic therapy.
Support (If Any): Flinders University of South Australia Research Grant.

0600

FATIGUE, SLEEPINESS AND SLEEP IN MARITIME WATCH SYSTEMS: A SERIES OF SIMULATOR STUDIES

van Leeuwen W[1], Kecklund G[1], Dahlgren A[3], Kircher A[2], Lützhöft M[2], Barnett M[4], Åkerstedt T[1]
[1]Stress Research Institute, Stockholm University, , Stockholm, Sweden, [2]Chalmers University of Technology, , Gothenburg, Sweden, [3]KTH Royal Institute of Technology, Stockholm, Sweden, , Stockholm, Sweden, [4]Warsash Maritime Academy, , Warsash, United Kingdom

Introduction: The present study investigated sleepiness and fatigue on the bridge and in the engine room in bridge officers and engineers during a simulated one-week journey in the North Sea and English Channel.
Methods: Two of the most common maritime watch schedules were used in the study: 6h on watch, followed by 6h off (6/6) and 4h on watch, followed by 8h off (4/8). The studies were carried out in the bridge and engine room simulators at Warsash Maritime Academy, UK and at Chalmers Technical University, Sweden. At Chalmers one free watch was used for administrative work, to simulate the effects of work during free watches. In total, 20 engineers, and 70 bridge officers participated. The measures included EEG and EOG recording for 24h, actigraphy during the week, hourly ratings of sleepiness (Karolinska Sleepiness Scale) and Psychomotor Vigilance Test (PVT) at the start and beginning of watches.
Results: The results showed that more than 50% of the participants fell asleep on night watches while showing strongly increased sleepiness ratings and slower reaction times on the PVT. Crew in the 6/6 schedule showed higher levels of sleepiness during watches and more than 1 hour less sleep than those in the 4/8 schedule. Total daily sleep durations were approximately 7 hours in the 4/8 schedule and 6 hours in the 6/6 schedule. The disturbance of the free watch resulted in increased incidents of falling asleep and in elevated levels of sleepiness.
Conclusion: Night watches at sea involve large increases of sleepiness and actual sleep on watch. Particularly 6/6 schedules and disturbed free watches have pronounced effects. The present study was carried out in simulators and need confirmation in studies at sea.
Support (If Any): This research project has been supported by the European Commission under the 7th Framework Programme (grant agreement number: 234000).

0601

LINKING SLEEP DURATION TO NIGHT SHIFT-WORK AND HYPERTENSION

Ceide ME[4,1], Pandey A[1,2], Olafiranye O[1], Pandey AK[2], Donat M[5,1], Brown CD[1], Jean-Louis G[1,3]
[1]Brooklyn Health Disparities Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [2]Internal Medicine, A.P. Medical P.C., Brooklyn, NY, USA, [3]Sleep Disorder Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [4]Psychiatry, SUNY Downstate Medical Center, Brooklyn, NY, USA, [5]Department of Family Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA

Introduction: The purpose of this study was to investigate whether short sleepers (<6hrs) working the night shift were at greater risk of reporting hypertension. We also explored whether associations varied based on individuals' race/ethnicity.
Methods: Analysis was based on the 2010 National Health Interview Survey (NHIS) survey, providing reported work schedule, a hypertension diagnosis, and habitual sleep durations. A total of 65,919 American adults provided valid data for the present analyses (mean age = 46.2 ±17.7 years; 52.7% were female). The NHIS is a cross-sectional household interview survey utilizing a multistage area probability design. During face-to-face interviews, personnel from the US Census Bureau used computer-assisted personal interviewing to acquire subjective data. Respondents provided anthropometric and socio-demographic data and physician-diagnosed chronic conditions.
Results: Of the entire sample, 32.6% reported a diagnosis of hypertension; 95.3% reported daytime shift-work and 4.7% reported night shift-work. Logistic regression analysis indicated that black night shift-workers were at higher risk of reporting hypertension than blacks who reported daytime shift-work [OR=1.16, 95% CI: 1.15-1.16; $p<0.001$]; no significant findings were noted for whites. Overall, short sleepers reporting night shift-work had a higher risk of reporting hypertension than day shift-workers [OR=1.39, 95% CI: 1.39-1.39; OR=1.72, 95% CI: 1.71-1.73; $p<0.001$]. After adjusting for effects of age, race/ethnicity, education, income, smoking, alcohol use, body mass index (BMI), emotional distress, and diabetes, short sleepers reporting night shift-work were 22% more likely to report hypertension [OR=1.22, 95% CI:1.22-1.23; $p<0.001$]. Interactions between race/ethnicity and night shift schedule among short sleepers suggested that black short sleepers working the night shift were at considerably greater risk than their white counterparts [OR=1.96, 95% CI:1.95-1.97; $p<0.001$].
Conclusion: Findings suggest that short sleepers reporting working the night shift may be at increased risk of having hypertension. Risk may be greatest for short sleepers of the black race/ethnicity.
Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

0602

SHIFT WORKERS REPORT WORSE SLEEP THAN DAY WORKERS, EVEN IN RETIREMENT

Monk TH[1], Buysse DJ[1], Billy BD[1], Fletcher ME[1], Kennedy KS[1], Begley A[1], Schlarb JE[2], Beach SR[2]
[1]Neuroscience Clinical and Translational Research Center, University of Pittsburgh Medical Center, Pittsburgh, PA, USA, [2]Survey Research Program - University Center for Social and Urban Research, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: The aim of this study was to explore how the level of shift work exposure during an older adult's working life might be related to subjectively reported sleep quality and timing during retirement.
Methods: Telephone interviews regarding past employment and sleep timing and quality (among other variables) were conducted using a pseudo-random age-targeted sampling process. Subjective sleep quality was assessed using a telephone version of the Pittsburgh Sleep Quality Index (PSQI). Timing of reported habitual bedtimes and rise-times were assessed using the Sleep Timing Questionnaire (STQ). Only retired seniors (65y+, n=1,113) were studied. Analysis was by ANOVA with shift work exposure in three bins (0y [n=387], 1y-15y [n=371], >15y [n=355]), and gender [n=634M, 479F] as factors.
Results: In retired shift workers, relative to retired day workers, past exposure to shift work was associated with higher (worse) PSQI scores by 0.96 units (1y-15y) and 0.61 units (>15y) [p=0.001, p < 0.03]. There was a main effect of gender (females higher [worse] scores than males by 1.02 units [p<0.0001]), but no gender by shift work exposure interaction [p>0.5]. A similar pattern of results was observed when two broad pre-retirement occupational categories were considered separately. The timing of current mean habitual bedtimes and rise-times (and also the variance around them) were very similar for the three shift work exposure groups.
Conclusion: Prior exposure to shift work would appear to be related to currently reported sleep problems during retirement. It is possible that differences in physical health and body mass may have had some mediating effect.
Support (If Any): AG13396, AG20677, RR024153.

0603

INDIVIDUAL CONTRIBUTORS TO CIRCADIAN ADAPTATION IN NIGHT SHIFT WORK

Boudreau P, Boivin DB
Douglas Mental Health University Institute, McGill University, Montreal, QC, Canada

Introduction: There is evidence to suggest that better circadian adaptation leads to improved night time performance and daytime sleep efficiency in night workers. However, individuals vary greatly in their capacity to adapt to atypical work schedules. The aim of the present study was to assess contributors to better circadian adaptation of night shift workers.
Methods: Police officers (30.1 ± 5.2 years) were randomly assigned to a control or intervention group based on bright light exposure at night (control, n=9; treatment, n=8). They underwent a 48-h in-lab assessment before and after a series of 7 consecutive night shifts Salivary samples were collected 1x/hour in the laboratory and assayed for their content in melatonin. Salivary melatonin phase and amplitude were calculated using a triple harmonic regression. We previously reported results of between-group comparisons based on the intervention group. Here, participants were grouped based on their degree of circadian adaptation which was considered substantial if salivary melatonin acrophase occurred in the daytime sleep period; n=7, 26.4±5.1 years) or incomplete if not (n=10, 32.6±5.4 years). Two-way ANOVAs (factors: Visit x Adaptation group) were utilized.
Results: Compared to the non-adapted group, adapted group officers were younger (P=0.016), exposed to greater light intensities at night (P<0.001), and tended to spent more time in bed in the daytime (P=0.078). Overall, they showed greater circadian amplitude of salivary melatonin compared to the non-adapted group (P=0.044). There was a trend for a significant visit x group interaction (P=0.06), with greater melatonin amplitude during the 2nd visit (but not the 1rst) in the adapted group compared non-adapted group (P<0.01).
Conclusion: Individual factors such as age and behavior of exposure to light and darkness affect the adaptation of circadian phase and amplitude to night shift work.
Support (If Any): This work was supported by an operating grant from the Institut de Recherche Robert-Sauvé en Santé et Sécurité du Travail; and salary support from the Fonds de la recherche en santé du Québec (DBB); and the Institut de Recherche Robert-Sauvé en Santé et en Sécurité de Travail (PB).

0604

BLUE ENRICHED ROOM LIGHT IN THE MORNING ENHANCES DAYTIME ALERTNESS AND NIGHT TIME SLEEP

Kunz D, Stoll C, Hädel S
Dept Physiology, Berlin, Germany

Introduction: Introduction Basic research on the effects of blue wavelength light on wakefulness suggests that there are two distinct pathways of activating effects of bright light. One is an immediate pathway, causing cortical activation during task performance. Another pathway is thought to act indirectly via the suprachiasmatic nucleus, controlling evening melatonin release and affecting the circadian pacemaker. However, it remains unknown whether these two mechanisms can be influenced in a real life environment by bright room light in the morning. The current study aims to compare biologically optimized room lighting to light bulb room lighting in the morning regarding subjective alertness, reaction times and night time sleep.
Methods: In a randomized cross-over design ten healthy participants were exposed to an optimized lighting condition (637 lux;3400 Kelvin) and 7 days later to a light bulb lighting condition (20 lux; 2400 Kelvin) or vice versa. Light exposure took place on three consecutive days from 8 to 11 am. During light exposure subjective alertness and reaction times on the psychomotor vigilance task were measured every hour. In the evening light conditions were controlled and sleep was polysomnographically recorded.
Results: During hours of optimized room lighting reaction times on the psychomotor vigilance task were significantly shorter compared to the light bulb condition (two-tailed paired t-test; p < 0,05). Similarly, subjective alertness in the optimized light condition was increased compared to the light bulb condition at all three of the hourly measurements (two tailed paired t-test; p < 0.05 at 9am; p < 0.1 at 10am and p < 0,05 at 11am). Interestingly, subjective alertness in the optimized light condition increased with every consecutive day, whereas this effect was absent in the light bulb condition (repeated measures ANOVA; interaction light condition * day * time: p < 0.05). Polysomnographic recordings revealed that after the optimized light condition participants experienced a mean of 29.4 minutes more total sleep time (two-tailed paired t-test; p< 0.05). Increased sleep was due to significantly more slow wave sleep (p< 0.05) and a trend towards more REM sleep (p< 0.1).
Conclusion: The current data show that optimized lighting in the morning is of great importance not only for immediate alertness, but also for sleep quality at night. Furthermore, results suggest that the immediate benefits of optimized room light increase with every consecutive day of light exposure.

0605

EVENING CAFFEINE PHASE DELAYS THE HUMAN CIRCADIAN CLOCK

Burke TM[1], Markwald RR[1], McHill AW[1], Chinoy ED[1], Snider JA[1], Bessman SC[1], Jung CM[1,2], Wright KP[1]
[1]Integrative Physiology, University of Colorado at Boulder, Boulder, CO, USA, [2]Department of Biological Sciences, University of Alaska Anchorage, Anchorage, AK, USA

Introduction: Shifting of the human circadian clock is a necessary component for treatment of circadian sleep disorders and rapid adaptation to jet travel. Caffeine, the most commonly ingested stimulant, has previously been reported to influence the phase of the SCN electrical activity rhythm and lengthen the physical activity rhythm in non-human models. We tested the hypothesis that caffeine would induce a phase delay shift of the human circadian clock. We also tested whether caffeine and bright-light combined would induce a greater phase shift than either alone.
Methods: Five (three females) healthy participants aged 23.8±3.1 years (mean±SD) completed a within-subject, ~49 day long phase shifting protocol. Circadian phase was assessed during constant routine protocols by determining salivary dim light melatonin onset pre and post four randomized, placebo controlled interventions: dim-light (~1.9 lux; ~0.6 Watts/m2) placebo (DLP), dim-light caffeine (2.9 mg/kg body mass, equivalent to 200 mg of caffeine in a 69 kg person, DLC), bright-light (~3000 lux; ~7 Watts/m2) placebo (BLP), and bright-light caffeine (BLC). Caffeine or placebo was administered double-blind three hours prior to participants' habitual bedtime, while three hours bright or dim-light exposure began at habitual bedtime.
Results: We observed average phase delays for DLC, 0.93±0.37 h (mean±SEM); BLP, 1.71±0.30 h; and BLC, 2.02±0.47 h that were all significantly larger than for DLP, 0.27±0.34 h (all $p < 0.01$). In addition, BLC significantly delayed circadian phase more than DLC ($p<0.01$).
Conclusion: Our findings demonstrate that a moderate dose of caffeine induces a phase delay of the human circadian clock that is approximately half that of evening exposure to bright light. These findings suggest that caffeine may facilitate treatment of circadian sleep disorders and jet travel.
Support (If Any): NIH R01 HL081761 and NIH/NCRR Colorado CCTSI Grant Number UL1 RR025780.

0606

IMPACT OF EVENING USE OF LIGHT-EMITTING ELECTRONIC READERS ON CIRCADIAN TIMING AND SLEEP LATENCY

Chang A[1,2], Aeschbach D[1,2,3], Duffy JF[1,2,3], Czeisler CA[1,2]
[1]Medicine, Brigham & Women's Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]Equal contributors to this work, Harvard Medical School, Boston, MA, USA

Introduction: The use of electronic readers has greatly increased in recent years. Exposure to light at night, even at low intensity, has been shown to induce phase delays of the melatonin rhythm and to acutely increase alertness in humans. Here we present results from a study comparing the effects of reading from a light-emitting electronic tablet vs. reading printed books before bedtime on circadian timing of melatonin onset and sleep latency.
Methods: Twelve healthy adults (18-30 years; 6 F) completed a 14-day inpatient protocol. The randomized, cross-over protocol consisted of two conditions: 5 consecutive evenings during which participants read light-emitting (~30-50 lux) electronic books (le-ebook) in dim light (~3 lux) for ~4h prior to bedtime, and 5 consecutive evenings when they read printed books in dim light for ~4h prior to bedtime. Circadian phase of the dim light melatonin onset (DLMO25%) was assessed from hourly blood samples collected in a constant posture (CP) on the first study day (baseline) and after each condition (le-ebook and print book). Sleep latency (i.e., interval between lights-out and first occurrence of any sleep stage) was assessed from PSG recordings on the 4th and 5th night of each condition. Mixed model ANOVA was used to compare the effect of condition on DLMO25% and sleep latency.
Results: There was an effect of condition (baseline, le-ebook, and print book; $p=0.003$) on circadian phase, with DLMO25% occurring 55±21 minutes (mean ± SEM) later in the le-ebook condition compared to the print book condition ($p=0.003$). Sleep latency was 7±4 minutes longer following the le-ebook condition than the print book condition ($p=0.006$).
Conclusion: This study provides evidence that use of light-emitting electronic devices in the pre-bedtime hours may cause shifts of the circadian timing system to later hours and prolong the time it takes to fall asleep.
Support (If Any): This study was supported by R01HL77453 and the Harvard Catalyst CTSC (UL1 RR025758).

0607

A NEW METHOD FOR THE VALID MEASUREMENT OF THE DIM LIGHT MELATONIN ONSET AT HOME

Burgess HJ
Biological Rhythms Research Laboratory, Rush University Medical Center, Chicago, IL, USA

Introduction: Measurement of the dim light melatonin onset (DLMO) is important for the diagnosis and treatment of circadian rhythm sleep disorders. The DLMO is usually measured in the laboratory or sleep clinic, but there is a pressing need for valid home assessments. Three critical barriers to accurate home DLMOs remain: (1) objective verification of dim light at home, (2) objective verification that saliva samples are taken at the correct times at home, and (3) reduction of sample labeling errors at home. We have developed a new method to overcome these problems including: (1) photosensor, (2) TrackCap and (3) label dispenser.
Methods: To date 4 healthy subjects (29-61 years, 2 males, 2 females), with no previous saliva collection experience, participated in a repeated measures study. Each subject collected saliva samples at home using our method on one night, followed by standard saliva collection in the laboratory (< 5 lux) the next night. Saliva samples were taken every 30 minutes in the 6 hours before habitual bedtime.
Results: Home DLMOs collected so far compare favorably with the laboratory DLMOs (10, 14, 17 and 22 minute differences, $p=0.64$). Lights could be dimmed within the home environment to avoid significant melatonin suppression; only one subject received light >50 lux during the saliva collection (first 8 minutes only), and one subject's home DLMO occurred before her laboratory DLMO. All subjects were able to correctly complete the home procedures, despite two subjects with family members (including children) present at home during the saliva collection.
Conclusion: These results suggest that our new procedure for home DLMOs: (1) is feasible and readily accepted by subjects and (2) yields DLMOs that are comparable to DLMOs collected with standard laboratory procedures. We continue to test our method in young and old healthy controls and patients with delayed sleep phase disorder.
Support (If Any): R01 AT007104 to HJB, copyright of method to Rush University Medical Center.

0608

A NATIONAL REGISTRY OF TOTALLY BLIND INDIVIDUALS WITH SLEEP-WAKE COMPLAINTS

Gallagher A, Lavedan C
Vanda Pharmaceuticals Inc, Washington, DC, USA

Introduction: Non-24-hour sleep-wake disorder (N24HSWD) is a circadian rhythm disorder common in blind individuals with no light per-

ception (NLP). We established a registry of over 1,000 NLP individuals with sleep-wake complaints. This was the main source of recruitment for a study of tasimelteon for the treatment of N24HSWD, where circadian rhythm was carefully evaluated. Data revealed a significant underdiagnosis of this disorder while circadian rhythm assessment confirmed its high prevalence.
Methods: A nationwide awareness N24HSWD campaign was conducted in the blind community in part through outreach efforts with national associations supporting visually-impaired individuals and numerous local non-governmental and governmental organizations. An IRB-approved survey was conducted by phone and online. Adults were included in the registry if they self-reported having NLP and sleep-wake complaints.
Results: About 60% of participants reported sleep-wake problems disrupting their life or daily activities extremely to moderately. Approximately 75% had at least three of the following complaints: impaired sleep maintenance (87%), staying awake during the day (78%), difficulty falling asleep (75%), daytime napping (72%). Over 70% had not consulted a doctor for their sleep-wake problems. For those individuals for whom circadian rhythm was later assessed, 73% were diagnosed with N24HSWD.
Conclusion: Most NLP individuals in the registry experienced multiple severe sleep-wake difficulties and many challenges engaging productively in a society aligned to a 24 hour day/night schedule. Despite this, few individuals sought medical help. Those who did, rarely reported a clear diagnosis. However, clinical evaluation confirmed the high prevalence of N24HSWD in this population and confirmed the value of this registry. The extent of underdiagnosis emphasizes the necessity to increase awareness of this disorder in the blind community and among health professionals.

0609
TIMING AND DURATION OF NAP EPISODES ARE COINCIDENT WITH MELATONIN ACROPHASE
Schreffler ER, Licamele L, Dressman MM, Feeney J, Polymeropoulos MH
Vanda Pharmaceuticals, Washington, DC, USA

Introduction: Blind patients with Non-24-Hour Sleep-Wake-Disorder (N24HSWD) experience debilitating daytime fatigue resulting in frequent naps of long duration. This makes it difficult to function in a 24 hour society. We sought to quantitate the magnitude of this problem in a large, well-controlled study and to examine possible correlations between nap timing and timing of melatonin secretion.
Methods: Subjects with self-reported total blindness and sleep complaints were enrolled in the SET Study. Subjects completed daily sleep and nap diaries. Data for nap frequency, duration, and timing from N24HSWD patients was compared during in-phase and out-of-phase periods of their circadian cycle. Additionally, nap data from N24HSWD patients was compared to entrained subjects. Timing of the circadian cycle was determined by measuring the melatonin metabolite (aMT6s).
Results: The data indicate that the timing of daytime naps is coincident with the timing of aMT6s secretion. Non-entrained subjects nap more often and for longer durations when they are out-of-phase compared to when they are in-phase. Furthermore, they nap longer and more frequently than those subjects who were entrained. No significant differences were observed between the entrained group and the non-entrained group when they were in-phase for both total nap time and frequency of naps.
Conclusion: The implications of daytime napping can be severe including difficulty performing at school and in the work place, maintaining relationships, increased risk for accidents, and a decrease in alertness. These data demonstrate that non-entrained individuals nap more frequently and for longer periods of time when their circadian rhythm is out-of-phase when compared to entrained individuals. Furthermore, the timing of naps is predicted by the timing of aMT6s secretion. These types of naps are unique as they seem to occur both because of a homeostatic correction for nighttime sleep deprivation and a strong circadian mechanism.

0610
SIGNIFICANT SLEEP IMPAIRMENT IN TOTALLY BLIND INDIVIDUALS WITH N24HSWD
Torres R, Licamele L, Feeney J, Dressman MA, Polymeropoulos MH
Vanda Pharmaceuticals, Rockville, MD, USA

Introduction: The majority of reported cases of non-24-hour sleep-wake disorder (N24HSWD) occur in blind individuals with no light perception. N24HSWD results when individuals are unable to synchronize their endogenous circadian rhythm to the 24-hour day-night cycle resulting in the gradual shifting of the endogenous rhythm. In a repetitive, lifelong cycle, they suffer from episodes of poor night sleep, and excessive daytime somnolence which is described by some as a burden second only to blindness. Sleep data collected from the SET study was used to investigate the magnitude of sleep impairment in these individuals.
Methods: The SET study is a multicenter, double-masked, placebo-controlled, parallel study to investigate the **S**afety and **E**fficacy of **T**asimelteon in subjects with N24HSWD. During the screening phase, sleep and nap data was collected via IVRS and circadian phase was assessed by measuring a melatonin metabolite (aMT6s) in urine. Sixty-two subjects diagnosed with N24HSWD were included in the analysis.
Results: Sleep data during the out-of-phase portion of the circadian cycle compared to the in-phase portion showed a greater than 30 minute decrease in total nighttime sleep with an accompanying greater than 30 minute increase in the duration of naps. Further analysis showed that sleep latency is highest during the transition from in phase to out of phase.
Conclusion: Sleep dysfunction varies significantly among individuals with N24HSWD. Overall, the sleep impairment is most significant when the circadian rhythm is out-of-phase with the 24-hour day-night cycle as blind individuals attempt to maintain a socially acceptable sleep-wake schedule. The resulting chronic sleep deprivation may lead to impairment in daily functioning, social interactions, school and work performance, and increases the risk for accidents.

0611
PLEIOMORPHIC EXPRESSION OF N24HSWD IN THE TOTALLY BLIND
Licamele L, Dressman MM, Feeney J, Polymeropoulos MH
Vanda Pharmaceuticals, Inc, Rockville, MD, USA

Introduction: Non-24-hour sleep-wake disorder (N24HSWD) is a circadian rhythm sleep disorder that occurs when individuals are unable to synchronize their endogenous circadian rhythm to the 24-hour day. N24HSWD is most commonly found in blind subjects lacking the ability to perceive light, the primary zeitgeiber for synchronizing the circadian system daily. In general, individuals with N24HSWD suffer from a variety of clinical symptoms as they cycle in-to and out-of phase. We investigated the variability of sleep related clinical symptoms across individuals characterized as having N24HSWD.
Methods: The SET study is an ongoing multicenter, double-masked, placebo-controlled, parallel study to investigate the Safety and Efficacy of Tasimelteon in subjects with N24HSWD. During the screening phase subjects maintained daily sleep diaries. The length of a subject's circadian cycle was determined by measuring the melatonin metabolite, 6-sulphatoxymelatonin (aMT6s).
Results: As a population, N24HSWD individuals suffer from a significant deficit of nighttime sleep as well as an increase in daytime somnolence when they are out-of-phase. Examination of the data on an individual level demonstrates that the expression of these clinical symptoms varies greatly. We present data from several individuals that exhibit

a non-24 hour circadian cycle, but who suffer from variable sleep related clinical symptoms.
Conclusion: These finding suggest that while circadian desynchrony typically results in cyclical episodes of poor nighttime sleep and increased daytime sleepiness, the expression can be variable across individuals. Some patients have a cyclical nighttime sleep deficit accompanied by cyclical occurrence of daytime naps. Others have only the cyclical nighttime sleep deficit but no cyclical naps. For some patients, the sleep deficit and the daytime naps may be non-cyclical. N24HSWD is a pervasive disorder with significant inter-patient variability in sleep and nap expression, requiring detailed evaluation to identify the disorder.

0612

SEVENTY PERCENT OF TOTALLY BLIND PEOPLE WITH SLEEP COMPLAINTS ARE NOT ENTRAINED TO THE 24 HOUR CLOCK

Dressman MM, Licamele L, Feeney J, Polymeropoulos MH
Vanda Pharmaceuticals Inc., Rockville, MD, USA

Introduction: Non-24-hour sleep-wake disorder (N24HSWD) is a serious circadian rhythm disorder with no available treatment. Tasimelteon is being developed as a potential therapeutic for N24HSWD. Desynchronization of the circadian rhythm is definitional of the disorder and constitutes a reliable method for diagnosis and assessment of treatment efficacy. Here we describe the tau distribution in a large cohort of self-reported totally blind individuals with sleep-wake complaints.
Methods: The SET study is an ongoing multicenter, double-masked, placebo-controlled investigation of the **S**afety and **E**fficacy of **T**asimelteon to treat N24HSWD. During screening tau is calculated by measuring the urinary melatonin metabolite (aMT6s). The secretion rate, acrophase, and tau are calculated from urine collected weekly for 48 hours (4-8-hour intervals) for each of four collection periods. A cosine is fitted to the data to estimate phase shift, mesor, and amplitude. Acrophase is determined as the phase shift modulus of 24 hours. Acrophase values are regressed against the start day.
Results: Tau was calculated during screening for 143 subjects. N24HSWD was diagnosed in 70% of subjects with tau ranging from 24.08 to 25.34 with a median of 24.45. Approximately 30% of subjects were entrained to the 24 hour day. Significant inter-individual variation in the peak aMT6s urinary secretion rates was observed.
Conclusion: The SET trial is a study of the largest reported cohort of totally blind N24HSWD sufferers with tau calculated and supports previous estimates of 70% prevalence in totally blind individuals. The high prevalence of N24HSWD in the totally blind population calls for increased education of health care professionals and the blind community about the significant risk factor total blindness poses for N24HSWD and the many challenges patients experience engaging productively in a society aligned to a 24 hour day/night schedule.

0613

ASSOCIATION OF CIRCADIAN CLOCK GENE POLYMORPHISMS WITH DIURNAL PREFERENCE IN KOREAN ADULTS

Lee JH[1,3], Kim SJ[2], Duffy JF[3], Lee SY[1], Jung TH[4], Suh IB[4]
[1]Psychiatry, Kangwon National University Hospital, Chunchon, Republic of Korea, [2]Neuropsychiatry, Hyosung Hospital, Cheongju, Republic of Korea, [3]Sleep Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, MA, USA, [4]Laboratory Medicine, Kangwon National University Hospital, Chunchon, Republic of Korea

Introduction: Diurnal preference refers to individual differences in preferred sleep-wake timing, and one source of such variation is the circadian timing system. Mutations in circadian "clock" genes can alter circadian period, and polymorphisms in clock genes have been reported to be associated with diurnal preference and/or sleep timing. However, not all such reports have been replicated, and racial/ethnic differences in study populations have been suggested as a contributing factor. We examined the association of previously reported clock gene polymorphisms with diurnal preference in a group of Koreans.
Methods: Nine hundred seventeen subjects age 18 years or older were recruited from visitors to the National Museum in Chunchon City from 2010 to 2011. The Korean Sleep-Wake Questionnaire (SWQ-K) including the Morningness-Eveningness Questionnaire (MEQ), Epworth Sleepiness Scale (ESS), and Pittsburgh Sleep Quality Index (PSQI) was administered. Standard scores on the MEQ were used to categorize subjects as morning type (MT), neither type (NT) and evening type (ET). Sixty-three MT (age=43.7±12.5, M:F=26:37) and 37 ET (age=28.2±7.3, M:F=13:24) were randomly selected from 304 participants who had provided their DNA as part of the study. Seven previously reported single nucleotide polymorphisms (SNPs) in 7 clock genes (CLOCK, PER1, PER3, CK1ε, CK1δ, CRY1,CRY2) and 2 SNPs in PER2 were analyzed by DNA sequencing up to 677 bp.
Results: The genotypes and allele frequencies in the 9 SNPs were not significantly different between MT and ET subjects. We found two previously unreported polymorphisms that did differ between MT and ET subjects. The A allele frequency of PER1 C2495A was significantly higher in MT (MT:ET= 0.134:0.027, $p<0.05$), as was the A allele frequency of PER3 G2767A (MT: ET= 0.22:0.11, $p=0.056$). The new PER3 G2767A occurred with the known PER3 C2741G in 4 of 30 cases.
Conclusion: While we did not find an association between diurnal preference and 9 previously reported SNPs in clock genes we did find an association with 2 novel SNPs. Whether this finding is related to the age and/or sex difference between the MT and ET groups, or whether it is specific to ethnic Koreans remains to be tested in other populations.
Support (If Any): Basic Science Research Program through the National Research Foundation of Korea (NRF)(to JHL) funded by the Ministry of Education, Science and Technology (2010-0003160). JFD is supported by NIH grant HL077453 and by an award from the Brigham and Women's Hospital Biomedical Research Institute Fund to Sustain Research Excellence.

0614

VALIDATION OF THE KOREAN VERSION OF HORNE & ÖSTBERG MORNINGNESS-EVENINGNESS QUESTIONNAIRE (MEQ-K) IN ADULTS AGED 20-39

Kim SJ[1], Jang KH[2], Kim IS[3], Lee SY[2], Lee JH[2]
[1]Neuropsychiatry, Hyosung Hospital, Cheongju, Republic of Korea, [2]Psychiatry, Kangwon National University Hospital, Chunchon, Republic of Korea, [3]Psychiatry, Gwangju Municipal Ingwang Hospital, Gwangju, Republic of Korea

Introduction: Morningness-Eveningness refers to individual difference in diurnal preference of sleep-wake timing. Individuals with evening preference tend to show poorer sleep quality and greater sleep need due to sleep deficit. In addition to the difference in sleep-wake timing, circadian rhythms of core body temperature and melatonin are also different according to the morningness-eveningness. In order to validate the Korean version of Horne & Östberg Morningness-Eveningness Questionnaire (MEQ-K), we compared the sleep-wake rhythm measured by actigraphy between the subjects with different chronotype, and examined the relationship of sleep-wake rhythm with sleep habits and sleep quality.
Methods: The Korean version of Sleep-Wake Questionnaire (SWQ-K) including the MEQ was administered to the subjects age 18 years or older recruited from visitors to the National Museum in Chunchon City from 2010 to 2011. Standard scores of the MEQ were used to categorize subjects as morning type (MT), neither type (NT) and evening type (ET). The Chronbach alpha of MEQ-K was 0.77, and the correlation coefficient was 0.914 ($p<0.05$) for the test-retest reliability. Actigraphy data (Actiwatch-2, Philips-Respironics Co.) were collected in 10 MT (age=35.2±4.3, M:F=1:9), 11 NT (age=34.1±6.5, M:F=2:9), and 10 ET (age=31.7±6.1, M:F=2:8). For each subject, cosinor analysis on acti-

graph data of 7 days (Actiware version 5.59) was done to obtain the amplitude and acrophase of sleep-wake rhythm.
Results: There was a significant difference in the mean acrophase between the MT, NT and ET groups, and the acrophases of MT subjects were significantly earlier than those of ET subjects ($p<0.01$). The acrophase was positively correlated with sleep need, and negatively with wake time after sleep onset (WASO) ($r=0.428$, -0.399 respectively; $p<0.05$). The amplitude was positively correlated with sleep efficiency ($r=0.552$, $p<0.01$), and negatively with time in bed, WASO, and fragmentation index ($r=-0.482$, -0.676, -0.655 respectively; $p<0.01$).
Conclusion: The validity of the MEQ-K measuring morningness-eveningness was verified by the significant difference in acrophases between the MT, NT and ET groups. The earlier acrophase of sleep-wake rhythm was associated with reduced sleep need and greater awakenings, and the lower amplitude was with poor sleep maintenance.
Support (If Any): Basic Science Research Program through the National Research Foundation of Korea (NRF)(to JHL) funded by the Ministry of Education, Science and Technology (2010-0003160).

0615

TIMED BRIGHT LIGHT AND MELATONIN THERAPY IN SIGHTED ADOLESCENTS WITH DELAYED/FREE-RUNNING RHYTHM DISORDER OVERLAP

Malkani R, Reid KJ, Zee P
Northwestern University, Chicago, IL, USA

Introduction: Patients with free-running rhythm disorder (FRD) have progressive daily delays in the circadian rhythm leading to difficulty falling asleep, difficulty waking up, and inability to entrain to a 24-hour cycle. FRD, rare in sighted individuals, may be preceded by delayed sleep phase disorder (DSPD). We describe a clinic-based approach for evaluation and circadian-based treatment of FRD in sighted adolescents.
Methods: Three sighted male adolescents (13, 15, 17 years old) with history of DSPD presented with FRD to the Northwestern University Sleep Center. All participants completed a detailed clinical history and underwent physical examination. Sleep logs for 14-32 days and actigraphy for 14 days were obtained. Salivary melatonin was collected under dim light at the patients' homes to determine the dim light melatonin onset (DLMO). Treatment with bright light (10,000 lux) and melatonin 0.5-4 mg was administered based on the timing of the sleep/wake rhythm and DLMO.
Results: Sleep logs and actigraphy showed progressive daily delays in the sleep/wake cycle by 1 hour (2 patients) and 0.7 hours (1 patient). DLMO occurred 5-6 hours before sleep onset in 2 patients; DLMO was not captured in 1 patient. Treatment involved combined timed bright light and melatonin therapy in 2 of the 3 patients. Bright light was used to shift the circadian rhythm to the desired sleep and wake times. When the sleep/wake cycle occurred at the desired time, melatonin administration 4 hours before sleep onset and bright light exposure upon awakening were effective to stably entrain the circadian rhythm. One patient achieved long-term compliance (> 6 months).
Conclusion: Adolescents with DSPD may be at increased risk for FRD. FRD in sighted persons can be effectively managed in the clinic with a combined approach of timed bright light and melatonin. However, adherence to scheduled sleep and wake times and light therapy may be especially challenging.

0616

LINK BETWEEN DIABETIC COMPLICATIONS AND CIRCADIAN REST-ACTIVITY RHYTHMICITY

Kadono M, Hasegawa G, Nakanishi N, Ushigome E, Asano M, Yamazaki M, Fukui M, Nakamura N
Endocrinology and Metabolism, Kyoto Prefectural University of Medicine, Kyoto, Japan

Introduction: Emerging evidence from a variety of studies indicates that circadian rhythmicity is associated with aging process. Diabetes is considered to be a premature aging process. In particular, diabetic complications, neuropathy and angiopathy, are critical factors for the disease prognosis, accelerating patients' physical aging. Therefore, it is possible that the progression of these complications could involve disruption of circadian rhythmicity. In this study, we investigated the association between actigraphic estimates of the rest- activity rhythm and diabetic complications.
Methods: Fifty-three outpatients in our diabetes clinic wore an actigraph for consecutive 7days (men /women 24/29, age 68.5±8.2 yrs, BMI<25kg/m^2, type2/type1 diabetes 50/3). Patients with depression, dementia, liver cirrhosis, renal failure, blindness and shift work were excluded. Activity profiles were analyzed using nonparametric variables, including dichotomy indices, interdaily stability(IS), intradaily variability(IV), relative amplitude(RA), nocturnal awakening (former-NA(22:00-1:00), latter-NA(1:00-4:00)), and morning activity(MoA).
Results: Patients with progressive diabetic retinopathy were more likely to have lower RA compared to those without retinopathy ($p<.07$). Patients with symptomatic neuropathy had significantly lower IS, higher former-NA, and lower MoA ($P<.05$, $<.04$, and $<.03$, respectively). The levels of urinary albumin excretion were positively correlated with IV and latter-NA($P<.01$ and $<.02$, respectively), and negatively correlated with IS and MoA ($P<.01$, and $<.05$, respectively). After adjusting for sex, age, and antihypertensive use, the significance of these associations persisted. The history of cardiovascular diseases and HbA1c levels were not associated with any of the actigraphic parameters.
Conclusion: Diabetic complications, angiopathy and neuropathy, were associated with disruption of circadian rest- active rhythm, manifesting as lower interdaily stability, higher intradaily fragmentation, higher nocturnal waking, and lower morning activity. The current results indicate a key common regulator of circadian rhythms and vascular function. It can be also speculated that the circadian disruption will cause difficulty daily blood sugar control, and thus hasten the development of these complications, resulting in a vicious cycle. Taken together, chronobiological approach, especially, circadian rhythms entrainment should be considered as a possible therapy for diabetes.

0617

MULTIPLE CONSECUTIVE NURSING SHIFTS AND THE RISK OF HYPOGLYCEMIA IN CRITICALLY ILL PATIENTS WHO ARE RECEIVING INTRAVENOUS INSULIN

Ayas N[4,1,6], Tholin H[3], Cheema R[4], Rogers A[5], Dodek P[1,2,6], Norena M[2], Wong H[2]
[1]Medicine/Critical Care, University of British Columbia, Vancouver, BC, Canada, [2]CHEOS, ProvidenceHealthcare, Vancouver, BC, Canada, [3]Critical Care Medicine, Vancouver General Hospital, Vancouver, BC, Canada, [4]Sleep Disorders Program, University British Columbia, Vancouver, BC, Canada, [5]School of Nursing, Emory University, Atlanta, GA, USA, [6]Critical Care Division/Medicine, Providence Healthcare, Vancouver, BC, Canada

Introduction: Because of nurse shortages and other factors, ICU nurses commonly work multiple consecutive 12-hr shifts that leave little time for sleep. Working multiple consecutive shifts could compromise vigilance and patient care, especially with respect to managing high risk medications such as insulin. We hypothesized that rates of hypoglyce-

mia in patients receiving an insulin infusion would increase as the number of consecutive shifts worked by nurses increased.
Methods: We identified patients who had hypoglycemia (glucose <=3.5mmol/l, 63 mg/dl) between December 2008 and December 2009 in 3 ICUs in Vancouver, British Columbia. For each hypoglycemic event, we counted the number of shifts worked on consecutive days during the previous 72 hours by the bedside nurse who was caring for the patient at the time of hypoglycemia (case shift). For each case shift, we identified up to three control shifts (24, 48, and 72 hours before the hypoglycemic event in the same patient when there was no hypoglycemic events) and counted the number of consecutive shifts worked by those nurses in the previous 72 hours. This analysis allowed us to control for patient associated confounders. Conditional logistic regression was used to determine the association between number of shifts worked and occurrence of hypoglycemic events.
Results: 270 hypoglycemic events were identified. For 196 of them, we were able to identify one or more control shifts. Compared to nurses who had not worked a shift in the preceding day, the odds ratio of a hypoglycemic event was 1.58 (95% CI: 1.12, 2.52), 2.16 (95% CI: 1.25, 3.73), or 2.54 (95% CI: 1.28, 5.06) for nurses working their 2nd, 3rd, or 4th consecutive shift respectively.
Conclusion: Working multiple consecutive nursing shifts is associated with increased risk of hypoglycemic events in ICU patients.
Support (If Any): This work was supported by the MSFHR and a grant from VCHRI.

0618

EFFICACY AND TOLERABILITY OF ARMODAFINIL IN PATIENTS WITH EXCESSIVE SLEEPINESS ASSOCIATED WITH SHIFT WORK DISORDER: THE IMPACT OF SHIFT DURATION

Hull SG[1], Harsh J[2], Yang R[3]
[1]Graymark Healthcare, Inc, Overland Park, KS, USA, [2]University of Southern Mississippi, Hattiesburg, MS, USA, [3]Cephalon, Inc, Frazer, PA, USA

Introduction: Armodafinil has been shown to improve clinical condition and wakefulness during the last 4 hours of the night shift, as well as overall functioning in patients with shift work disorder (SWD). This *post-hoc* analysis examined whether duration of the night shift worked (≤9 hrs versus >9 hrs) affected the efficacy and tolerability of armodafinil in patients with SWD.
Methods: Patients had diagnosed SWD (DSM-IV and ICSD-2 criteria), worked at least five 6-12 hour night shifts per month, had mean Karolinska Sleepiness Scale (KSS) score >6, and Global Assessment of Functioning (GAF) score <70. Patients received 150 mg armodafinil or placebo on nights worked for 6 weeks and data were analyzed based on shift duration: ≤9 hour shifts and >9 hour shifts. Efficacy assessments were change in late-in-shift Clinical Global Impression-Change (CGI-C) score related to excessive sleepiness, GAF, late-in-shift KSS, and modified Sheehan Disability Scale (SDS-M) from baseline to final visit. Final visit data included last observation carried forward.
Results: Of the 383 patients enrolled in the study, 279 (73%) worked shifts ≤9 hrs and 104 (27%) worked shifts >9 hrs. At final visit, a greater proportion of armodafinil patients demonstrated an improvement in late-in-shift CGI-C score from baseline compared to placebo regardless of shift duration (≤9 hrs: 78% vs. 60% [p=0.0017]; >9 hrs: 77% vs. 46% [p=0.002]). Similar improvements were observed for the GAF and late-in-shift KSS but not the SDS-M, where significant improvement was only observed in the >9 hr group. Armodafinil was generally well-tolerated and the most common adverse event was nausea.
Conclusion: These findings indicate that shift duration did not affect the improvement with armodafinil over placebo in terms of late-in-shift clinical condition and wakefulness and overall functioning in patients with SWD. Only patients working >9 hrs demonstrated reduced disability following armodafinil treatment compared to placebo.
Support (If Any): This study was sponsored by Cephalon, Inc., Frazer, PA.

0619

A POST-HOC ANALYSIS EXAMINING THE EFFICACY AND TOLERABILITY OF ARMODAFINIL IN HEALTHCARE WORKERS WITH EXCESSIVE SLEEPINESS ASSOCIATED WITH SHIFT WORK DISORDER

Bogan RK[1], Umlauf MG[2], Yang R[3]
[1]SleepMed of South Carolina, Columbia, SC, USA, [2]University of Alabama, Tuscaloosa, AL, USA, [3]Cephalon, Inc., Frazer, PA, USA

Introduction: Excessive sleepiness in shift workers may lead to increased workplace accidents and mistakes. The wakefulness-promoting agent armodafinil has been shown to significantly improve clinical condition and wakefulness during the night shift and overall functioning in patients with SWD. A *post-hoc* analysis examined efficacy and tolerability late in the night shift of healthcare workers with SWD receiving armodafinil.
Methods: Patients in this 6-week study were diagnosed with SWD (DSM-IV and ICSD-2 criteria), worked at least five 6-12 hour night shifts per month, with Global Assessment of Functioning (GAF) score <70, and mean Karolinska Sleepiness Scale (KSS) score >6. Following randomization, patients received 150 mg armodafinil or placebo. Change in Clinical Global Impression-Change (CGI-C) related to excessive sleepiness late in the shift (including the commute home [0400 to 0800]), GAF, late-in-shift KSS, and modified Sheehan Disability Scale (SDS-M) from baseline to final visit were assessed. Final visit data included last observation carried forward.
Results: Of the 383 patients enrolled in the original study, 56 (15%) were healthcare practitioners and 37 (10%) were healthcare support staff. Both populations were pooled: 47 patients received armodafinil and 46 patients received placebo. The proportion of patients with an improvement in late-in-shift CGI-C from baseline was significantly greater in the armodafinil group versus the placebo group for those patients who completed the 6-week study (72% vs. 49%; p=0.0350) but not at final visit (67% vs. 51%; p=0.0978). Significant improvements in the GAF, late-in-shift KSS, and SDS-M were observed at Week 6 and final visit. Headache was the most common adverse event.
Conclusion: These results show that armodafinil significantly improved late-in-shift clinical condition after 6 weeks of treatment. Armodafinil also significantly improved overall functioning and late-in-shift wakefulness and reduced patient disability score. As with the overall study population, headache was the most common adverse event.
Support (If Any): This study was sponsored by Cephalon, Inc., Frazer, PA.

0620

INFLUENCE OF NIGHT SHIFT WORK ON SLEEP-WAKE CYCLE, 24-HOUR BLOOD PRESSURE AND STATE ANXIETY

Durocher JJ[1], Witting JL[1], Drummer TD[2], Carter JR[1]
[1]Kinesiology and Integrative Physiology, Michigan Technological University, Houghton, MI, USA, [2]Mathematical Sciences, Michigan Technological University, Houghton, MI, USA

Introduction: Night shift work has been linked to development of cardiovascular disease (CVD). 24-hour ambulatory blood pressure (BP), state anxiety and total sleep time (TST) are reportedly influenced by shift work; however these variables have not been collectively examined in fixed shift workers. Therefore, we hypothesized that fixed 12-hour night shift work would negatively affect TST and state-anxiety levels, and that these changes would be associated with elevated 24-hour BP.
Methods: We examined 28 healthcare professionals on fixed 12-hour shifts (15 night shift; 13 day shift) during a work day and off day. 24-hour BP measurements (Spacelabs Healthcare), state anxiety (Speilberger's STAI) and TST (sleep diary) were assessed on both test days. Data

were analyzed with repeated measures ANOVA. The within subjects factor was work day versus off day, and the between subjects factor was shift type (i.e. night or day shift). The relationships between state anxiety, TST and BP were examined using Pearson's correlation analysis.
Results: Fixed night shift workers demonstrated increases ($P \leq 0.01$) in 24-hour systolic (126±2 vs. 122±2 mmHg) and diastolic (79±2 vs. 75±1 mmHg) arterial BPs during work days compared to off days. In contrast, 24-hour BP was similar during work and off days in fixed day shift workers. Night shift workers reported reduced TST on work days versus off days (345±16 vs. 552±30 minutes; $P<0.01$), whereas day shift workers report similar TST on each day (475±16 vs. 437±20 minutes). Anxiety scores did not differ between testing days or groups. Changes in BP (off day vs. work day) were correlated ($P<0.01$) to changes in TST.
Conclusion: Our findings suggest disruption of the normal sleep-wake cycle (i.e. TST), not changes in state anxiety, contribute to increased BP and possibly a heightened long-term risk for CVD in night shift workers.

0621

REST-ACTIVITY CYCLE DISTURBANCES IN THE ACUTE PHASE OF A MODERATE TO SEVERE TRAUMATIC BRAIN INJURY

Duclos C[1,2], Dumont M[1,2], Bernard F[3,4], Blais H[1], Paquet J[1], Menon DK[5], Gosselin N[1,2]
[1]Centre for Advanced Research in Sleep Medicine, Hôpital du Sacré-Coeur de Montréal, Montréal, QC, Canada, [2]Department of Psychiatry, Université de Montréal, Montréal, QC, Canada, [3]Intensive Care Unit, Hôpital du Sacré-Coeur de Montréal, Montréal, QC, Canada, [4]Université de Montréal, Montréal, QC, Canada, [5]Division of Anaesthesia, University of Cambridge, Cambridge, United Kingdom

Introduction: Sleep-wake disturbances (SWD) are among the most disabling symptoms after traumatic brain injury (TBI) and probably arise in the first weeks following TBI. Little is known about origin and evolution of these SWD. SWD could have severe consequences by exacerbating cognitive deficits. This study investigated rest-activity circadian rhythm during the acute phase of moderate/severe TBI.
Methods: Ten hospitalized patients (17-55 years old; 8 men) with moderate/severe TBI were included. Patients wore actiwatches for 15.7±7.3 days, during the waking stage in the intensive care unit when continuous sedation was discontinued. The activity counts were summed for day period (7:00-21:59) and night period (22:00-6:59). Ratio of day period activity to total 24-h activity was calculated. To identify the presence of circadian rhythm, actigraphy data were submitted to a cosinor analysis by 48-hour periods, shifted successively by 24 hours. Acrophase and acrophase variability across days were also derived from this analysis. Comparison between days 1 to 5 and days 6 to 10 were also performed using paired t-tests.
Results: Patients were tested 17.5±9.8 days after TBI. 77.4±12.7% of total activity occurred during the day period and no significant improvement was observed between days 1 to 5 and days 6 to 10. The average fit with cosinor was 9.2±7.7% and a trend was found for improvement when days 1 to 5 were compared to days 6 to 10 ($t(8)=-2.11$, $p=0.07$). Acrophase occurred at 14h46±3h42 and a trend for a decrease in day-to-day acrophase variability was found between days 1 to 5 and days 6 to 10 ($t(8)=2.29$, $p=0.05$).
Conclusion: These preliminary data suggest that hospitalized patients with moderate/severe TBI tested in the acute stage had altered rest-activity circadian rhythm, but this rhythm tended to improve over time. Further studies will compare TBI patients to non-TBI controls who have experienced a similar period of critical illness and sedation.
Support (If Any): Research supported by the Canadian Institutes of Health Research (CIHR) and by the Fonds pour la recherche en santé du Québec (FRSQ).

0622

MAGNET RESONANCE DIFFUSION CHANGES IN THE HYPOTHALAMUS AND MEDIAL SEPTUM ACCOMPANY EPILEPTOGENIC PHASE SHIFT IN HIPPOCAMPAL CIRCADIAN RHYTHMS

Stanley DA[1,2], Parekh MB[2], Talathi SS[1,2,4], Ditto WL[7], Mareci TR[3], Carney PR[1,2,5,6]
[1]Biomedical Engineering, University of Florida, Gainesville, FL, USA, [2]Pediatrics, University of Florida, Gainesville, FL, USA, [3]Biochemistry and Molecular Biology, University of Florida, Gainesville, FL, USA, [4]Neuroscience, University of Florida, Gainesville, FL, USA, [5]Neurology, University of Florida, Gainesville, FL, USA, [6]Wilder Center of Excellence for Epilepsy Research, University of Florida, Gainesville, FL, USA, [7]Department of Physics and Astronomy, University of Hawai'i at Mānoa, Honolulu, HI, USA

Introduction: The relationship between diurnal rhythms and epilepsy has been established for over a century, but the underlying mechanisms remain elusive. Previously we reported 24-hour rhythms in spontaneous hippocampal spikes as a function of epilepsy. Following status epilepticus injury, a significant shift (>5 hours) was observed in the acrophase of this rhythm that persisted throughout the entire latent period of epileptogenesis. Similarly, hippocampal gamma-frequency rhythms showed 24-hour modulation that shifted >5 hours post stimulus. This suggests a fundamental and permanent alteration in hippocampal circadian drive. Despite these alterations, core body temperature rhythms showed that the suprachiasmatic nucleus (SCN) clock phase was unperturbed. Hence, we hypothesize that there may be damage to brain regions that indirectly relay clock information from the SCN to the hippocampus; incorporating such damage into a computer model has successfully reproduced the phase shift. Here we will study MRI markers of structural damage in two brain regions important for 24-hour regulation: the medial septum (MS) and lateral hypothalamus (LH).
Methods: MRI imaging was conducted on (N=8) epileptic adult male Sprague Dawley rats and (N=4) age matched controls. Rats were made epileptogenic by electrical stimulation in the right ventral hippocampus, resulting in status epilepticus. Sixty days post-stimulus, brains were excised for MRI analysis of average diffusivity (AD) and fractional anisotropy (FA). Statistical significance was evaluated by t-test ($P<0.1$).
Results: The MS showed a significant increase in AD 60-days post stimulus (11.1%, $P=0.09$), consistent with neuron loss in this region; FA decreased but not significantly. The LH showed a 23.9% decrease in FA and a 5.52% rise in AD, but significance was not achieved due to high animal variability ($P=0.11$ and $P=0.35$, respectively); however, longitudinal in vivo MRI analysis is underway to improve these statistics.
Conclusion: An increase in AD at 60-days post injury is consistent with neuron loss in the MS; similarly, reduced FA is associated with Wallerian degeneration and may reflect loss of LH axonal structure. This suggests that epilepsy is associated with structural alteration to the circadian system that may be responsible for the observed misalignment of 24-hour hippocampal rhythms.
Support (If Any): This work was supported by National Institutes of Biomedical Imaging and Bioengineering (NIBIB) (THM, PRC), the Collaborative Research in Computational Neuroscience Grant (CRCNS) (WLD, PRC, THM), NIH R01 EB004752 (PRC, WLD, THM), the Wilder Center of Excellence for Epilepsy Research, ASU High Performance Computing Initiative Grant (DAS, WLD), the Children's Miracle Network (SST, MBP, DAS, PRC), Office of Naval Research (WLD), National Science and Engineering Research Council of Canada (DAS), and Startup funds from Dept. of Pediatrics at UF (SST).

0623

WORK SCHEDULES, SLEEP PATTERNS, TEMPERATURE RHYTHM IN LONG DISTANCE BUS DRIVERS

Diez JJ[1,2,3], Vigo D[2,3], Perez Chada D[4], Brangold M[5], Golombek D[3,6], Cardinali D[2,3]

[1]Departamento de Fisiologia, Facultad de Medicina, Universidad Austral, Buenos Aires, Argentina, [2]Departamento de Docencia e Investigacion, Facultad de Medicina, Universidad Catolica Argentina, Ciudad Autónoma de Buenos Aires, Argentina, [3]CONICET, Ciudad Autónoma de Buenos Aires, Argentina, [4]Departamento de Medicina, Hospital Universitario Austral, Buenos Aires, Argentina, [5]Facultad de Medicina, Universidad Favaloro, Ciudad Autónoma de Buenos Aires, Argentina, [6]Universidad de Quilmes, Buenos Aires, Argentina

Introduction: Long distance drivers in Argentina usually cover very long journeys without enough time to rest, alternating with a partner. Resting conditions during the journey are precarious limiting the time and quality of their sleep.
Methods: A sample of 84 long-distance bus drivers (all males) was assessed. Wrist actigraphy and skin temperature were recorded during 7 days. Total sleep time (TST), sleep "during the trip" (SDT), sleep "in a bed" (SIB) and trip/total sleep ratio (TTR) were computed. Skin temperature was analized by Cosinor; mesor, acrophase, amplitude and percentage of rhythm (PR) were determined. The sample was divided in two groups according to trip duration: A: 15 to 17 hours, and B: 9 to 11 hours. Actigraphic and temperature data were compared by t test for independent paired samples. Values are expressed as mean ± standard error.
Results: Age and body mass index did not differ between groups. There was no difference in the time slept "in a bed" (271 ± 12 min). Schedule A subjects had higher values of TST (A: 467 ± 26 min vs. B: 358 ± 33 min; $p = 0.026$), SDT (A: 204 ± 24 min vs. B: 106 ± 16 min; $p = 0.012$) and TTR (A: 0.41 ± 0.03 vs. B: 0.22 ± 0.03; $p = 0.002$) when compared to schedule B drivers. The latter revealed lower mesor (B: 32.92 ± 0.13 C° vs. A: 33.45 ± 0.09 C°; $p = 0.001$), higher amplitude (B: 0.66 ± 0.06 C° vs. A: 0.38 ± 0.04 C°; $p < 0.001$) and higher PR (B: 35.30 ± 3.14% vs. A: 18.56 ± 2.11%; $p < 0.001$) than group A. Acrophase was similar in both groups.
Conclusion: Longer work schedules where associated to lower temperature amplitude and rhythm strength and higher proportion of sleep during the trip.
Support (If Any): This study was supported by the Superintendencia de Riesgos del Trabajo and CONICET.

0624

IMPACT OF THE RESIDENCY PROGRAM MODEL ON SLEEP, ALERTNESS AND PROFESSIONAL PERFORMANCE

Perez Chada D[1], Lopez-Gabeiras P[2], Simonelli G[6], Eiguchi K[4], Lemus J[4], Vigo D[3,5], Cardinali D[3,5]

[1]Medicine, Hospital Universitario Austral, Buenos Aires, Argentina, [2]Becaria ANPCyT, Ciudad Autonoma de Buenos Aires, Argentina, [3]Teaching and Research, Universidad Católica Argentina, Ciudad Autonoma de Buenos Aires, Argentina, [4]Ministerio de Salud, GCBA, Ciudad Autonoma de Buenos Aires, Argentina, [5]CONICET, Ciudad Autonoma de Buenos Aires, Argentina, [6]UBA, Ciudad Autonoma de Buenos Aires, Argentina

Introduction: Medical Residents are subjected to a job routine that causes disruption of the sleep/wake cycle. There are few studies about the working conditions and fatigue among medical residents in Argentina. The aim of this study is to identify the possible impact of the working structure of the residency system on sleep quality, sleepiness and functional outcomes in medical residents.
Methods: A self- administered in person survey assessed demographic and job characteristics in a sample of clinical and surgical residents. Sleep quality was evaluated through the Pittsburg Sleep Quality Index (PSQI), sleepiness with the Epworth Sleepiness Scale (ESS), and functional outcomes of sleep (FOSQ-10). Results are reported as frequency (%) or mean ± SE.
Results: Data from 420 medical residents working in 7 large County Hospitals in the City of Buenos Aires were analyzed. Mean age (± SE) 29.0 ± 0, females 292 (69.9%) The sample was divided in two groups, group A were residents completing 1st and 2nd years of training, while group B were completing the 3rd and 4th years and according to the specialty in clinical or surgical. Regarding the year of training we observed PSQI (Group A) = 11.9±0.13 vs. PSQI (Group B) = 11.4±0.18, $p=0.024$; ESS (Group A) = 15.1±0.28 vs. ESS (Group B) = 12.6±0.38, $p=0.000$; FOSQ (Group A) = 11.6 ± 0.17 vs. FOSQ (Group B) = 11.1 ±0.28, $p=0.170$. Regarding the specialty we observed PSQI (clinical) = 11.7±0.12 vs. PSQI (surgical) = 11.6±0.26, $p=0.684$; ESS (clinical) = 14.1±0.26 vs. ESS (surgical) = 15.4±0.52, $p=0.029$; FOSQ (clinical) = 11.9±0.15 vs. FOSQ (surgical) = 11.5±0.39, $p=0.308$.
Conclusion: Medical residents demonstrated poor sleep quality and excessive day time sleepiness. Surgical residents are more fatigued than clinical residents and a similar difference was observed between groups A and B. These results have important public policy implications for postgraduate medical education.
Support (If Any): This study and PGB were supported by the ANPCyT, Argentina.

0625

CLINICAL COMPARISON BETWEEN DELAYED SLEEP PHASE DISORDER, PRIMARY INSOMNIA, INSOMNIA SECONDARY TO HYPNOTIC DEPENDENCE AND HEALTHY SUBJECTS

Jimenez U[1], Santiago J[1], Haro R[1], Marin HA[2]

[1]Clinica de Sueno, UNAM, Distrito Federal, Mexico, [2]Facultad de Psicología, Universidad Cooperativa de Colombia, Medellin, Colombia

Introduction: Delayed Sleep Phase Disorder (DSPD) is mainly characterized by habitual sleep-wake times which are delayed usually more than 2 hours, according to conventional or social acceptable times; it has been reported that patients complain of difficulty in falling asleep, but once sleep is set, it is reported as normal.
Methods: The aim was to compare Sleep Habits, Subjective Sleep Quality, Athens Insomnia Scale and ESS between Healthy Subjects group HS (n=21), DSPD (n=29), patients with Primary Insomnia PI (n=15) and Insomnia secondary to Hypnotics Dependence IHD (n=9). We used a structured clinical interview (based on ICSD-II), and validated versions of AIS and ESS.
Results: Compared to HS, PI and IHD, DSPD patients showed a significant increase in number of tobacco cigarettes smoked /24 hours (mainly during night time) and in the use of internet before lie down and after mid night. Concerned to HS, DSPD and both groups of Insomniacs showed a significant decrease in Subjective Sleep Quality; and significant increases in Subjective Sleep Latency, number of awakenings, Early Morning Awakening and nights with insomnia per week. DSPD patients exhibited normal score in AIS and ESS.
Conclusion: Independent of the growing evidence concerned to genetic causes, we identified motivational, behavioral and even nicotine consumption during night time in DSPD patients and it could be considered as maintaining factors of the circadian disorder. As has been described in ICSD-II, DSPD patients exhibited normal level in Insomnia and Sleepiness symptoms; however, we also identified low sleep quality in DSPD similar to insomnia patients.

0626

WITHIN-SUBJECT STABILITY OF SUBJECTIVE CHRONOTYPE AND ASSOCIATION OF CHRONOTYPE WITH SLEEP PROBLEMS, LIFESTYLE, AND DEPRESSION IN THE WISCONSIN SLEEP COHORT STUDY

Young EJ, Finn L, Hagen EW, Peppard PE
Population Health Sciences, Univ of Wisconsin, Madison, WI, USA

Introduction: The Horne-Ostberg Morningness-Eveningness Questionnaire (MEQ) is a widely-used instrument measuring individuals' "subjective chronotype" ranging from evening-preference ("owls") to morning-preference ("larks"). However, long-term within-subject MEQ reproducibility has not been investigated in a population-based sample. Furthermore, while evening-preference has been associated with maladaptive sleep habits and other outcomes, past studies were limited by small samples or a focus on adolescents. We investigate long-term reproducibility (up to 16 years) of MEQ-chronotype in adults and investigate associations of chronotype with adverse outcomes using data from the Wisconsin Sleep Cohort study (WSC).
Methods: For this analysis, the WSC sample comprised 1240 men and women, 33-81 years old, with baseline and up to 4 follow-up sleep studies at 4-year intervals. Studies included the MEQ, and detailed questions about lifestyle, depression, sleep quality, and medical history. Baseline MEQ scores (higher scores indicate greater morningness preference) for each study was correlated with subsequent scores to assess intra-subject reproducibility. Associations of MEQ scores with the insomnia symptoms, excessive daytime sleepiness (EDS), sleep duration, depression, sedative use, and smoking were examined. For analyses, continuous and categorical (lowest quartile="owl", highest="lark") variables for MEQ score were examined. Logistic regression estimated odds ratios (OR) for MEQ associations with outcomes, adjusted for age and sex.
Results: MEQ scores were highly correlated within subjects over all 4-year study intervals (r=0.83-0.87, p<0.0001). "Owls" were significantly more likely to report insomnia symptoms (OR range=2.1 to 4.1, depending on symptom), EDS (OR=2.0, 95% CI=1.1-3.7), dissatisfactory sleep (OR=2.1, CI=1.6-2.8), current cigarette use (OR=1.6, CI=1.2-2.3), sedatives use (OR=1.9, CI=1.2-3.1), and depressive symptomology (OR=2.3, CI=1.7-3.1). Retirement and menopausal status were not significantly associated with MEQ scores.
Conclusion: Within-subject MEQ score is consistent throughout midlife, suggesting subjective adult chronotype is a stable trait. "Owls" may be at higher risk for sleep problems, negative health behaviors, and depression.
Support (If Any): R01HL62252; 1UL1RR025011.

0627

SLEEP CONSOLIDATING EFFECTS OF PINK NOISE WITH THE ANALYSIS OF CARDIOPULMONARY COUPLING METHOD

Zhou J[1], Liu D[2], Li X[2], Ma J[3], Zhang J[1,2], Fang J[1,2]
[1]Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [2]College of Engineering, Peking University, Beijing, China, [3]Dept. of pulmonary, Peking University, Beijing, China

Introduction: Many people get stuck in poor sleep quality and many existed improving methods have side effects. Here we examined the consolidating effect of pink noise on sleep of normal beings with the analysis of cardiopulmonary coupling method under consideration that polysomnogram approach may cause subjective uncomfortable for participants and the error on judgment of sleep states.
Methods: 40 subjects were involved in the group of nocturnal sleep and 10 participants were chosen for nap test. Small holter was utilized to record the electrocardiography data. Each subjects slept for two consecutive experimental periods in randomized order to prevent the 'first night' effect which could impair the results. The mean sleep length is 7.5 hours in nocturnal sleep and 1 hour in nap. Considering that for each individual the whole sleep time could be different from the others, the sleep quality was quantified by the percentages of stable sleep time in whole sleep with comparisons between the noise exposure group and the control group.
Results: The results indicate that in nocturnal sleep the noise exposure group reaches a mean of 58% (±13%) stable sleep time, with 23% higher in percentages, while the control group has only 47% (±14%). For the nap tests, 64% (±19%) stable sleep time appears in the noise group, which is much higher than that of 44% (±12%) in the control group, with 45% higher values. Meanwhile, the percentages of both unstable sleep time and REM stage & wake time are much reduced in the noise group.
Conclusion: This study demonstrates that steady pink noise has significant effect on inducing more stable sleep time and preliminary evidence of brain wave synchronization is observed with the help of complexity analysis of the electroencephalogram signals recorded in naps which shows that the fractal dimensions of these signals decreased with the introduction of pink noise.

0628

EVALUATION OF PHOTIC COUNTERMEASURES FOR CIRCADIAN ENTRAINMENT TO AN 8-HOUR ADVANCE OF SLEEP

Chang A[1,2], Anderson C[1,2], Cain SW[1,2], Czeisler CA[1,2]
[1]Medicine, Brigham & Women's Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Prior to short duration space missions, it is critical that the circadian rhythms of astronauts be synchronized to the sleep-wake schedules required for launch in order to minimize potential problems in flight due to circadian disruption. Crewmembers are often scheduled to awaken 5-7h before variable launch times, and their circadian rhythms must be shifted during the week-long pre-launch quarantine period. Here we evaluate the effectiveness of short-wavelength-enriched (green) light as a countermeasure for circadian misalignment.
Methods: Forty-three participants completed an 8-day inpatient protocol in which the timing of the 8-h sleep episode was advanced by 8h. Participants were randomized to one of five conditions: 1) WHITE ambient light (~90 lux) and a GRADUAL shift in which the sleep episode was incrementally advanced over 5 days, 2) GREEN light (~90 lux) and a GRADUAL shift, 3) WHITE light and a SLAM shift consisting of an abrupt 8-h advance on day 3 following an extended 32-h wake episode, 4) GREEN light and a SLAM shift, or 5) COMBINED bright white (~450 lux) and green light (~90 lux) and a modified SLAM shift with 2 short naps scheduled prior to the abrupt advance. We assessed circadian phase of the dim light melatonin onset (DLMO) on the first day (baseline) and during a constant routine on day 7. We compared the effect of protocol condition on DLMO using mixed model ANOVA.
Results: We found greater phase advances of the DLMO in participants from the COMBINED light and modified SLAM shift condition compared to the other 4 conditions (p<0.05).
Conclusion: The COMBINED light condition and slam shift condition showed the most facilitation for rapid circadian entrainment to an advance of the sleep episode. This may provide a lighting countermeasure to sleep and circadian disruption for use during space missions.
Support (If Any): Research supported by NSBRI HPF01601 and the Harvard Catalyst CTSC (UL1 RR025758).

0629

DAYTIME URINARY NOREPINEPHERINE LEVELS IN HYPERAROUSED INSOMNIACS

Roehrs T[1,2], Randall S[1], Roth T[1,2]
[1]Sleep Disorders & Research Center, Henry Ford Health System, Detroit, MI, USA, [2]Psychiatry & Behavioral Neurosciences, School of Medicine, Wayne State University, Detroit, MI, USA

Introduction: Insomnia is characterized as a disorder of hyperarousal. The most frequently reported sign of hyperarousal has been an elevated MSLT average daily sleep latency, but not all insomniacs show such elevations. Another finding reflecting hyperarousal in insomnia has been elevated levels of 24 hr catecholamines. We sought to determine whether or not daytime urinary norepinepherine levels would vary among insomniacs as a function of MSLT.
Methods: Primary insomniacs (N=100), ages 32-64, meeting DSM-IVR criteria and the additional screening sleep efficiency criteria of <85% and no other primary sleep disorders on an 8-hr NPSG participated. They were without psychiatric diseases or drug dependency and were in good general health. On the day after the screening NPSG they received a standard MSLT (1000, 1200, 1400, and 1600 hr). No screening MSLT criteria were applied. Urine was collected 700-1500 hr on a day each in month 1 and 8 of a clinical trial (nightly zolpidem 10 mg vs placebo for 12 months) and assayed for norepinepherine (NE) levels (Ward Laboratories, Ann Arbor, MI).
Results: The MSLT average daily sleep latency ranged from 1-20 min and those with elevated MSLTs (i.e., >15 min) (n= 42) were compared to those with lower MSLTs (i.e., < 10 min) (n= 27). Those with High MSLTs compared to those with Low MSLTs had significantly higher daytime urinary NE levels in month 1 (23.2+2.9 vs 21.6+1.9 ug/L) and in month 8 (28.2+4.0 vs 17.6+2.29 ug/L) ($p<0.03$; main effect of groups with no interactions). Daytime NE levels did not differ as a function of nightly hypnotic use (placebo vs active drug) over the 8 months.
Conclusion: These are the first data to differentiate hyperaroused from non-hyperaroused insomniacs defined by MSLT on any two physiological measures of arousal. The NE differences were consistent across 8 months.
Support (If Any): NIH, grant #: R01DA17355 (TAR).

0630

COMPARISON OF AWAKENING PROBABILITY DUE TO NOCTURNAL RAILWAY AND AIRCRAFT NOISE IN THE FIELD

Elmenhorst E[1], Mueller U[1], Rolny V[1], Pennig S[1], Quehl J[1], Maass H[1], Basner M[1,2]
[1]Flight Physiology, German Aerospace Center, Institute of Aerospace Medicine, Cologne, Germany, [2]Department of Psychiatry, Division of Sleep and Chronobiology, University of Pennsylvania, Perelman School of Medicine, Philadelphia, PA, USA

Introduction: Surveys suggest that - at the same noise level - railway noise is less annoying than aircraft or road traffic noise. Thus, railway noise is less strongly regulated in some European countries. However, in a laboratory study performed at the DLR-Institute of Aerospace Medicine railway noise lead to higher degrees of sleep fragmentation than aircraft noise. Our objective was to compare reactions to aircraft and railway noise in the field.
Methods: In a field study on railway noise, 33 healthy participants (mean age 36.2 years ± 10.3 (SD); 22 females) were examined during nine consecutive nights. Polysomnography and noise events were recorded during every night. In total, 8866 railway noise events were used for analysis of noise-induced awakenings. In a field study on aircraft noise, data from 64 subjects and 10658 noise events were recorded. The datasets from rail and aircraft noise were pooled to facilitate a direct comparison.
Results: In agreement with former studies, macrostructure of sleep was only slightly altered by noise. Awakening probability (sleep stage changes to wake/S1) due to railway noise increased significantly from 6.5% at 35 dB(A) to 20.5% at 80 dB(A) maximum sound pressure level ($p<0.0001$). In the comparison of traffic noise sources, awakening probability decreased in the order freight train noise, aircraft noise, and passenger train noise. Different reaction probabilities were explained amongst others by the sound pressure rise time of the noise event.
Conclusion: In contrast to the results of annoyance surveys, nocturnal freight train noise lead to significantly increased awakening probabilities that exceeded those observed for aircraft noise at the same maximum sound pressure level. These results were in line with our laboratory findings.

0631

AROUSAL PHENOTYPES IN INSOMNIA: A STUDY OF THEIR SLEEP AND DAYTIME CORRELATES

Sanchez-Ortuno M[1], Carney CE[2], Wyatt JK[3], Edinger JD[4]
[1]University of Murcia, Murcia, Spain, [2]Ryerson University, Toronto, ON, Canada, [3]Rush University Medical Center, Chicago, IL, USA, [4]Duke University Medical Center, Durham, NC, USA

Introduction: Presleep arousal is thought to perpetuate sleep disturbance in insomnia, and to determine daytime symptoms more so than disturbed sleep per se. Yet, arousal can manifest in various forms (e.g. physiological, cognitive) and as either a stable or fluctuating state across nights. This study was conducted to identify arousal profiles among insomnia sufferers and to examine relationships between these profiles and sleep and daytime variables.
Methods: Profile analysis via multidimensional scaling was conducted using means and day-to-day variability indices derived from visual analogue scale (VAS) ratings of three types of presleep arousal (physical tension, active mind and frustration) provided by 187 participants (126 women, mean age=47.1 years). Along with the VAS, individuals completed sleep diaries for a mean of 13.9 days, as well as the Epworth Sleepiness Scale, Fatigue Severity Scale, Dysfunctional Beliefs About Sleep Scale (DBAS), and the Beck Depression and Anxiety Inventories. Pearson correlations were conducted within the subset of individuals exhibiting "predominant" profiles, n=95 (i.e., those with:(1) a load/weight on any of the identified prototypical profiles exceeding the mean value for all participants in the study; and (2) having >50% of their observed variance explained by the prototypical profiles). These individuals' weights on the identified profiles were correlated with their averaged sleep diary (SOL, WASO, TST, SE and sleep quality ratings) and questionnaire measures.
Results: Three of the four identified prototypical profiles showed distinctive correlates. The profile characterized by high and stable ratings of somatic, cognitive and emotional arousal was associated with poor sleep quality (r=-.43) and elevated anxiety (r=.41). The profile showing high day-to-day arousal variability was related to longer WASO (r=.36) and daytime fatigue (r=.38). The profile marked by elevated and stable cognitive arousal ratings was associated to poor sleep quality (r=-.43), higher DBAS scores (r=.47) and lower daytime sleepiness (r=-.42).
Conclusion: Despite reporting poor sleep quality, high arousal phenotypes tend to be relatively alert and anxious, rather than fatigued, during the day. These findings support the contention that hyperarousal could influence daytime symptoms more so than does sleep itself. Furthermore, consideration of the various arousal profiles identified herein could help predict who may respond to insomnia treatments specifically addressing this phenomenon.
Support (If Any): This research was supported by a Pickwick Fellowship Award (PI: Colleen E. Carney) from the National Sleep Foundation, and by the National Institute of Mental Health Grant # R01, MH067057 (PIs: Jack D. Edinger & James K. Wyatt).

0632

DOES HYPERAROUSAL INCREASE DAYTIME ERROR PRONENESS AMONG INSOMNIA SUFFERERS?

Edinger JD[1,2], Means MK[3,2], Krystal AD[2]
[1]Division of Sleep Medicine, National Jewish Health, Denver, CO, USA, [2]Psychiatry & Behavioral Sciences, Duke University Medical Center, Durham, NC, USA, [3]Psychology, VA Medical Center, Durham, NC, USA

Introduction: Hyperarousal is viewed as central to insomnia sufferers' sleep difficulties as well as their hyper-alertness on daytime tests such as the Multiple Sleep Latency Test (MSLT). Currently little is known about the effects of this hyperarousal on daytime cognitive functioning. This study was conducted to examine the relationship between hyperarousal and insomnia sufferers' error rates during simple and complex attention tasks.
Methods: Eighty-nine (48 women; MAge=49.8 yrs.) well-screened primary insomnia sufferers and 95 (48 women; MAge=47.0 yrs.) age- and gender-matched normal controls underwent 3 home and 3 lab nighttime PSGs as well as a 4-nap MSLT. Prior to each nap, participants completed sleepiness ratings and a 20-minute computer-administered battery of simple and complex attention tests. The number of errors made by each participant across all 4 testing trials was tabulated and used as the primary dependent measure. The insomnia and normal groups were each subdivided into "alert" (e.g., MSLT mean onset latency > 8 minutes) and "sleepy" (e.g., MSLT mean onset latency <= 8 minutes) groups to allow for testing the main and interaction effects of participant type and level of alertness observed.
Results: Participants classified as "alert" had markedly longer MSLT latencies than "sleepy" participants (12.7 vs. 5.4 minutes). However, both alert and sleepy insomnia sufferers reported greater sleepiness than controls. The only demographic difference between the groups was that "alert" subjects were older (51.2 vs. 45.4, p=0.03). The increased daytime alertness of "alert" participants was accompanied by greater nocturnal sleep disruption reflected by lower sleep efficiencies (83.5% vs. 86.2%, p=0.03), suggesting 24-hour hyperarousal in this group. This hyperarousal was accompanied by more performance errors on attention tests based on an age-adjusted ANCOVA wherein we observed a significant interaction between alertness group and participant type (insomnia vs. control) (p=0.004). Alert insomnia sufferers made the most errors (Mean=5.2±.6) whereas alert controls committed the fewest (Mean=3.2±.4) across trials.
Conclusion: Hyperarousal in insomnia may lead to more apparent daytime alertness yet dispose insomnia sufferers to higher errors rates on tasks requiring their attention. This finding may suggest hyperarousal is involved in the elevated work/traffic accident rate reported for insomnia sufferers.
Support (If Any): This research was supported by Grants from the Department of Veterans Affairs Merit Review Program (Grant # 0009) and The National Heart, Lung and Blood Institute (Grant # R01-HL-073259-01).

0633

THE PRE-SLEEP EXPERIENCE QUESTIONNAIRE: MEASURING HYPERAROUSAL AND ITS SHORT-TERM RELATIONSHIP WITH SLEEP IN INDIVIDUALS WITH INSOMNIA AND GOOD SLEEPERS

Zottola K[1], Germain A[2,1], Buysse DJ[2], Begley A[2], Hall MH[2,1]
[1]Psychology, University of Pittsburgh, Pittsburgh, PA, USA, [2]Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

Introduction: Hyperarousal plays a central role in insomnia, yet little is known about its short-term association with sleep. To address this limitation, we developed the Pre-sleep Experience Questionnaire (PSEQ) which assesses the short-term relationship between cognitive and somatic components of hyperarousal and sleep. As an initial validation study, we examined PSEQ scores in good sleepers and individuals with insomnia.
Methods: Laboratory-assessed sleep and PSEQ's were collected in 100 individuals with insomnia and 74 good sleeper controls matched for age and sex (mean age= 37.6, 58.1% female). Administered upon waking, the PSEQ assesses cognitive and somatic arousal "as you were falling asleep last night." One night of polysomnograpy and PSEQ scores were used to examine the relationship between pre-sleep hyperarousal and measures of sleep continuity (sleep latency, wakefulness after sleep onset (WASO)) and cortical hyperarousal during NREM sleep (EEG beta power).
Results: Patients with insomnia reported higher levels of cognitive and somatic arousal than did good sleepers (p's <.05). However, PSEQ scores were only associated with sleep in good sleepers; higher levels of arousal were associated with longer sleep latencies (cognitive r= .37, p<.01 and somatic r= .29, p<.05). No such association was observed in patients with insomnia. PSEQ scores were not associated with WASO or NREM beta power in either group.
Conclusion: Patients with insomnia reported more pre-sleep arousal than good sleepers, but arousal at sleep onset was unrelated to sleep in patients with insomnia. These results suggest that the short-term relationship between cognitive and somatic arousal with sleep differs for individuals with insomnia and good sleepers. Situational arousal on any given night may interfere with the sleep onset process in good sleepers whereas conditioned hyperarousal may play a more prominent role in sleep processes in individuals with insomnia.
Support (If Any): Support for the current study was provided by NAR00003, MH024652, MH083035, MH061566, AT004429, CPMS 633, MH24652, AG20677, MH01554 and RR024153.

0634

DIURNAL PATTERNS OF POSITIVE AFFECT AND AFFECTIVE NEURAL CIRCUITRY VARY ACCORDING TO CHRONOTYPE IN ADULTS WITH PRIMARY INSOMNIA

Hasler BP[1], Germain A[1], Nofzinger E[1], Kupfer DJ[1], Krafty R[2], Rothenberger S[2], James JA[3], Bi W[4], Buysse DJ[1]
[1]Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA, [2]Statistics, University of Pittsburgh, Pittsburgh, PA, USA, [3]Radiology, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA, [4]Biostatistics, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

Introduction: While it is well-established that insomnia is a risk factor for the onset of affective disorders, the specific characteristics of insomnia that confer risk remain unclear. Insomnia patients with an evening chronotype may be at particular risk, perhaps due to alterations in positive affect and its related affective circuitry. We explored this possibility by comparing diurnal patterns of positive affect and the activity of relevant brain regions in morning- and evening-types with primary insomnia.
Methods: We assessed self-reported positive affect 4 times per day in 27 adults with primary insomnia (15 women). We assessed diurnal variation in the relative regional cerebral metabolic rate of glucose uptake by using [18F]fluorodeoxyglucose positron emission tomography during morning and evening wakefulness. Region-of-interest (ROI) analyses focused on two positive affect-related brain regions, including the medial prefrontal cortex (mPFC) and striatum, using a threshold of p<0.01 and minimum extent of 15 contiguous voxels. Sleep was assessed using diaries (7 days) and the Pittsburgh Sleep Quality Index (PSQI).
Results: Chronotypes differed in their daily patterns of self-reported positive affect and metabolism of associated brain regions. Evening-types displayed diurnal patterns of positive affect characterized by phase delay and smaller amplitude compared to those of morning-types with insomnia. In parallel, evening-types showed a reduced degree of diurnal variation in the metabolism of both the medial prefrontal cortex and

the striatum, as well a lower overall metabolism in these regions across both morning and evening wakefulness. Finally, evening-types had later sleep latencies (based on diary and PSQI) and more irregular sleep timing (diary).
Conclusion: These preliminary findings suggest that alterations in the diurnal activity of positive affect-related neural structures may underlie differences in the diurnal rhythms of self-reported positive affect between morning- and evening-types, and may constitute one mechanism for increased risk of affective disorders among insomniac evening-types.
Support (If Any): This work was supported by grants from the National Institutes of Health (UL1-RR024153, R01-MH24652, and T32-HL082610).

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INCREASED ROSTRAL ANTERIOR CINGULATE CORTEX VOLUME IN TWO INDEPENDENT GROUPS WITH PRIMARY INSOMNIA

Winkelman J[1,2], Plante DT[3], Benson KL[4], Schoerning LJ[5,1], Buxton OM[1], Renshaw P[6], Gonenc A[4,2]
[1]Division of Sleep Medicine, Brigham and Women's Hospital, Brighton, MA, USA, [2]Psychiatry, Harvard Medical School, Boston, MA, USA, [3]Psychiatry, University of Wisconsin School of Medicine and Public Health, Madison, WI, USA, [4]Brain Imaging Center, McLean Hospital, Belmont, MA, USA, [5]SleepHealthCenters, Brighton, MA, USA, [6]Psychiatry, University of Utah School of Medicine, Salt Lake City, UT, USA

Introduction: Emerging data suggests that primary insomnia (PI) may be associated with alterations in cortical and subcortical volumes compared to normal sleepers. Given our previous data demonstrating reduced GABA levels in the rostral anterior cingulate cortex (rACC) in PI, we examined the volumes of this structure bilaterally in two independent groups of subjects with PI.
Methods: Two separate and independent groups of unmedicated subjects who met DSM-IV criteria for PI were compared to two separate healthy control (HC) groups (Study 1: PI=20, HC=15; Study 2: PI=21, HC=20). Both studies included two weeks of sleep diaries supplemented by actigraphy. All participants underwent MRI scanning on a 3.0 Tesla scanner. T1-weighted images with contiguous 1.3-mm slices in the sagittal plane were obtained. Volumes were measured automatically with FreeSurfer image analysis suite (version 5.0) and results normalized to total intracranial volume. Unpaired t-tests (two-tailed) were used to compare rACC volumes between groups. Post-hoc correlations of rACC volumes to insomnia severity measures were performed (uncorrected for multiplicity).
Results: Both studies demonstrated increases in rostral ACC volume in PI compared to HC (Study 1: right side p=0.055, left side p=0.030; Study 2: right side p=0.027, left side p=0.017). No differences between PI and HC were observed for intracranial volumes. In PI subjects from Study 1, right rACC volume was correlated with sleep onset latency (SOL) by both diary (r=.63, p=0.005) and actigraphy (r=.59, p=0.010) and left rACC with SOL by diary (.69, p=.002); both right and left rACC volumes were correlated with WASO by actigraphy (r=.46, p=0.057 for both). In Study 2, right rACC volume was correlated with SOL by diary (r=.44, p=.046).
Conclusion: Rostral ACC volumes are increased, when corrected for intracranial volume, in PI compared to HC in two independent groups with PI. Clinical severity measures in the PI group correlate with rACC volume.
Support (If Any): Supported in part by the American Sleep Medicine Foundation Physician Scientist Training Award to DTP (#48-PA-09).

0636

SLEEP AND SICKNESS ABSENCE: A PROSPECTIVE REGISTER-LINKED STUDY OF FINNISH EMPLOYEES

Haaramo P[1], Lallukka T[1], Rahkonen O[1], Sivertsen B[2,3,4]
[1]Hjelt Institute, Department of Public Health, University of Helsinki, Helsinki, Finland, [2]Division of Mental Health, Norwegian Institute of Public Health, Bergen, Norway, [3]Faculty of Psychology, University of Bergen, Bergen, Norway, [4]Division of Psychiatry, Helse Fonna HF, Haugesund, Norway

Introduction: Combined measure of sleep duration and insomnia symptoms appears a stronger predictor of health outcomes than either component on its own. Our aim was to examine the joint association of sleep duration and insomnia symptoms with subsequent sickness absence.
Methods: The participants of the Finnish Helsinki Health Study were 40-60-year-old employees of the City of Helsinki (N=6845, 79% women). The baseline surveys were conducted in 2000-2002 and prospectively linked to the employer's sickness absence register data, mean follow-up time being 4.1 years. Sleep duration, insomnia symptoms (Jenkins Sleep Questionnaire), and confounding factors were derived from the baseline surveys. The outcome was the sickness absence spells. Poisson regression analysis was used to yield risk ratios (RR) with 95% confidence intervals (CI).
Results: A joint association of sleep duration and insomnia symptoms with subsequent sickness absence was found. Short (5h or less, RR 2.07, 95% CI 1.65-2.59) and long sleepers (9h or more, RR 1.83, 95% CI 1.27-2.62) with insomnia symptoms had a higher risk for medically certified sickness absence spells (4-14 days) as compared to 7-hour sleepers without insomnia symptoms. The longer the sickness absence spells, the stronger were the U-shaped associations. The risk for sickness absence spells longer than 60 days was equally strong for short (RR 3.89, 95% CI 2.20-6.88) and long sleepers (RR 3.88, 95% CI 1.60-9.38) with insomnia symptoms. Adjustments attenuated these associations, but they nevertheless remained.
Conclusion: Sleep duration and insomnia symptoms were jointly associated with subsequent sickness absence. This association was dominated by insomnia symptoms. To have a more comprehensive understanding of the associations between sleep and work disability both sleep duration and insomnia symptoms need to be simultaneously examined.

0637

A RANDOMIZED, PLACEBO-CONTROLLED, TRIAL OF COGNITIVE BEHAVIORAL THERAPY FOR CHRONIC INSOMNIA DISORDER DELIVERED VIA AN AUTOMATED MEDIA-RICH WEB APPLICATION

Espie CA[1,6], Kyle SD[1], Williams C[2], Brown JS[3], Ong JC[4], Douglas NJ[5], Hames P[6]
[1]University of Glasgow Sleep Centre, Institute of Neuroscience & Psychology, University of Glasgow, Glasgow, United Kingdom, [2]Institute of Health & Wellbeing, University of Glasgow, Glasgow, United Kingdom, [3]Institute of Psychiatry, London, United Kingdom, [4]Rush University Medical Center, Chicago, IL, USA, [5]Department of Sleep Medicine, Edinburgh Royal Infirmary, Edinburgh, United Kingdom, [6]Sleepio Ltd., London, United Kingdom

Introduction: The purpose of this study was to determine the effectiveness of a novel web-based CBT course for chronic insomnia delivered by an automated 'virtual therapist' when compared with a credible placebo intervention using the same media-rich web-based delivery mechanism. This approach is required for two reasons. First, internet applications of CBT are at an embryonic stage. A 'gold standard' scientific approach will build the necessary foundations for future research. Second, and more specifically, web products are known to be intrinsically appealing and engaging to many people and so may be particularly vulnerable to placebo response or the influence of non-specific therapeutic factors.

Methods: One hundred sixty-four adults (120 F: [mean age 49y (18-78y)] meeting proposed DSM-5 criteria for Insomnia Disorder, were randomly assigned to CBT (n=55; 40 F), Imagery Rehearsal Therapy (IRT: n=55; 42 F) or Treatment as Usual (TAU: n=54; 38 F). CBT and IRT each comprised 6 online sessions delivered by an animated personal therapist, with automated web and email support. Participants also had access to a library/ back catalogue of session content and 'Wikipedia' style articles. CBT users had access to a moderated social network/ community of users. TAU comprised no restrictions on 'usual care' and access to an online sleep diary. Major assessments were conducted at baseline, post-treatment, and 8-week follow-up; outcomes were appraised by online sleep diaries and clinical endpoint.
Results: CBT was associated with sustained improvement across all sleep variables. Specifically, findings favored CBT at post-treatment relative to both TAU (d=0.95) and IRT (d=1.06) [both large effect sizes (ES)], and at 8 weeks relative to IRT (d=1.00) and TAU (d=0.69) on the primary end-point of sleep efficiency (SE; total time asleep expressed as a percentage of the total time spent in bed). Clinical benefits of CBT were evidenced by superiority over placebo on daytime measures (small ES) and by improved sleep-wake functioning on the Sleep Condition Indicator (range of d=0.77-1.20). Three-quarters of CBT participants completed treatment with SE >80%, more than half with SE>85% and one-third with SE>90%, and these improvements were largely maintained during follow-up.
Conclusion: CBT delivered using an online media-rich web application with automated support and a community forum is effective in improving the sleep and associated daytime functioning of adults with insomnia disorder.

0638

SLEEPINESS, FATIGUE AND SELF-REPORTED SIDE-EFFECTS DURING SLEEP RESTRICTION THERAPY FOR INSOMNIA

Kyle SD, Crawford M, Miller C, Espie CA
University of Glasgow Sleep Centre, Institute of Neuroscience & Psychology, University of Glasgow, Glasgow, United Kingdom

Introduction: Sleep Restriction Therapy (SRT) is one of the most effective components of CBT for insomnia. It is also one of the most challenging; previous work from our group revealed the presence of side-effects and implementation difficulties during week one of treatment. Here we report the number and nature of side-effects, levels of fatigue and sleepiness experienced by patients throughout the course of a 4-week SRT intervention.
Methods: Twenty-seven patients (20 females; Mean age=48.9) meeting criteria for primary insomnia have completed the full SRT protocol. The intervention involves one main session to deliver SRT instructions, and four subsequent brief interactions to review sleep efficiency. Patients completed the Epworth Sleepiness Scale (ESS) and Flinders Fatigue Scale (FFS) at baseline, weeks 1, 2, 3, 4, and 3 months follow-up; and a side-effects inventory throughout treatment and at follow-up, asking them to check whether they had experienced 14 specified symptoms as a consequence of SRT.
Results: Insomnia severity, measured with the ISI, significantly decreased from baseline to post-treatment [M=18.8 (4.2) v. 11.2 (6.9), p<.01]. ESS scores demonstrated a main effect of time (p<.0001), significantly increasing (all p<.05) from baseline [M=4.2 (3.6)] during weeks 1 [M=6.5 (4.2)], 2 [M=7.1(5.1)], 3 [M=6.8 (5.0)] and 4 [M=6.2(5.0)], returning to baseline levels at follow-up [M=4.3(4.4); p>.05]. This pattern of increased sleepiness was paralleled by an increase in the proportion of patients scoring in the excessive sleepiness range (8% at baseline, peaking at 38% during week 2, and reducing to 17% at 3 months). Fatigue also showed a main effect of time (p<.01), increasing (non-significantly; p=.18) during week 1, and showing a gradual decrease over weeks 2,3 and 4, being significantly lower than baseline by 3 months (p<.01). Self-reported side-effects were common during weeks 1 (Mean number of symptoms=6.8 (3.2)], 2 [M=7.1 (3.5)] and 3 [M=5.7 (3.6)], decreasing significantly by 3 months [M=4.6 (3.6)]. The five most commonly reported side-effects were fatigue/exhaustion, extreme sleepiness, impaired memory, reduced energy/motivation and difficulty concentrating.
Conclusion: This preliminary work tentatively indicates that SRT is associated with negative side-effects and elevated daytime sleepiness, both of which appear maximal within the first 2-3 weeks of therapy. Awareness of the potential for adverse events during SRT implementation may inform patient care.
Support (If Any): Research funding from The Chief Scientist Office.

0639

A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED TRIAL OF ESZOPICLONE FOR THE TREATMENT OF INSOMNIA IN PATIENTS WITH CHRONIC LOW BACK PAIN

Krystal AD, Preud'homme XA, Goforth HW
Psychiatry, Duke, Durham, NC, USA

Introduction: Insomnia, which is almost universal in chronic low-back pain (LBP), has long been viewed as a pain symptom which did not merit specific treatment. Recent data suggest that adding insomnia therapy to pain-targeted treatment should improve outcome, however, this has not been empirically tested in LBP or in any pain condition treated with a standardized pain regimen. We aimed to test the hypothesis that adding insomnia therapy to pain-targeted treatment might improve sleep and pain outcomes in LBP.
Methods: This was a double-blind, placebo-controlled, one-month trial carried out in 70 adults with LBP who met diagnostic criteria for insomnia. The study sample was comprised of 52 of these subjects who had at least 1 post-randomization assessment. Subjects were randomized to receive Eszopiclone 3 mg plus naproxen 500 mg BID or matching placebo plus naproxen 500 mg BID. The primary outcome measure was sleep diary-derived total sleep time. Primary pain outcomes were Visual Analogue Scale (VAS) and Patient Global Impression (PGI) pain ratings.
Results: : Analyses in the intent-to-treat population indicated that eszopiclone significantly improved total sleep time (p<0.0001) and nearly all sleep measures (p<0.05) as well as VAS pain (p<0.004) and PGI pain (p<0.08) and depression (0.024) compared with placebo. Changes in pain ratings were significantly correlated with changes in sleep.
Conclusion: The addition of insomnia-specific therapy (eszopiclone) to a standardized naproxen pain regimen significantly improves sleep, pain, and depression in LBP patients. The findings indicate the importance of administering both sleep and pain-directed therapies to LBP patients in clinical practice and provide the strongest evidence to date that improving sleep disturbance may improve pain. Further studies will be needed to determine if the observed effects are associated with other insomnia therapies and in other pain conditions.
Support (If Any): This study was supported by an investigator initiated grant from Sepracor Corp. to Dr. Krystal.

0640

A POPULATION-BASED STUDY OF THE NATURE AND PREVALENCE OF OFF-LABEL MOTN USE OF PRESCRIPTION HYPNOTICS

Kessler RC[1], Berglund P[2], Shahly V[1], Shillington AC[3], Stephenson JJ[4], Roth T[5]
[1]Department of Health Care Policy, Harvard Medical School, Boston, MA, USA, [2]Institute for Social Research, University of Michigan, Ann Arbor, MI, USA, [3]Epi-Q, Inc., Oak Brook, IL, USA, [4]HealthCore, Inc., Wilmington, DE, USA, [5]Sleep Disorders and Research Center,, Henry Ford Health System, Detroit, MI, USA

Introduction: Middle-of-the-night (MOTN) awakening followed by difficulty returning to sleep is a highly prevalent insomnia phenotype associated with significant morbidity. It was only recently that the FDA

approved a drug specifically for this patient population. This study was conducted in 2010 to assess the prevalence and nature of off-label MOTN hypnotic use (as no drug had yet been approved), and the results are described herein.

Methods: 1,927 subjects, ages 18-64yrs, receiving a hypnotic prescription in the past year, were randomly sampled from >120,000 eligible members of a health plan (>34 million lives). Respondents with a history of MOTN hypnotic use who reported never using a hypnotic twice in the same night (n=209), plus a weighted sample of at-bedtime only users (n=303), were studied further.

Results: 20.2% of the 1,927 subjects reported using hypnotics during MOTN awakening at least some of the time - 11.1% never used hypnotics twice in the same night and 9.1% did - and 79.8% used them at bedtime only. Of those studied further (n=512), 43.0% of MOTN and 28.0% of bedtime users reported MOTN awakening as their biggest sleep problem. Of those reporting MOTN insomnia as their biggest sleep problem, 51.5% reported MOTN use. Only 14.0% of those who used MOTN did so under doctors' direction. 86.0% of MOTN users had a MOTN dosing rule to determine when during the night to take the medication: average MOTN use time was 6 hours before having to arise. Hypnotics taken MOTN and at-bedtime were essentially the same, with the three most commonly used drugs being zolpidem, eszopiclone and temazepam.

Conclusion: These data demonstrate that hypnotics are frequently used in the middle of the night, albeit off label, thus highlighting a medical need for drugs which have been evaluated for safety and efficacy of MOTN use.

Support (If Any): This study was funded by Transcept Pharmaceuticals, Inc.

0641

LONG TERM SAFETY AND EFFICACY OF SUVOREXANT IN PATIENTS WITH PRIMARY INSOMNIA

Herring WJ[1], Snyder E[1], Paradis E[1], Liu M[1], Snavely D[1], Roth T[2], Michelson D[1]

[1]Merck, Whitehouse Station, NJ, USA, [2]Henry Ford Hospital, Detroit, MI, USA

Introduction: Orexinergic activity in the brain plays a critical role in sleep/wake regulation. Suvorexant is an investigational orexin receptor antagonist previously shown to be effective and well-tolerated over 4-weeks in patients with primary insomnia. We evaluated its clinical profile over long-term use.

Methods: 12-month, randomized, double-blind, placebo-controlled, trial of nightly suvorexant (40-mg for patients 18-64 years; 30-mg for patients ≥65 years) in patients with Primary Insomnia. Safety was assessed by adverse event (AE) reports. Efficacy was assessed by patient self-report of total-sleep-time (sTST), time-to-sleep-onset (sTSO), and wake-after-sleep-onset (sWASO); the primary evaluation period was the first 4-weeks, with exploratory efficacy analyses performed over the 12-month treatment phase. The 12-month treatment phase was followed by a randomized discontinuation phase to assess possible rebound and withdrawal effects, the latter through use of the Tyrer Withdrawal Symptom Questionnaire (TWSQ); patients previously on suvorexant were randomized to suvorexant or placebo while those on placebo remained on placebo.

Results: 522 patients were randomized to suvorexant and 259 were randomized to placebo; 62% in each group completed the 12-month portion of the study and 97% of these completed the discontinuation phase. Treatment with suvorexant was generally safe and well-tolerated (proportion of patients discontinuing due to AE over the 12-month phase: suvorexant=11.7%, placebo=8.5%); the AE showing the largest treatment difference over the 12-month phase was somnolence (suvorexant=13.2%, placebo=2.7%). The percent of patients who reported ≥3 withdrawal symptoms on the TWSQ on any of the first 3 nights of the discontinuation phase was low (≤3.2% in any treatment group), with no statistically significant differences between treatments. Suvorexant was superior to placebo ($p<0.001$) in improving sTST (by 23-minutes), sTSO (by 10-minutes), and sWASO (by 9-minutes) over the first 4-weeks, and at each month over 12-months (nominal p-values<0.05).

Conclusion: Suvorexant was generally safe, well-tolerated and effective over 12-months, with no evidence of significant rebound or withdrawal effects following discontinuation.

Support (If Any): Merck.

0642

HEART RATE VARIABILITY ON USERS OF SEDATIVE-HYPNOTIC MEDICATIONS

Burke PR, Moraes W, Cintra F, da Silva RS, Bittencourt LA, Tufik S, Poyares D

Psychobiology, Universidade Federal de São Paulo, São Paulo, Brazil

Introduction: Heart rate (HR) variations are physiological, mainly modulated by the Autonomic Nervous System and are secondary to breathing, stress, exercise, hemodynamic and metabolic changes, and sleep. This study`s hypothesis is that HR variability (HRV) during sleep can be modulated by the use of sedative-hypnotic medications.

Methods: 1042 volunteers of both genders from the city of São Paulo underwent an all-night polysomnography (PSG) and calculation of off-line HRV analysis by dedicated software (Cardiosistemas ®). Analysis in time domain was obtained from sleep onset to final awakening. In addition, some variables obtained by examining the PSG, as the minimum oxygen saturation (SatO2 min) and apnea-hypopnea index (AHI) and body weight were analyzed. The participants were divided into 2 groups: take (group 1) and do not take (group 2) sleeping pills. Of the total, 762 participants answered the question properly: 204 were included in group 1 and 558 in group 2. The diagnosis of insomnia was made according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV). Insomnia was quantified using the Insomnia Severity Index.

Results: 1) Comparison between groups: Group 1 had significantly lower SDNN (standard deviation of the average of all normal RR intervals), SDNN index (the mean of all the 5-minute standard deviations of normal RR intervals), pNN50 (the percent of differences of adjacent RR intervals longer than 50 milliseconds). 2) Regression: SDNN ($p = 0.03$), SDNNIDX ($p = 0.03$) and pNN50 ($p = 0.01$) were significantly associated with the use of sleeping pills, even after controlling for confounding factors such as insomnia, AHI, SatO2 min and body weight.

Conclusion: Regardless of the severity of insomnia, the AHI, SatO2 min and body weight, the population who took sedative-hypnotic medications showed a decrease in HRV, especially with reduced parasympathetic component.

Support (If Any): AFIP, FAPESP and CNPq.

0643

COGNITIVE BEHAVIORAL THERAPY FOR SLEEP AND PAIN IN OLDER ADULTS WITH CO-MORBID INSOMNIA AND OSTEOARTHRITIS: RESULTS OF THE LIFESTYLES RANDOMIZED CONTROLLED TRIAL

Vitiello MV[1], McCurry SM[2], Von Korff M[3], Shortreed SM[3], Balderson BH[3], Baker LD[1], Keefe FJ[4], Rybarczyk B[5]

[1]Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, USA, [2]Psychosocial and Community Health Nursing, University of Washington, Seattle, WA, USA, [3]Group Health Research Institute, Seattle, WA, USA, [4]Psychiatry and Medical Psychology, Duke University, Durham, NC, USA, [5]Psychology, Virginia Commonwealth University, Richmond, VA, USA

Introduction: Osteoarthritis (OA) is a common cause of pain and disability among older adults with the prevalence of OA over 60% among persons > 65 years. Since both OA pain and sleep disturbance are common among older adults, and adversely affect function and quality of life, there is a compelling rationale for integrated management of both

pain and sleep in OA. The likely reciprocal effects of pain dysfunction and sleep disturbance suggest potential benefits of such an integrated approach. Here we report the results of LIFESTYLES, a RCT testing the effects of an integrated intervention for pain and insomnia management.
Methods: 367 older adults with co-morbid OA and insomnia were randomized to three groups: CBT-Pain/Insomnia (CBT-PI), CBT-Pain (CBT-P) and Education Only Control (EOC), each of six weekly 90 minute sessions. Sleep, pain, function, affect and cognition were assessed pre and post-treatment and at 9-month follow-up.
Results: All LIFESTYLES interventions were perceived as comparably credible and subject retention was very high (post-treatment = 96.7 and 9-month = 92.9%). CBT-PI significantly ($p<.001$) improved Insomnia Severity Index (ISI) scores and actigraphic sleep efficiency (SE) relative to EOC across 9 months. CBT-PI significantly ($p<.001$) improved ISI relative to CBT-P, while both significantly ($p<.001$) improved SE relative to EOC across 9 months. Pain was not significantly reduced by any LIFESTYLES intervention. However, an apriori planned subgroup analysis of subjects with higher baseline pain revealed a CBT-PI-related trend ($p=.06$) towards less pain severity across 9 months.
Conclusion: CBT-PI, an integrated cognitive behavioral approach to sleep disturbance and pain in OA resulted in significantly improved sleep and a trend towards reduced perceived pain in older adults with higher levels of baseline pain at post-treatment and 9 month follow-up relative to standard CBT for pain or an education only control.
Support (If Any): Supported by PHS grant AG031126 (Multiple PIs: MVV, SMM and MVK).

0644

THE STAGE OF CHANGE SCALE FOR INSOMNIA (SOCSI)- A NEW SCALE TO MONITOR READINESS TO CHANGE DURING A SLEEP RESTRICTION THERAPY FOR INSOMNIA

Crawford M[1,2,3], Kyle SD[1], Juliet F[2], Bartlett DJ[2,3], Grunstein RR[2,3], Espie CA[1,3]
[1]University of Glasgow Sleep Centre, Glasgow, United Kingdom, [2]Woolcock Institute of Medical Research, University of Sydney, Sydney, NSW, Australia, [3]NHMRC Centre for Integrated Research and Understanding of Sleep, Sydney, NSW, Australia

Introduction: Behaviour change is a dynamic process with individuals passing through stages reflecting varying degrees of readiness for change. Sleep restriction therapy (SRT), an established treatment for insomnia, requires intense behaviour change that is often paradoxical to the patient's initial goals. This study aimed to document the relationship between stage of change and adherence to SRT.
Methods: Twenty-three individuals with primary insomnia (mean age=48; female=18) have completed the 4-week SRT and 3-month follow up. The intervention included a baseline session introducing rationale/instructions, with 4 subsequent brief titrating sessions (week 1-4). Stage of Change is measured at each time point. Objective adherence to prescribed time in bed (pTIB) and variation in bed and rising times (vTIB) was established with actiwatch event markers. The stage of change questionnaire also measured self-efficacy and an open-box response format enabled a patient-generated account of pros/cons of and strategies to help implement change.
Results: The treatment intervention produced significant change in insomnia severity scores from baseline (mean=19) to post treatment (mean=12, $p<0.01$). All participants were in the preparation stage at baseline. At week 1 individuals scored in the preparation stage (n= 7; 30%) and the action stage (n=16; 70%).This ratio remained for all subsequent time points. At follow-up the ratio changed with 44% in a preparation or lower stage, and 56% in action/maintenance. A non-parametric Mann-Whitney test showed that both minute deviation from pTIB and vTIB during treatment was increased (poorer adherence) in individuals who at week 1 scored in the preparation stage (medians = 28.5; 31.4) compared to those in the action stage (medians = 11; 10.5) all $p<0.05$. Lower self-efficacy pre-treatment was associated with more variability in actual rising time during the 4 weeks ($r=-.5$, $p<0.05$). Sleep improvements and tiredness were most often reported as the pros and cons for change respectively, at baseline individuals often reported behavioural strategies to help implement change (finding activities), however more cognitive strategies (staying motivated) were more likely to be reported at post treatment.
Conclusion: Documenting readiness to change and self-efficacy at early periods during therapy can provide useful information about who will adhere to a sleep restriction programme.
Support (If Any): Centre of Integrated Research and Understanding of Sleep (CIRUS) Sackler Institute of Psychobiological Research.

0645

DOUBLE BLIND, POLYSOMNOGRAPHIC, TWO-WAY CROSSOVER STUDY WITH A GASTRIC RETENTIVE ACCORDION-PILL ZALEPLON, IN SUBJECTS WITH INSOMNIA

Friedman H[2], Navon N[2], Koshorek G[1], Reinberg R[2], Roth T[1]
[1]Sleep Disorders & Research Center, Henry Ford Hospital, Detroit, MI, USA, [2]Intec Pharma Ltd, Jerusalem, Israel

Introduction: The majority of insomniacs experience both difficulties in falling asleep as well as staying asleep either concurrently or cyclically during the course of their insomnia. Zaleplon has previously been shown effective for sleep onset but not sleep maintenance. Its rapid onset as well as offset of action makes it an ideal candidate for a sustained release formulation for treating both sleep induction and maintenance. The Accordion Pill™-Zaleplon (Zaleplon AP) combines the two attributes of zaleplon, rapid absorption and rapid elimination with the controlled release of the Accordion Pill™ technology to provide a treatment that will bring a fast onset of sleep, maintain sleep throughout the night and be rapidly cleared once drug release is finished, to avoid daytime sedation and hangover effect.
Methods: This was a phase II, polysomnographic double-blind, crossover study in adult patients with insomnia. Participants (n=83) received placebo, and Zaleplon AP 25mg before bedtime for 2 consecutive nights with 4-7 days of washout between treatments. The primary endpoint was Total Sleep Time both by PSG and patient report and the key secondary endpoints were sleep induction followed by sleep maintenance and Number of Awakenings. Residual effects were evaluated within 1 hour of awakening using the Digit Symbol Substitution Test (DSST) and a memory test.
Results: The primary endpoint TST significantly increased both as measured by PSG (18 minutes) as well as patient reports (22 minutes) both $p<001$ relative to placebo. In terms of secondary endpoints sleep latency was significantly decreased as measured by PSG and patient reports (both $p<001$). WASO was decreased in the first part of the night. Finally, patients reported a significant improvement in sleep quality. DSST, memory testing and patient reports showed no (even directionally) residual effects.
Conclusion: Zaleplon AP at 25 mg significantly improves total sleep time reduces sleep latency and WASO in the early part of the night. Using multiple assays there is no evidence of residual effects. These data support pursuing Zaleplon AP 25mg and as well as higher doses for the treatment of insomnia.

0646

RESPONSE AND REMISSION DEFINITIONS FOR CBT-I: A QUANTITATIVE REVIEW

McKay GD[1,2], Berkowitz Sturgis EK[1,2], Grandner MA[3], Gehrman P[1,2], Perlis ML[1,2]

[1]Behavioral Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [3]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Over the last 40 years, there have been >200 clinical trials of CBT-I. Outcomes from these trials were usually reported as mean change from pre-treatment to post-treatment. In order to enhance the clinical relevance of the contemporary randomized clinical trials (RCTs), recent studies have also provided outcome data in terms of response and remission.

Methods: In order to gain an appreciation for the current operationalizations of these clinical variables, a quantitative review was conducted using PubMed and PsycInfo (RCTs between 2001-2011). A total of 21 studies were identified: 5 provided criteria for treatment response and 19 provided criteria for remission.

Results: Remission was assessed in 3 ways: 1) using the Insomnia Severity Index (ISI) or the Pittsburgh Sleep Quality Index (PSQI) alone [6 studies], 2) using threshold values for SL, WASO and SE% [8 studies], or 3) a combination of these approaches [3 studies]. The modal cut-offs for remission were an ISI of 8 or less, 5-6 on the PSQI , and SL and/or WASO values of <30 minutes, with one article using a <15 minute rule. SE% (>85% or ≥85%) was taken into account on 7 occasions, but was never used as the sole criteria. Treatment response was assessed in 2 ways: 1) Percent change pre-to-post on SL, WASO, NWAK, and/or TWT [4 studies] and 2) An absolute or relative change pre-to-post on the ISI [3 studies]. The modal cutoff for response was a 50% change pre-to-post for both the ISI and on SL, WASO, NWAK, and/or TWT measures. The absolute change pre-to-post for the ISI was 7.

Conclusion: While there is great heuristic value in framing treatment efficacy in this manner (i.e., what percentage of patients get better and/or recover based on a quantitative metric), the definitions are highly variable and there is a clear need to standardize these metrics.

Support (If Any): This work was supported by T32HL007713, R01AT003332, and R01MH077900.

0647

CHRONIC HYPNOTIC SELF-ADMINISTRATION AND HYPERAROUSAL IN INSOMNIA

Roehrs T[1,2], Randall S[1], Roth T[1,2]

[1]Sleep Disorders & Research Center, Henry Ford Health System, Detroit, MI, USA, [2]Psychiatry & Behavioral Neurosciences, School of Medicine, Wayne State University, Detroit, MI, USA

Introduction: Insomnia is hypothesized to be a disorder of hyperarousal shown by elevated mean daily sleep latency on the Multiple Sleep Latency Test (MSLT). Elevations are not seen in all insomniacs. We evaluated whether hyperarousal in insomnia is predictive of increased hypnotic self-administration during chronic use.

Methods: Insomniacs (N=58), ages 32-65, meeting DSM-IV-TR criteria and a screening NPSG sleep efficiency of <85%, no other primary sleep disorders, no psychiatric diseases or drug dependency and in good health were recruited. All received a MSLT (1000, 1200, 1400, 1600 hrs) at baseline. Participants took 10mg zolpidem or placebo, double-blind, nightly for 12 consecutive months. In months 1, 4 and 12, self-administration assessments occurred. The zolpidem group had a color-coded zolpidem (10mg) or a placebo capsule on sampling nights 1 and 2, counter balanced. The following 5 nights, participants chose 1, 2, or 3 zolpidem (5mg each) or placebo capsules. The placebo group choose color-coded placebo capsules, up to 3 nightly. All medications were taken 30 min before bedtime.

Results: The placebo group increased the number of capsules taken over months (M1: 8.2, M4: 9.9, M12: 9.7) (p<.004), while the zolpidem group did not (M1: 8.7, M4: 8.9, M12: 9.0) (NS). Across both insomnia groups those with High MSLTs (>15 min) took a greater number of capsules (placebo or drug) in months 1, 4, and 12 than those with Low MSLTs (<10 min) (M1:9.4 vs 8.4, M4:10.4 vs 8.7, M12:10.7 vs 8.0) (p<.05). Finally, there was a trend showing those with High MSLTs were more likely to increase from month 1 the number of capsules taken in months 4 (1.0 vs 0.3) and 12 (1.4 vs -0.5) compared to those with Low MSLTs (p<.08).

Conclusion: Hyperarousal among insomniacs, as defined by MSLT, is predictive of higher rates of self-administration (both placebo and active drug) during 12 months of nightly use.

Support (If Any): NIDA, grant#: R01DA17355 awarded to Dr. Roehrs.

0648

CHRONIC ZOLPIDEM: CORRELATION OF SUBJECTIVE AND OBJECTIVE EFFICACY MEASURES AND DAYTIME FUNCTION

Randall S[1], Roehrs T[1,2], Roth T[1,2]

[1]Sleep Disorders & Research Center, Henry Ford Health System, Detroit, MI, USA, [2]Psychiatry & Behavioral Neurosciences, School of Medicine, Wayne State University, Detroit, MI, USA

Introduction: Insomnia is defined as a report of difficulty falling asleep or staying asleep associated with daytime impairments or distress. Yet NPSG studies of hypnotic efficacy do not relate NPSG efficacy results to patient reports of daytime function. This study evaluated the correlation of NPSG effects with subjective results and daytime function during chronic zolpidem treatment in primary insomniacs.

Methods: Primary insomniacs (N=91) meeting DSM-IV-TR criteria, ages 23-70, without psychiatric disease or drug dependency and in good general health participated. They also had to have a NPSG screening sleep efficiency of <85%. Participants were randomly assigned to receive 10mg zolpidem or placebo nightly, double blind for 12 consecutive months. On 2 consecutive nights in months 1 & 8, zolpidem efficacy was assessed with an 8hr NPSG. All dependent measures were the monthly mean of 2 nights. Post-sleep questionnaires queried for estimates of sleep latency, WASO, TST, morning concentration and sleepiness following the NPSG. Pearson correlations were conducted between objective and subjective sleep variables.

Results: Across both months subjective measures of sleep latency (r=0.617), WASO (r=0.705) and TST (r=0.388) were correlated with their objective counterpart (all, p<0.05). With zolpidem, the percentage of stage 3/4 sleep was negatively correlated with morning sleepiness at month 1 (r=-0.573) and month 8 (r=-0.340, both p<0.02), but not in the placebo group. Morning concentration was positively correlated with the percentage of stage 3/4 sleep assessed at month 1 (r=0.518; p=0.001) but not in month 8 (r=-0.264; p=0.091) in the zolpidem group. On placebo, there were no significant correlations between the percentage of stage 3/4 sleep and concentration ability in the morning.

Conclusion: Overall, subjective evaluations of sleep latency, WASO, and TST paralleled NPSG results. Within the zolpidem group increased percentage of stage 3/4 sleep was associated with decreased morning sleepiness (or alertness) and with improved concentration.

Support (If Any): NIDA, grant#: R01DA17355 awarded to Dr. Roehrs.

0649

A NEW METHOD OF DYNAMIC, RELATIONAL, ELECTROENCEPHALIC AUDITORY FEEDBACK FOR PRIMARY INSOMNIA

Tegeler CH[1], Kumar S[1], Conklin D[1], Turner D[2], Tegeler C[2], McCall V[3], Houle T[2]

[1]Neurology, Wake Forest School of Medicine, Winston-Salem, NC, USA, [2]Anesthesiology, Wake Forest School of Medicine, Winston-Salem, NC, USA, [3]Psychiatry, Wake Forest School of Medicine, Winston-Salem, NC, USA

Introduction: Effective non-drug therapy for insomnia is needed. High-resolution, relational, resonance-based electroencephalic mirroring (HIRREM) is a computer-based, non-invasive method to facilitate greater client-unique, autocalibrated improvements of balance and harmony in cortical neural oscillations, as measured by scalp-recorded spectral EEG. Proprietary sensors collect more precise data for mapping frequencies and amplitudes. During sessions, the dominant floating mid-range EEG frequency is translated to an audible tone, which is played back through earphones with <25 msec delay. Resonance between the tones and oscillating neural circuits act to balance and harmonize amplitudes and frequencies uniquely for the subject. We explore HIRREM for primary insomnia.
Methods: After informed consent, 20 subjects (14 women, age 45.4 +/- 13.9, mean ISI 18.6) with primary insomnia, and an Insomnia Severity Index (ISI) of ≥ 15, were randomized to 8-12 sessions of HIRREM over 3 weeks, plus usual care (HUC), or usual care alone (UC). Pre- and post-HIRREM data collection included ISI (primary outcome), CES-D, SF-36, HR, BP, neuro-cognitive testing, and VAS scales. The UC group crossed-over to receive HIRREM. ISI was repeated 4-6 weeks following HIRREM.
Results: Analysis for differential change of ISI in the initial intervention period for HUC vs UC showed a drop of -10.3 points (95% CI: -13.7 to -6.9, p<0.0001, standardized effect size of 2.68). Differential change for the cross-over UC group was statistically identical, and effects persisted, with slightly lower ISI at 4-6 weeks post-HIRREM. Differential change in the HUC group was significant for CES-D (-8.8, CI -17.5 to -0.1, p=0.047), but other secondary outcomes were not significant.
Conclusion: HIRREM appears feasible, with significant, clinically relevant benefits for primary insomnia. Effects persisted for one month after completion. In spite of a small cohort, and wait-list design, we confirm a need for additional studies.
Support (If Any): Supported by a research grant from Brain State Technologies, Inc, Scottsdale, AZ.

0650

AGE EFFECTS ON ZOLPIDEM EFFICACY

Randall S[1], Roehrs T[1,2], Roth T[1,2]

[1]Sleep Disorders & Research Center, Henry Ford Health System, Detroit, MI, USA, [2]Psychiatry & Behavioral Neurosciences, School of Medicine, Wayne State University, Detroit, MI, USA

Introduction: Aging is a risk factor for insomnia and hence may also impact the efficacy of hypnotics. Most hypnotic efficacy studies combine insomniacs of various ages in the same analysis, or more typically study only one age group, making it difficult to delineate treatment efficacy as a function of age. Zolpidem hypnotic efficacy as a function of age was assessed in a post hoc analysis of a comprehensive clinical trial of long-term hypnotic use in chronic insomnia.
Methods: Primary insomniacs (N=91) meeting DSM-IV-TR criteria, ages 23-70, without psychiatric disease or drug dependency were recruited. On screening insomniacs were required to have a NPSG sleep efficiency of <85%. Randomly assigned participants received 10mg zolpidem or placebo, double blind nightly for 12 months. Zolpidem efficacy was assessed with an 8hr NPSG on 2 consecutive nights in months 1 (M1) and 8 (M8) of the trial. Age categories analyzed were: young (21-45yrs, N=29), middle (46-59yrs, N=42), and older (62-70yrs, N=20).
Results: At baseline, sleep efficiency among age groups did not differ (p=0.802), likely due to the screening criteria. Among the middle (M1: +7%, M8: +8%; p<0.001) and old age (M1: +12%, M8: +8%; p<.02) groups zolpidem vs placebo increased sleep efficiency in M1 & M8 with no months or months by drug interactions. In contrast, sleep efficiency was not improved (p=0.18) among the young insomniacs. Among the placebo subjects in the young age group sleep efficiency increased relative to baseline in M1 (+10%; p<0.002) and M8 (+9%; p<0.01), while in the middle and old age groups no change from baseline occurred among the placebo subjects.
Conclusion: Zolpidem efficacy was found among middle and old age insomniacs, but not in those < 45 yrs old. The absence of zolpidem efficacy in the young was due to a placebo response not seen in the older insomniacs.
Support (If Any): NIDA, grant#: R01DA17355 awarded to Dr. Roehrs.

0651

EFFECTIVENESS OF A SINGLE-SESSION COGNITIVE BEHAVIORAL THERAPY PROGRAM IN A LARGE GROUP SETTING FOR INSOMNIA

Gulley CC[1], Becker K[1], Ho S[1], Chang JW[1], Petrilla JC[1], Kim JB[1], O'Neill K[1], Hwang D[1,2]

[1]Sleep Medicine, Kaiser Permanente, Fontana, CA, USA, [2]Pulmonary, Critical Care, Sleep Medicine, NYU School of Medicine, New York, NY, USA

Introduction: Cognitive behavioral therapy (CBT) is recommended for long-term chronic insomnia management. Traditionally, CBT is performed utilizing multiple sessions and as individuals or small groups. This limits effectively addressing the high volume of insomnia in the population. We assess the effectiveness of a single-session CBT program performed in a larger group setting.
Methods: Kaiser Permanente Fontana Medical Care Program conducts a CBT program for primary insomnia (Sleep Eazzzy) consisting of one 2.5 hour session in groups up to 20 persons, taught by a physician assistant. Program addresses: sleep hygiene, beliefs about sleep, relaxation techniques, sleep restriction therapy, sleep medication use, and sleep position optimization. Individual telephone follow-up is conducted and repeated until there is significant improvement or patient declines further follow-up (program completed). Subjective responses from the final telephone follow-up were compared to baseline to assess program effectiveness.
Results: 303 of 586 patients referred to Sleep Eazzzy over 12 months had completed the program. 270 (89.1%) reported insomnia improvement (self-reported improvement was mild in 24%, moderate in 33%, and resolution of insomnia in 32%). Statistically significant improvement was seen comparing averages of pre and post program sleep parameters: sleep latency (55 vs 25 minutes), number of awakenings (3.0 vs 1.4), total sleep time (5.0 vs 6.6 hours). The 110 patients on sleep medications decreased their use (6.2 vs 4.0 nights/week), and 32 (29%) discontinued use of sleep medications. Improvements were similar for all groups: men (112), women (191), obstructive sleep apnea (84), use of anti-depressants (56), fibromyalgia (25), shiftworkers (18), restless leg syndrome (15). Patients had an average of 1.3 telephone calls for program completion.
Conclusion: This study suggests that a single-session CBT program in a larger group setting may effectively treat insomnia. Objective assessment of sleep parameters and duration of effect is required.

0652
WITHDRAWN

0653
OUTCOMES OF NON-PHARMACOLOGICAL TREATMENT OF BEHAVIORAL INSOMNIA OF CHILDHOOD IN A SLEEP CLINIC POPULATION

Stear TJ[1], Zallek SN[1,2,3], Lipovsky C[1]
[1]Sleep Center, OSF St. Francis Medical Center, Peoria, IL, USA, [2]INI Sleep Center, Illinois Neurological Institute, Peoria, IL, USA, [3]University of Illinois College of Medicine at Peoria, Peoria, IL, USA

Introduction: Night wakings and bedtime refusal affect approximately 30-40% of children. Sleep problems often have negative effects on children, parents and families. Two ways of treating sleep problems include pharmacotherapy and behavioral therapy. There is limited published evidence of the safety or effectiveness of pharmacotherapy as a treatment for sleep problems; however many receive this type of treatment. There is extensive evidence in the literature for behavioral therapy as an effective method in combating childhood insomnia yet little has been shown of the effects of behavioral therapy for childhood insomnia in a sleep clinic population. The purpose of this study was to compare the clinical outcomes of behavioral techniques versus no intervention for the treatment of Behavioral Insomnia of Childhood in a sleep clinic population.
Methods: Records from 148 subjects aged 8 months to 16 years who reportedly applied behavioral techniques for childhood insomnia provided at the time of initial consultation were analyzed in blinded fashion by two board certified sleep physicians. The change in subjectively reported sleep quality and quantity after treatment was rated on a -3 to +3 scale. Behavioral techniques included gradual withdrawal, The Sleep Fairy by Janie Peterson, sticker charts, and a set sleep schedule. The control group consisted of 31 subjects who did not apply behavioral techniques or other intervention for insomnia after the initial clinical consultation. Treatment and control groups were compared using the Mann-Whitney Test.
Results: Behavioral therapy in the treatment group was associated with a mean rating of change in sleep quality or quantity of +1.557 (on a -3 to +3 scale) compared to +0.097 for the control group ($P<0.0001$).
Conclusion: Behavioral techniques were associated with increased sleep quality and quantity in the treatment subjects vs. controls. These findings suggest that behavioral therapy for childhood insomnia in a sleep clinic population is an effective form of treatment.

0654
THE SHORT-TERM PHYSIOLOGICAL EFFECTS ON HEART RATE VARIABILITY AND DIGITAL INFRARED THERMOGRAPH VIA ACUPUNCTURE ON COLLEGIATE FEMALE STUDENTS WITH PRIMARY INSOMNIA

Yang C[1], Wei C[2]
[1]Neurology, Chang Bing Show Chwan Memorial Hospital, Changhua County, Taiwan, [2]Sleep Center, Chang Bing Show Chwan Memorial Hospital, Changhua County, Taiwan

Introduction: We explored the physiological effects of the automatic nervous system (ANS) and the temperature of face and palms by the stimulation of acupuncture on primary insomnia subjects.
Methods: Thirty-three female college students of primary insomnia (PI) and 275 female healthy college students were recruited the study. They all received the single stimulation of acupuncture in the points including Neiguan (PC-6), Shenmen (HT-7), Taichong (LR-3), Hegu (LI-4), Zusanli (ST-36), Sanyinjiao (SP-6). The blood pressure, 5-minutes heart rate variability (HRV) and the digital infrared thermograph of face and palms were collected before and after acupuncture in both groups.
Results: The activity of index of very-low-frequency (VLF, 0.003-0.04Hz), high frequency (HF, 0.15-0.40Hz), low-frequency (LF, 0.04-0.15Hz), total power (TP, 0-0.5 Hz), LF in normalized units (LF%) , heart rate, systolic blood pressure and the average temperature in PI group were significant lower ($p<.001$) than normal group, but the index of HF in normalized units (HF%) in PI group was significant higher ($p<.001$) than normal group on pre-acupuncture stage. Except the heart rate, the VLF, HF, LF, TP, systolic blood pressure, diastolic blood pressure and the average temperature in PI group were significant higher ($p<.001$) than normal group on post-acupuncture stage.
Conclusion: The PI group showed that dysfunction in ANS and the temperature over body surface. The acupuncture stimulation on special points could regulate physiological effects. The acupuncture may be one of the effective methods for primary insomnia.

0655
TOLERABILITY, PHARMACOKINETIC AND PHARMACODYNAMIC EVALUATION OF MULTIPLE ASCENDING DOSES OF NEU-P11 IN INSOMNIA PATIENTS

Laudon M[1], Katz A[1], Metzger D[2], Staner L[2], Pross N[2], Cornette F[2], Guichard N[2], Nir T[1], Zisapel N[1,3]
[1]Neurim Pharmaceuticals Ltd., Tel Aviv, Israel, [2]FORENAP, Rouffach, France, [3]Department of Neurobiology, Faculty of Life Sciences Tel Aviv University, Tel Aviv, Israel

Introduction: Neu-P11 is a novel drug developed for insomnia. It is a melatonin MT1/MT2 receptors agonist, serotonin 5-HT-1A/1D receptors agonist, with pain related P2X3, TRPV1 and Nav1.7 channel inhibition capacities. In relevant animal models Neu-P11 demonstrated hypnotic, antidepressant and analgesic properties. In a phase I study in healthy volunteers the drug was well-tolerated and demonstrated sleep promoting effects and good oral bioavailability.
Methods: The current study was a double-blind placebo-controlled cross-over multiple ascending dose study of Neu-P11 in insomnia patients. Primary insomnia patients between the ages of 18-65 were treated by ascending doses of 2mg, 5mg, 20mg and 50mg of Neu-P11 or placebo nightly for 6 days with 1 month washout between treatments. The tolerability, pharmacokinetics and pharmacodynamics (whole night polysomnography and memory recall capacity) of Neu-P11 were evaluated.
Results: Twenty eight participants with DSM-IV primary insomnia (60.7% female, mean age 39.8, SD 11.5 years) were randomized and 24 completed the study. The study confirmed that Neu-P11 is generally safe and well tolerated, with a pharmacokinetic profile typical of a short acting hypnotic drug ($T_{1/2}$=1.2-2.9 hrs) and no evidence of accumulation. Despite the relatively small number of patients (6/group), polysomnographic recordings indicated that Neu-P11 (20 mg and 50 mg) significantly improved sleep continuity (number of awakenings and sleep fragmentation $p<0.01$ for both) while sleep latency showed trends of decrease compared to placebo. Trends towards improvements were also seen in subjective outcomes of sleepiness (measured by the Karolinska Sleepiness Scale) and sleep quality (measured by the National Sleep Foundation Sleep Diary) in uninterrupted nights at the higher doses of Neu-P11. Neu-P11 had no detrimental effects on memory consolidation or on sleep architecture.
Conclusion: The safety, tolerability pharmacokinetics and pharmacodynamic effects of Neu-P11 together with the preclinical findings make Neu-P11 a plausible drug candidate for the treatment of primary and comorbid insomnia.
Support (If Any): This research was supported by Neurim Pharmaceuticals Ltd.,Tel Aviv, Israel.

0656

EEG POWER SPECTRAL PROFILE OF THE OREXIN RECEPTOR ANTAGONIST SUVOREXANT (MK-4305) IN PATIENTS WITH PRIMARY INSOMNIA AND IN HEALTHY SUBJECTS

Herring WJ[1], Ma J[1], Snyder E[1], Svetnik V[1], Hutzelmann J[1], Liu K[1], Lines C[1], Roth T[2], Michelson D[1]
[1]Merck, Whitehouse Station, NJ, USA, [2]Henry Ford Hospital, Detroit, MI, USA

Introduction: Brain orexinergic activity plays a key role in sleep/wake regulation. Previous results from a Phase 2B study of the investigational dual orexin receptor antagonist suvorexant (MK-4305) in primary insomnia patients demonstrated significant dose-related improvement of sleep. We have now evaluated the EEG power spectral profile of suvorexant in the Phase 2B study, and compared its profile to that of other hypnotic agents in healthy subjects.
Methods: Polysomnographies (PSGs) from 254 primary insomnia patients were collected in a randomized, double-blind, placebo-controlled, 2-period (4-weeks per period) cross-over Phase 2B study of suvorexant 10, 20, 40, and 80mg. After removing signal artifacts, the power spectra of the EEG signal at frequencies ranging from 1Hz to 32Hz in the C3-A2 channel of each PSG recording during non-REM (NREM) and REM sleep were calculated separately using Welch's method. The EEG spectral profiles of trazodone 150mg, zolpidem 10mg, gaboxadol 15mg, and suvorexant 50mg in healthy subjects were also calculated in a similar way using data from three other separate studies.
Results: The Day 1 spectral profiles of suvorexant at all 4 doses during both NREM and REM sleep stages were flat and close to 1.0 (placebo) at all frequencies. Spectral profiles at 4 weeks were also generally flat although they showed greater variability than at Day 1. The Day 1 spectral profile of suvorexant in healthy subjects was generally similar to that observed in primary insomnia patients. In contrast, the other three drugs had distinct EEG spectral profiles during sleep in healthy subjects that differed from each other, showing either increases or decreases relative to placebo at varying frequencies.
Conclusion: Suvorexant had limited effects on the EEG power spectral profile, in contrast to the three comparator hypnotics. These findings suggest the possibility that antagonism of the orexin pathway might lead to improvements in sleep without major alterations in patient sleep neurophysiology, as assessed by EEG.
Support (If Any): Merck.

0657

EFFICACY AND SAFETY OF ESMIRTAZAPINE IN ELDERLY PATIENTS WITH PRIMARY INSOMNIA IN A 2-WEEK SLEEP LABORATORY TRIAL

Krystal AD[1], Roth T[2], Pong A[3], Stet L[4], Ivgy-May N[3]
[1]Duke University School of Medicine, Durham, NC, USA, [2]Henry Ford Hospital, Detroit, MI, USA, [3]Neuroscience and Opthalmology, Merck, Whitehouse Station, NJ, USA, [4]MSD Europe, Oss, Netherlands

Introduction: Esmirtazapine maleate is an investigational dual 5-HT_2 and H_1 receptor antagonist for the treatment of insomnia. This randomized, double-blind, multicenter, placebo-controlled, sleep laboratory trial assessed the efficacy and safety of esmirtazapine in elderly patients with insomnia.
Methods: Patients ≥65 years of age were selected during a single blind placebo screening period which included two polysomnography (PSG) nights. Five hundred and thirty eight patients with a diagnosis of primary insomnia were randomized 1:1:1:1 to receive esmirtazapine 0.5mg, 1.5mg, 3mg, or placebo for 16 days followed by a 7-day single blind placebo period to assess withdrawal and rebound. PSG (Nights 1/2, 15/16) were used to assess efficacy. The primary and key secondary efficacy variables were PSG measured Wake-After-Sleep-Onset (WASO) and Latency-to-Persistent-Sleep (LPS), respectively, averaged over Nights 1, 2, 15, and 16. Daily sleep diaries were also used to assess patient reported efficacy. Residual effects were assessed using the Digit-Symbol Substitution Test, Bond-Lader scale, and morning questionnaire. Potential rebound was assessed using the Tyrer withdrawal symptoms questionnaire.
Results: Esmirtazapine 0.5mg, 1.5mg, and 3.0 mg showed statistically significant ($p<0.0001$) improvement in PSG measured WASO with a reduction in median WASO (average over all PSG Nights) of 19.5, 28.8, and 26.2 minutes, respectively compared to placebo. Significant difference from placebo on WASO was also observed for the individual time points ($P < 0.005$). Esmirtazapine also significantly improved LPS ($p<0.05$) and subjective WASO and total-sleep-time. Esmirtazapine 1.5 mg and 3.0 mg generally appeared to have a numerically greater effect than 0.5 mg on most efficacy measures. The most frequently reported adverse event with esmirtazapine was somnolence (3mg=12.0%, 1.5mg=8.8%, 0.5mg=4.5%, placebo=1.5%). There was no evidence of residual effects based on the results of the DSST, Bond-Lader Scale, and morning questionnaire. There was no evidence of rebound insomnia or withdrawal after therapy discontinuation.
Conclusion: Esmirtazapine 0.5mg, 1.5mg, and 3mg demonstrated significant improvements on measures of sleep maintenance, onset, and duration. Esmirtazapine was generally safe and well-tolerated.
Support (If Any): Merck.

0658

EFFICACY AND SAFETY OF ESMIRTAZAPINE IN NON-ELDERLY ADULT PATIENTS WITH PRIMARY INSOMNIA: A 2-WEEK OUTPATIENT TRIAL

Ivgy-May N[1], Roth T[2], Amari N[1], Pathiraja K[1], Walsh JK[3]
[1]Neuroscience and Opthalmology, Merck, Whitehouse Station, NJ, USA, [2]Henry Ford Hospital, Detroit, MI, USA, [3]St. Luke's Hospital, Chesterfield, MO, USA

Introduction: Esmirtazapine maleate is an investigational dual 5-HT_2 and H_1 receptor antagonist for the treatment of insomnia. This randomized, double-blind, multicenter, placebo-controlled outpatient trial assessed the efficacy and safety of esmirtazapine in non-elderly adult patients with insomnia.
Methods: Five hundred and twenty six patients aged 18-64 with a diagnosis of primary insomnia were randomized 1:1:1:1 to receive esmirtazapine 1.5mg, 3mg, 4.5mg, or placebo for 14 days followed by a 7-day follow-up period, during which rebound and withdrawal were assessed. The primary and key secondary efficacy variables were subjective Total Sleep Time (sTST) and subjective Sleep Latency (sSL), across the double-blind period. Next-day residual effects were assessed using the Bond-Lader scale, and morning alertness questionnaire.
Results: Of the 526 randomized, 463 patients completed the study. All doses of esmirtazapine showed statistically significant ($p<0.0001$) improvements in sTST, by approximately 30-40 minutes versus placebo. Esmirtazapine also significantly improved sSL ($p<0.05$), by approximately 10-12 minutes versus placebo. Significant improvement was also observed for WASO and number of awakenings for the 4.5 mg esmirtazapine compared to placebo ($P<0.005$). Overall, the effects observed for 4.5 mg esmirtazapine were numerically greater than those observed for 1.5 and 3.0 mg. Compared to placebo, esmirtazapine 1.5mg, 3mg and 4.5mg groups had higher percentages of patients that discontinued due to an adverse event (0.0% versus 2.9% and 5.6%, and 7.0% respectively), with somnolence being the adverse event most frequently resulting in discontinuation. Somnolence was also the most frequently occurring adverse event (1.5mg=7.3%, 3mg=8.8%, 4.5mg=7.0%, placebo=1.5%). There was no evidence of residual effects based on Bond-Lader and morning questionnaire. There was no evidence of rebound insomnia or withdrawal symptoms upon discontinuation.
Conclusion: Esmirtazapine 1.5 to 4.5mg demonstrated significant improvements on patient-reported measures of sleep duration, onset and maintenance. Esmirtazapine was generally safe and well-tolerated.

Support (If Any): Merck.

0659

EFFICACY AND TOLERABILITY OF THE DUAL OREXIN RECEPTOR ANTAGONIST MK-6096 IN JAPANESE PATIENTS WITH PRIMARY INSOMNIA: RANDOMIZED, CONTROLLED, ADAPTIVE CROSSOVER POLYSOMNOGRAPHY STUDY

Hisada S[1], Kikuchi M[1], Takahashi K[1], Aoki I[1], Connor KM[2], Herring JW[2], Uchimura N[3]

[1]MSD K.K., Tokyo, Japan, [2]Merck Research Laboratories, Upper Gwynedd, PA, USA, [3]Kurume University Hospital, Kurume, Japan

Introduction: Orexinergic activity originating in the lateral hypothalamus plays a critical role in sleep/wake regulation. Drugs that influence orexinergic tone may be useful in the treatment of sleep disorders. MK-6096 is a novel potent and selective dual orexin receptor antagonist. A Phase IIB study of MK-6096 was conducted in 6 countries including US and Japan to identify effective doses for Phase III studies. While typically separate domestic studies tend to be conducted in Japan due to the concerns of ethnic differences, Japan joined this global phase IIB study after confirmation of similar PK and safety profiles between Japanese and non-Japanese healthy subjects.

Methods: This study was a Phase IIB, multicenter, randomized, double-blind placebo controlled, 2-period adaptive crossover polysomnography study to evaluate the safety and efficacy of MK-6096 (2.5, 5, 10 and 20 mg) in patients with primary insomnia. The primary outcome measure was sleep efficiency (SE). 326 patients were randomized in total, of whom 50 patients were in the Japan cohort.

Results: Based on the overall data, all doses of MK-6096 were significantly superior to placebo for the co-primary endpoints of the change from baseline in SE at Night 1 and Week 4 (p-values < 0.02). The secondary endpoints of WASO and LPS were also significantly improved. The treatment effects of MK-6096 in Japanese patients were generally consistent with those observed in the overall population for SE, WASO and LPS. MK-6096 was generally well-tolerated, and there were no significant safety differences between Japanese and non-Japanese patients.

Conclusion: These results demonstrated that MK-6096 was efficacious and generally well-tolerated in patients with primary insomnia. The treatment effects were consistent between Japanese and overall patients, and there were no significant safety differences between Japanese and non-Japanese patients. This result supports Japan's participation in future global study of MK-6096.

Support (If Any): Merck Research Laboratories.

0660

ADVERSE EVENTS RECORDED IN FOUR CLINICAL TRIALS OF SKP-1041, A MODIFIED-RELEASE FORMULATION OF ZALEPLON

Rosenberg R[1], Walsh JK[2], Staner L[3]

[1]NeuroTrials Research, Inc, Atlanta, GA, USA, [2]Sleep Medicine & Research Center, St. Luke's Hospital, Chesterfield, MO, USA, [3]Forenap Pharma, Rouffach, France

Introduction: SKP-1041 is a modified-release formulation of zaleplon designed to prevent middle-of-the-night awakening in patients with primary insomnia. Four clinical trials have been conducted; each recorded the incidence of adverse events with this new formulation and an overview is reported here.

Methods: Three phase I, crossover studies compared one dose of SKP-1041 15mg to immediate-release zaleplon 10mg (IRZ: positive control), and/or placebo in non-elderly (N=44) and elderly (N=23) healthy subjects; one phase II crossover study in non-elderly patients (N=67) compared two doses of SKP-1041 (10mg, 15mg, 20mg) to IRZ and placebo. In one study SKP-1041 was evaluated after a single morning dose and a single evening dose. Adverse events events (AEs) for all studies were recorded through follow-up 4-7 days postadministration.

Results: Overall 74 treatment-emergent AEs were reported in 144 study participants: SKP-1041 10mg (7), 15mg (26), 20mg (7); placebo (21), IRZ (13). Of these events, 10 were considered related to SKP-1041: 10mg (3), 15mg (6), 20mg (1). Headache was the most frequent SKP-1041 AE (4 incidents); other AEs were 1 incident each of frequent awakening, orthostatic hypotension, anemia, atrioventricular block 1st degree, decreased neutrophil count, and decreased WBC. All AEs were considered mild except for 1 headache (moderate), and 1 event of orthostatic hypotension (severe); all AEs were transient and required no treatment. The incidence of headache, the most frequently reported AE in the study that administered SKP-1041 in the morning and evening, was equally reported for morning (2) and evening (2). Of the three AEs reported in the study with elderly subjects (dizziness, frequent awakening, infection [pharyngitis]) the incident of frequent awakening was considered related to SKP-1041.

Conclusion: The adverse event profile of SKP-1041 has so far shown no clinical concerns for continued study and development.

Support (If Any): Supported by Somnus Therapeutics, Inc.

0661

AN ECOLOGICAL MOMENTARY ASSESSMENT OF INSOMNIA IN RESPONSE TO BRIEF SLEEP RESTRICTION THERAPY

Miller C[1,2], Kyle SD[1], Espie CA[1]

[1]University of Glasgow Sleep Centre, University of Glasgow, Glasgow, United Kingdom, [2]Woolcock Institute of Medical Research, University of Sydney, Sydney, NSW, Australia

Introduction: Sleep Restriction Therapy (SRT) is a highly utilised, effective, but difficult component within Cognitive Behavioural Therapy for Insomnia. In this study, the Daytime Insomnia Symptom Scale (DISS) was employed within an ecological momentary assessment technique to examine the daytime impact before and during SRT.

Methods: Seven participants screened for primary insomnia completed paper-based versions of the Daytime Insomnia Symptom Scale at four time points per day (wake-up, noon, 18:00, and bedtime), for one week before the intervention (Baseline) and for three weeks during the intervention (Weeks: One, Two, and Three).

Results: Four factors from the DISS were examined; Sleepiness & Fatigue, Positive Mood, Negative Mood, & Alert Cognition. Mixed models were run on all factors. Sleepiness & Fatigue increased from baseline to week one. Scores then decreased significantly by the end of week two and decreased further by the end of week three. Positive Mood decreased by the end of week one compared to baseline. Scores then increased significantly by the end of week two compared to week one. At week three scores were significantly higher compared to baseline. Alert Cognition decreased significantly between baseline and week one. Scores then significantly increased between weeks one and two. This was then maintained over week three. Negative mood held fairly constant from baseline until the end of week three. By week three scores significantly decreased compared to week one.

Conclusion: This study demonstrates that it is possible to profile reports of daytime functioning through insomnia treatment response. Implications may inform clinical guidelines.

Support (If Any): The Chief Scientist Office Scotland, NHMRC Centre for Integrated Research and Understanding of Sleep (CIRUS), The Sackler Institute of Psychobiological Research.

0662

EFFICACY AND SAFETY OF ESMIRTAZAPINE IN A SIX-WEEK SLEEP LABORATORY IN PATIENTS WITH PRIMARY INSOMNIA

Ivgy-May N[1], Amari N[1], Pathiraja K[1], Rowe E[1], Roth T[2]
[1]Neuroscience and Opthalmology, Merck, Whitehouse Station, NJ, USA, [2]Henry Ford Hospital, Detroit, MI, USA

Introduction: Esmirtazapine maleate is an investigational dual 5-HT_2 and H_1 receptor antagonist for the treatment of insomnia. This was a randomized, double-blind, multicenter, placebo-controlled trial assessing the efficacy and safety of esmirtazapine in patients with insomnia.
Methods: Patients were screened during a single blind placebo period including two polysomnography (PSG) nights. Four hundred and nineteen patients (age18-64) with primary insomnia reporting sleep onset and maintenance difficulties were randomized to esmirtazapine 3.0 mg, 4.5 mg, or placebo for 42 nights followed by 7 nights of single blind placebo period to assess withdrawal and rebound. Efficacy (PSG) was assessed on Nights 1, 15, and 36 and rebound on Nights 43/44. The primary and key secondary efficacy variables were PSG measured Wake After Sleep Onset (WASO) and Latency to Persistent Sleep (LPS), respectively, averaged over the double-blind period. Daily sleep diaries and evening questionnaires were also evaluated. Residual effects were assessed using the Digit-Symbol Substitution Test (DSST), Bond-Lader scale, and morning questionnaire.
Results: Esmirtazapine 3.0 mg, 4.5 mg showed statistically significant ($p<0.0001$) improvement in PSG measured sleep onset as well as sleep induction at every time point with a reduction in median WASO and LPS (averaged over the treatment period) of ~30 and ~13 minutes, respectively, compared to placebo. Esmirtazapine, 3.0 mg and 4.5 mg significantly improved subjective measures of sleep onset, maintenance, and duration at every time point. There was no evidence of rebound insomnia or withdrawal upon therapy discontinuation. The overall results of the DSST, Bond-Lader Scale and alertness questionnaire suggested no residual effects with either esmirtazapine dose. Esmirtazapine 3.0 - 4.5 mg was generally safe and well tolerated. The most frequently reported adverse event was somnolence (11.5% and 13.0% for esmirtazapine 3.0 and 4.5 mg, respectively vs. 2.9% for placebo). Increase in body weight of > 7% from baseline to Day 43 was observed in 4.9% of the subjects in the 4.5 mg esmirtazapine group vs. 0.8% in each, esmirtazapine 3.0 mg, and placebo.
Conclusion: Esmirtazapine 3.0-4.5 mg demonstrated significant improvement on objective and subjective measures of sleep duration, onset and maintenance. Esmirtazapine was generally safe and well tolerated.
Support (If Any): Merck.

0663

A PHASE II RANDOMIZED, 4-WAY CROSS-OVER, DOUBLE-BLIND, PLACEBO-CONTROLLED, MULTICENTER DOSE-FINDING TRIAL WITH ESMIRTAZAPINE IN PATIENTS WITH PRIMARY INSOMNIA

Ruwe F[1], Ivgy-May N[1], IJzerman-Boon P[1], Roth T[2], Zammit G[3]
[1]Neuroscience and Opthalmology, Merck, Whitehouse Station, NJ, USA, [2]Henry Ford Hospital, Detroit, MI, USA, [3]Clinilabs, Inc., New York, NY, USA

Introduction: Esmirtazapine maleate is an investigational dual 5-HT_2 and H_1 receptor antagonist for the treatment of insomnia. We report here the results of a Phase 2 dose finding study of esmirtazapine in patients with insomnia.
Methods: Sixty patients aged 18-64 with a diagnosis of primary insom¬nia reporting sleep onset and maintenance difficulties were randomized to one of 4 treatment sequences in a 4-way cross-over Latin Square design study with three doses of esmirtazapine (1.5, 3.0, and 4.5 mg) and placebo. Each treatment sequence consisted of four treatment periods of 2 consecutive nights in a sleep laboratory separated by 5-day single-blind placebo washout periods. Patients were selected following a single blind placebo screening period of 3-14 days followed by 2 consecutive screening/baseline polysomnography (PSG) nights. The primary efficacy variable was Total Sleep Time (TST) as measured by PSG. Sleep diaries completed daily from baseline to the conclusion of each treatment sequence were also evaluated.
Results: Esmirtazapine 1.5 mg, 3.0 mg and 4.5 mg showed statistically significant improvement in PSG measured TST (averaged over the two PSG nights in each period) as compared to placebo ($p<0.0001$). Mean TST was 28.9, 37.1, and 30.6 minutes greater than placebo for esmirtazapine 1.5, 3.0, and 4.5 mg, respectively. A statistically significant positive effect was also observed for all three esmirtazapine doses on PSG measured 'wake time after sleep onset'. Statistically significant improvement in 'latency to persistent sleep' compared to placebo (-8.0 minutes) was observed for 3.0 mg and 4.5 mg. Esmirtazapine 1.5-4.5 mg improved subjective TST and improvement in subjectively reported sleep latency was observed for 3.0 mg and 4.5 mg esmirtazapine compared to placebo. Esmirtazapine 1.5 - 4.5 mg showed no greater incidence of AEs compared to placebo. No SAEs were reported, and no clinically relevant differences from placebo were found on lab variables, physical examination, vital signs and ECG. Esmirtazapine treatment was not associated with residual sedation as measured by a morning questionnaire and the Bond Lader Scale.
Conclusion: Esmirtazapine 1.5-4.5 mg demonstrated significant improvement on objective measures of sleep duration, onset and maintenance as well as patient reported sleep duration and onset. Esmirtazapine effect on onset appeared to be dose dependent. Esmirtazapine was generally safe and well-tolerated.
Support (If Any): Merck.

0664

IMPROVEMENT IN EARLY MORNING AWAKENINGS IN ADULT AND ELDERLY PATIENTS WITH INSOMNIA TREATED WITH DOXEPIN 3 AND 6 MG

Durrence H, Dorsey B
Somaxon Pharmaceuticals, Inc., San Diego, CA, USA

Introduction: This report reviews the effects of doxepin (DXP; Silenor) 3 and 6mg on early morning awakenings (EMA) from 5 clinical trials.
Methods: EMA endpoints from 5 double-blind placebo-controlled trials are reported. Study A was a 12-week trial of elderly insomnia patients [N=240; DXP 3mg]. Study B was a 5-week trial of adult insomnia patients (N=221; DXP 3mg, 6mg). Study C was a transient insomnia trial (N=565; DXP 6mg). Studies D and E were Phase 2 crossover trials of adult (N=67) and elderly (N=76) insomnia patients (DXP 3mg, 6mg). The primary method of evaluating efficacy for all trials was polysomnography (PSG). EMA was assessed with PSG Sleep Efficiency% in the last quarter-of-the-night (SE-LQ) and in the final hour of the night, Hour 8 (SE-H8). Data from the first and final assessment point [Study A=Night (N) 85; Study B=N29; Studies C,D, and E were 1/2 nights] of the study are reported.
Results: DXP 3mg (Study A, B, D, and E; $p<0.05$) and 6mg (Study B, C, D, and E; $p<0.05$) significantly improved SE-LQ on N1 in all trials, with improvements vs PBO ranging from 8% (Study B, 3mg) to 15% (Study A, 3mg). DXP 3mg (Study A, B, D, and E; $p\leq0.0013$) and 6mg (Study B, C, D, and E; $p\leq0.0001$) significantly improved SE-H8 on N1 in all trials, with improvements vs PBO ranging from 9% (Study D, 3mg) to 17% (Study A, 3mg). The significant improvements in SM and EMA were maintained in all studies, excepting SE-LQ on N29 (Study B, 3mg $p=0.07$).
Conclusion: DXP 3 and 6mg demonstrated significant improvements in the majority of EMA endpoints and timepoints, which was maintained at the final timepoint for all but one assessment. These data suggest DXP is effective at treating EMA (SE-LQ) in transient and chronic insomnia populations, and in both adults and the elderly.

Support (If Any): This study was funded by Somaxon Pharmaceuticals.

0665

THE ANTICIPATION AND CONSEQUENCES OF AN ACUTE STRESSOR ON SLEEP QUALITY

Neale LF[1], Barclay NL[1], Moss MC[2], Ellis JG[1]
[1]Northumbria Centre for Sleep Research, Northumbria University, Newcastle upon Tyne, United Kingdom, [2]Department of Psychology, Northumbria University, Newcastle upon Tyne, United Kingdom

Introduction: Research has demonstrated that stress is detrimental to sleep, however little evidence currently exists regarding the differential effects of the timing of a stressor on sleep quality. The current study aimed to investigate the impact of both a morning stress task and an evening stress task on sleep quality the night prior to and night following the stress task.
Methods: An opportunity sample of 40 participants, age range 18-65 years (mean age 30.5, SD 15.61), were randomly allocated to perform an acute stress task either in the morning (N=20: 3 males, 17 females) or in the evening (N=20: 11 males, 9 females). Participants completed a 3 night sleep diary to assess sleep quality across 3 consecutive days (Baseline night: Night 0, Pre-test night: Night 1, and Post-test night: Night 2). The Multi-tasking Framework (MTF) was used to induce acute psychophysiological stress the day after Night 1 at either 9AM (AM condition) or 9PM (PM condition). Prior to the day of testing participants were informed of their randomisation and when to expect the acute stress task.
Results: After controlling for chronotype (using the Morningness-Eveningness Questionnaire), a significant interaction effect was found with participants in the AM testing condition having reduced sleep quality the night prior to the stress task (Night 1) and those in the PM testing condition having reduced sleep quality the night following the stress task (Night 2) ($F(1,37)=21.17$, $p<.001$).
Conclusion: These findings suggest that the effect that a stress task has upon sleep quality depends upon the timing of the stressor. Future research should further examine such timing effects using ecologically valid stressors, as well as accounting for individual differences in circadian phase.

0666

ARE PEOPLE WITH INSOMNIA AFRAID OF THE DARK? A PILOT STUDY

Moss TG, Atwood ME, Crowe BM, Carney CE
Psychology, Ryerson University, Toronto, ON, Canada

Introduction: Poor sleepers often experience arousal upon entering the bed/bedroom. The arousal may be conditioned (i.e., from repeated negative experiences); however, another possible mechanism could relate to the dark itself. Studies suggest that darkness is linked to increased startle and arousal. No studies have investigated whether fear of the dark (FOD) plays a role in arousal for poor sleepers.
Methods: Undergraduate students (N = 93, 76% females; M = 22 years old) completed the Insomnia Severity Index (ISI) to classify participants into good and poor sleepers, and a FOD questionnaire. Participants listened to bursts of sudden white noise stimuli (presented binaurally via headphone), while in counterbalanced light and dark conditions. Eyeblink latency was measured with an electrooculogram (EOG).
Results: Chi Square analyses revealed that relative to good sleepers (26%), more poor sleepers (46%) reported current fear of the dark ($p = .05$). An ANOVA that tested for differences in: eyeblink latency (time from the white noise stimuli to the eyeblink) good vs poor sleepers, light vs dark, and first versus second time-block, found a significant 3-way interaction ($p = .04$). A decrease in eyeblink latency was observed among poor sleepers in the second dark condition, whereas good sleepers had increased eyeblink latency in the second dark (i.e., habituation) phase.
Conclusion: The observed decrease in eyeblink latency in poor sleepers in the second dark phase suggests that unlike good sleepers who habituate to the stimuli by the second block, poor sleepers experience increasing, or anticipatory fear in the dark. Moreover, poor sleepers have greater startle in the dark only, thus it is not merely hyperarousal. Fear of the dark may contribute to increased arousal once the lights are turned off at bedtime for this subset of poor sleepers. Future studies could test whether this is a risk for insomnia and whether phobia treatment is warranted.

0667

A SURVEY OF SLEEP DISORDERS IN AUSTRALIA

Hillman DR[1], Lack LC[2]
[1]Pulmonary Physiology and Sleep Medicine, West Australian Sleep Disorders Researh Institute, Perth, WA, Australia, [2]Psychology, Flinders University, Adelaide, SA, Australia

Introduction: Poor sleep imparts a significant personal and societal burden making it important to have accurate estimates of these disorders in order to make appropriate health policy decisions. The present study is the first comprehensive survey of sleep habits, disorders, and daytime impairments conducted on a representative sample of the Australian population.
Methods: An established survey research company conducted a nation wide telephone survey in 2010 with representative sampling from all states, gender and ages 14-70+ years. A response rate of 72% yielded a total of 1,512 responses. Frequency of sleeping and daytime problems were judged on a four point scale from "rarely or never" to "almost every night (day)" and was the same or similar scale to the Sleep in America Polls and other Western countries.
Results: Frequent (at least a few times/week or more) sleep difficulties (initiating, maintaining and inadequate sleep) and daytime fatigue, sleepiness, and irritability were highly prevalent (20-35%) and generally more so in women. Older age groups (50+) reported more difficulty maintaining sleep, pauses in breathing during sleep, restless legs, and prescribed sleep medication. However, they also reported less difficulty initiating sleep, less un-refreshing sleep, less inadequate sleep, and fewer daytime impairments. More sleep is reported on weekends (7.37 hours) than week nights (7.16 hours) except in the 18-24 and the 65+ age groups. Total sleep declined with age to the 35-49 age group after which it showed a small increase.
Conclusion: Sleeping difficulties and daytime impairments in Australia are highly prevalent and at least comparable to that in other Western countries. In this study it is the young to middle aged groups (18-50 years) that suffer the most from inadequate sleep. Although night time awakening is more common in the older age groups, they seem more likely to achieve their sleep need.
Support (If Any): Research Grant from the Sleep Health Foundation of Australia.

0668

GENDER EFFECTS OF 1.75 MG AND 3.5 MG ZOLPIDEM TARTRATE SUBLINGUAL TABLETS FORMULATED WITH A CARBONATE-BICARBONATE BUFFER ON SLEEP ONSET FOLLOWING MIDDLE-OF-THE-NIGHT AWAKENING AND ON NEXT-DAY RESIDUAL EFFECTS

Roth T[1], Hull SG[2], Singh NN[3], Steinberg F[4], Krystal AD[5]
[1]Sleep Disorders and Research Center,, Henry Ford Health System, Detroit, MI, USA, [2]Sleep Disorders Research, Vince and Associates Clinical Research, Overland Park, KS, USA, [3]Transcept Pharmaceuticals, Inc., Pt. Richmond, CA, USA, [4]Chief Medical Advisor, Transcept Pharmaceuticals, Inc., Pt. Richmond, CA, USA, [5]Duke Clinic Sleep Lab, Duke University Medical Center, Durham, NC, USA

Introduction: 1.75mg and 3.5mg zolpidem tartrate sublingual tablet (Intermezzo, ZST), formulated with a carbonate-bicarbonate buffer to promote more rapid absorption, was approved by the FDA for the treat-

ment of middle-of-the-night awakening with difficulty returning to sleep (MOTN), and with gender-specific dosing instructions. Thus, this analysis evaluates the gender effects on time to return to sleep and residual effects.

Methods: : Post-hoc analyses was performed to examine gender in a double-blind, placebo-controlled 3-way cross-over study in patients with a history of MOTN. Patients had to demonstrate polysomnographic mean sleep latency of ≥20 minutes on screening nights. Treatments consisted of 2 nights of dosing followed by a 5-12 day washout. Fifty-eight female and 24 male patients were randomized. Patients were dosed with 3.5mg, 1.75mg or placebo 4h after lights out, kept awake for 30 minutes, then returned to bed for 4h. Time to return to sleep was assessed by PSG and post-sleep questionnaires. Residual effects were measured by objective/subjective measures.

Results: In both genders, compared to placebo, both the 3.5mg and 1.75mg ZST significantly decreased sleep latency based on PSG and post-sleep questionnaires. Following the 1.75mg dose, 60% and 44% of the women and men, respectively, were asleep within 20 minutes . The rates following the 3.5mg dose were 80% and 63% in women and men, respectively. Placebo response rates were significantly lower: 26% (women) and 33% (men). Neither dose in neither gender showed residual effects.

Conclusion: These data demonstrate that sublingual zolpidem tartrate is effective in reducing time to return to sleep in MOTN insomnia without producing residual effects. Further, the effects of 1.75 mg in women and 3.5 mg in men are comparable. This gender related dosing is consistent with previously reported differences in zolpidem pharmacokinetics.

Support (If Any): Funded by Transcept Pharmaceuticals, Inc.

0669

PHARMACOKINETICS FOLLOWING SINGLE AND MULTIPLE ADMINISTRATION OF THE NOVEL NON-BENZODIAZEPINE HYPNOTIC DRUG LOREDIPLON TO HEALTHY VOLUNTEERS

Santos B, Lindauer A, Baleeiro T, Gropper S, D'Aniello F, Horoszok L, Guglietta A

Department of Pharmacokinetics & Metabolism, Ferrer International, Barcelona, Spain

Introduction: Lorediplon is a novel pyrazolopyrimidine hypnotic drug currently under development for the treatment of insomnia.

Methods: The pharmacokinetic profile was assessed in two randomized, parallel, double-blind, placebo-controlled studies, conducted in healthy subjects. In the first trial, 8 ascending single oral doses were studied ranging from 1 to 40 mg with 8 subjects (2 receiving placebo) per dose group following a single oral administration of Lorediplon. Twenty-one blood samples per subject were drawn until 72 hours after dosing. In the second study a dose of 5, 10, 15 or 25 mg was given once daily for 7 consecutive days (8 subjects/group, 2 receiving placebo). Fourteen blood samples were taken over 24 hours after the first and last dose, and before administration on days 2 to 6 (total of 36 samples/subject). Pharmacokinetic parameters were derived using the non-compartmental approach.

Results: Lorediplon was rapidly absorbed from the gastrointestinal tract reaching maximum plasma concentrations at approximately 2 hours (range of median across dose groups: 1.3 to 3.5 hours). Systemic exposure was dose proportional since the AUC increased linearly with increasing dose. Following repeated daily dosing; pre-dose concentrations remained virtually constant, indicating that steady-state was rapidly reached. The median accumulation ratio (AUC0-τ_day7 / AUC0-τ_day1) ranged from 0.90 to 1.28 across dose groups, demonstrating that no relevant accumulation of Lorediplon occurred. Plasma concentrations declined in a biphasic fashion with a clinical half-life (i.e. the time it takes for Cmax to reduce by 50%) of approximately 4-6 hours.

Conclusion: Lorediplon demonstrated pharmacokinetic properties suitable for a medication to induce and maintain sleep. These data support the conduct of clinical trials in individuals with insomnia expressing different phenotypes.

0670

SUVOREXANT, A DUAL OREXIN RECEPTOR ANTAGONIST, DOES NOT IMPAIR NEXT DAY DRIVING PERFORMANCE IN HEALTHY ELDERLY SUBJECTS

Vermeeren A[2], Vuurman E[2], Bautmans A[1], Li X[1], Vets E[3], Lewis N[1], Heirman I[1], Laethem T[1], Troyer M[1], Sun H[1]

[1]Clinical pharmacology, Merck & Co., Upper Gwynedd, PA, USA, [2]Dept of Neuropsychology & Psychopharmacology, Maastricht University, Maastricht, Netherlands, [3]SGS Life Science Services, Antwerpen, Belgium

Introduction: Suvorexant is a potent orexin receptor antagonist that is being developed for treatment of insomnia.

Methods: The present study was to assess the potential for residual effects of single and repeated evening doses of suvorexant 15 and 30 mg on highway driving in 24 healthy elderly subjects (65-80 years old) in a double-blind, placebo-controlled 4-period crossover study. Suvorexant was administered for eight consecutive nights (from Days 1 to 8). Residual effects were assessed on the mornings of Day 2 and Day 9, using a one-hour highway driving test at 9 hr postdose, and cognitive and balance tests at ~11 hr postdose. Single dose of zopiclone 7.5 mg was administered as an active control on Day 1 and on Day 8 only. The primary endpoint was Standard Deviation of Lateral Position (SDLP in cm), a measure of "weaving" in the highway driving test.

Results: Preliminary results showed that Zopiclone significantly impaired driving performance as assessed by SDLP on Day 2 and Day 9. In contrast, suvorexant at 15 and 30 mg did not produce any clinically meaningful change in SDLP after single and repeated dosing. The 90% CIs of mean changes in SDLP (suvorexant - placebo) were below the pre-specified clinical bound of 2.4 cm (see Table). The same conclusion was achieved by symmetry analysis of SDLP, which showed no statistically significant greater number of subjects with treatment differences above 2.4 cm. There was also no significant impairment of suvorexant on other driving performance measures (e.g. standard deviation of speed), memory or balance evaluations.

Conclusion: It is concluded that single and repeated doses of 15 and 30 mg suvorexant are not associated with next-day residual impairment as assessed by highway driving performance, balance and cognitive tests in elderly subjects, whereas Zopiclone impaired driving performance to a clinically meaningful extent.

0671

TREATMENT EFFICACY OF EXOGENOUS MELATONIN FOR INSOMNIA IN OLDER ADULTS: A META-ANALYSIS

Brault J[1], Musselman RP[2], Lee EK[1]

[1]Psychiatry, University of Ottawa, Ottawa, ON, Canada, [2]Epidemiology and Community Medicine, University of Ottawa, Ottawa, ON, Canada

Introduction: Melatonin is a key hormone involved in regulating circadian rhythms and has been reported to have soporific effects. Sleep regulation changes with age, which can lead to increased daytime sleepiness, memory problems and mood changes. Studies of the effects of melatonin on older adults have produced mixed results. The objective of this study is to pool existing data from clinical trials in order to determine if melatonin is an effective treatment for insomnia in older adults.

Methods: Medline 1948 to present was searched between August 4, 2011 and October 6, 2011 with search terms pertaining to older adults, insomnia and melatonin. Studies were limited to clinical trials. Selected outcome parameters were total sleep time (TST), sleep onset latency (SOL), wake after sleep onset (WASO) and sleep efficiency (SE) as measured by polysomnography or actigraphy. Continuous outcome variables were analyzed using an inverse variance method with random effects model.

Results: 56 full-text articles were identified and screened by a single investigator. 9 studies involving 297 participants over the age of 55 satisfied the inclusion criteria. Data were extracted from these and used in this analysis. Statistically significant heterogeneity between the 9 studies was observed. Melatonin significantly increased TST by 18.29 min (95% CI (3.65, 32.94)), SE by 3.54% (95% CI (0.84, 6.24)) and significantly decreased SOL by 6.36 min (95% CI (11.37, 1.34)). Melatonin had no significant effect on WASO.
Conclusion: Melatonin is effective in improving TST, SOL and SE in older adults with insomnia. Melatonin does not seem to be effective in reducing the total duration of awakenings after sleep onset. These results, however, should be interpreted with caution given the presence of statistically significant heterogeneity among included studies.

0672

PERCEPTIONS OF NURSE PRACTITIONERS ABOUT ASSESSMENT AND TREATMENT OF INSOMNIA IN PRIMARY CARE SETTINGS

Redeker NS[1], Alexander N[2], Alexander I[1], Heaney B[1], Mehta S[1], Knechel N[1], Cline J[1], Paceill J[1], Whittemore R[1]
[1]Yale University School of Nursing, New Haven, CT, USA, [2]Prime Health Care PC, Glastonbury, CT, USA

Introduction: Although as many as a third of adult primary care patients report insomnia, it is under-diagnosed and under-treated in primary care settings. The purpose of this study was to evaluate primary care nurse practitioners' (NPs) perceptions about assessment and treatment of insomnia and the feasibility of providing behavioral insomnia treatment in U.S. community-based primary care settings.
Methods: We conducted 2 focus groups with 11 NPs who work in community-based primary care settings in southern New England. A structured focus group guide, based on the "3-P" model, was used to elicit perceptions about the importance of sleep/insomnia; contributing factors; ways in which NPs manage insomnia; and the feasibility of providing behavioral insomnia treatment. The discussions were recorded, data were transcribed, and thematic analysis was used.
Results: Participants believed that insomnia was prevalent and important. They identified many contributing factors that corresponded to the "3-p" model; and used a variety of pharmacological agents and some elements of sleep hygiene and relaxation, but not other elements of cognitive behavioral therapy for insomnia. Assessment of sleep was often not a routine component of care, and no one used a standard sleep diagnostic nosology. Several did not distinguish between insomnia and other sleep disorders. Several perceived that patients often exhibit drug-seeking behavior, but hypnotic prescriptions were not often evidence-based. Overall, the NPs thought that behavioral insomnia treatment would be beneficial. Barriers included lack of knowledge, structured materials, space for group sessions, and time; and concerns about coding, billing, and reimbursement.
Conclusion: NPs are receptive to improving the diagnosis and treatment of sleep disorders and insomnia. There is a need for structured, protocol-drive approaches to diagnosis and treatment that account for limited time available in patient encounters and a need to address reimbursement issues. Individual, rather than group treatment, is likely to be feasible.
Support (If Any): Renfield Foundation Intramural Research Grants, Yale School of Nursing.

0673

OBJECTIVE AND SUBJECTIVE DOSE EFFECTS OF LOREDIPLON AND ZOLPIDEM IN A PHASE ADVANCE MODEL OF INSOMNIA

Baleeiro T[2], Horoszok L[1], D'Aniello F[1], Staner L[3], Lindauer A[4], Santos B[4], Gropper S[2], Roth T[5], Guglietta A[1]
[1]Department of Project management, Ferrer International, Barcelona, Spain, [2]Department of Clinical Investigation, Ferrer International, Barcelona, Spain, [3]Clinical Trials Unit, Forenap, Rouffach, France, [4]Department of Pharmacokinetics, Ferrer Internation, Barcelona, Spain, [5]Sleep Disorders and Research Center, Henry Ford Hospital, Detroit, MI, USA

Introduction: Drugs enhancing GABAa transmission, such as zolpidem, are the medication of choice for the pharmacological treatment of insomnia. A transient insomnia model (5 hour phase advance) was used to evaluate the efficacy of lorediplon, a new non-BZD hypnotic drug acting as a GABAa receptor modulator.
Methods: 35 male healthy subjects were included in a 5-way randomized cross-over study. During each of the periods, sleep was recorded after a habituation night, in one phase advance night. Subject reported outcomes were measured in the morning before and after the phase advance nights with a Post sleep questionnaire and VAS. All subjects received 1, 5, 10 mg of lorediplon, placebo and zolpidem.
Results: The PSG results showed that lorediplon (5 mg and 10 mg) had increased total sleep time, beneficial effects in traditional measures of sleep maintenance (WASO) as well as favorable measures of sleep consolidation. In terms of sleep architecture there was an increase in the "deep" slow wave sleep. The magnitude of these effects were dose related, with minimal effects seen with 1 mg. In terms of subjective outcomes and as compared to zolpidem and placebo the subjects reported a better sleep quality, a comparable sleep onset, an increase of sTST, a decrease in the number of awakenings and of sWASO during the night.
Conclusion: Lorediplon demonstrated a dose dependent significant improvement in sleep. Lorediplon differs from zolpidem in terms of timing of the sleep effects, which are more marked in the middle of the night for lorediplon and at the beginning of the night for zolpidem. These sleep effects are also consistent by the PK profile of lorediplon. These results warrant clinical trials in patients with insomnia.

0674

ACUTE IN-LAB IMPLEMENTATION OF SLEEP RESTRICTION THERAPY FOR INSOMNIA DISORDER: IMPACT ON OBJECTIVE AND SUBJECTIVE SLEEP

Kyle SD, Miller C, Salveta C, Kane J, Rogers Z, Espie CA
University of Glasgow Centre, Institute of Neuroscience & Psychology, University of Glasgow, Glasgow, United Kingdom

Introduction: Sleep Restriction Therapy (SRT) is considered an important component of CBT for insomnia. Despite this, little is known about its efficacy as a single therapy or how it exerts its therapeutic effect, in terms of objective sleep alterations or sleep-related cognitive arousal. Here we report preliminary findings from an ongoing study into the mechanisms underlying SRT response.
Methods: Nine patients (6 females; mean age = 46.4) with Psychophysiological Insomnia have thus far completed the SRT protocol. Patients initially sleep two nights in the lab to exclude sleep-related co-morbidities and to acquire baseline assessment of sleep. The intervention involves one main session to deliver SRT rationale/instructions, and 4 subsequent brief interactions to review sleep efficiency. During the first 3 weeks of therapy, patients sleep 3 separate nights in the lab according to their prescribed sleep window. Home adherence to SRT was monitored with actigraphy and sleep diaries. Here we report within-subject changes (baseline to night 3) during in-lab SRT in relation to PSG-defined sleep continuity and architecture, self-report sleep and sleep-related cognitive arousal (assessed with the Glasgow Sleep Effort

Scale [GSES], Pre-Sleep Arousal Scale [PSAS], and the Glasgow Content of Thoughts Inventory [GCTI]).
Results: Self-reported SOL, WASO and sleep efficiency significantly improved from baseline to night 3 (all p<.05); there were no differences in TST. There were no significant improvements in objective sleep continuity or architecture, though there was a significant reduction in PSG-determined TST by an average of 65 minutes from baseline (p<.001). A misperception index (MI) was also calculated, showing that misperception of sleep tended to decrease over SRT (MI=.22 at baseline vs .11 at night 3; p=.10). Both sleep effort (GSES; p<.05) and intrusive thoughts/pre-sleep cognitive arousal significantly decreased (PSAS, GCTI; both p<.05), whereas there were no changes in pre-sleep somatic arousal through treatment.
Conclusion: These preliminary findings indicate that while markers of subjective sleep, sleep-related cognitive arousal, and the perception of sleep may improve during the acute period of SRT implementation, PSG-defined sleep may not. The marked decrements in TST may relate to recent reports of side-effects in some patients during SRT. Given the small sample these findings are necessarily preliminary.
Support (If Any): Research funding from The Chief Scientist Office.

0675

CBT TREATMENT OF SLEEP MEDICATION DEPENDENCE

Lichstein KL[1], Nau SD[1,2], Geyer JD[3], Doekel RC[4], Pegram V[4]
[1]Psychology, Univ of Alabama, Tuscaloosa, AL, USA, [2]Psychology, Univ of Memphis, Memphis, TN, USA, [3]Neurology, Univ of Alabama, Tuscaloosa, AL, USA, [4]Sleep Disorders Center of Alabama, Birmingham, AL, USA

Introduction: Much of the research on psychological management of hypnotic dependence has focused on older adults and sequenced presentation of CBT followed by drug withdrawal. The present study tests a middle aged sample and evaluates simultaneous CBT for insomnia and drug withdrawal.
Methods: 90 volunteers presenting with current insomnia and chronic prescription hypnotic use were PSG screened for other sleep disorders and randomized to three treatment conditions: CBT (relaxation, stimulus control, and sleep hygiene), placebo biofeedback (PL), or withdrawal only (W). CBT and PL also used the same scheduled gradual hypnotic withdrawal as W. Self-report assessment of sleep, medication consumption, and daytime functioning, and PSG evaluations occurred at baseline, posttreatment, and 1 year follow-up.
Results: Herein we report on sleep diary and medication consumption. Two key sleep measures, SOL and WASO, showed the identical pattern. A 3 groups (CBT, PL, W) × 3 points in time (base, post, and follow-up) MANOVA obtained a significant time effect for SOL (Wilks' $\Lambda = .68$, $F = 15.1$, $p < .001$) and WASO (Wilks' $\Lambda = .84$, $F = 5.8$, $p < .01$), but neither found a significant main effect for groups or a groups × time interaction. Similarly, for medication consumption we obtained a significant time effect (Wilks' $\Lambda = .54$, $F = 34.4$, $p < .001$), but no significant main effect for groups or a groups × time interaction. Combining groups, there was an 87.2% reduction in medication consumption from baseline to posttreatment and reduction from baseline to follow-up was largely maintained at 81.8%.
Conclusion: Though trends favored the CBT group, all groups exhibited significant sleep improvement to follow-up, combined with significant reduction in hypnotic use. These sleep effects for CBT are weaker than we have previously obtained with sequential vs. the current simultaneous CBT and drug withdrawal.
Support (If Any): NIH grant R01-DA13574.

0676

A SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS OF ACUPRESSURE, REFLEXOLOGY, AND AURICULAR ACUPRESSURE FOR INSOMNIA

Yeung W, Chung K, Poon M, Ho F
Department of Psychiatry, the University of Hong Kong, Hong Kong, Hong Kong

Introduction: Previous randomized controlled trials (RCTs) have shown that needle acupuncture may be efficacious for insomnia. Instead of needling, acupressure, reflexology, and auricular acupressure are procedures involving physical pressure on acupoints or reflex areas. These variants of acupuncture are gaining popularity, perhaps due to their non-invasive nature. However, no systematic reviews have been performed separately to analyze the non-invasive form of acupuncture therapy for insomnia.
Methods: A systematic review has been conducted to examine the efficacy and safety of acupressure, reflexology, and auricular acupressure for insomnia. Two independent researchers searched 5 English and 10 Chinese databases from inception to May 2010. The modified Jadad scale and Cochrane's risks of bias assessment were used to evaluate the methodologic quality.
Results: A total of 40 RCTs were identified for analysis. Only 10 studies used sham controls, 4 used double-blind design, 9 studies scored 3 or more by the modified Jadad scale, and all had at least 1 domain with high risk of bias according to the Cochrane's criteria. Meta-analyses of the moderate-quality RCTs (modified Jadad score ≥ 3) found that acupressure as monotherapy was marginally better than sham control in improving sleep questionnaire score. Studies that compared auricular acupressure and sham control showed equivocal results. It was also found that acupressure, reflexology, or auricular acupressure as monotherapy or combined with routine care was significantly more efficacious than routine care or no treatment.
Conclusion: Owing to the methodological limitations of the studies, the data, while somewhat promising, do not allow a clear conclusion on the benefits of acupressure, reflexology, and auricular acupressure for insomnia.
Support (If Any): The study was funded by the Hospital Authority of Hong Kong.

0677

A BRIEF PSYCHOEDUCATIONAL SLEEP PROGRAM REDUCES SLEEP ONSET LATENCY AMONG COLLEGE STUDENTS

Culnan E[1], Nash CO[1], Hildenbrand A[1], Kloss JD[1], Sexton-Radek K[2]
[1]Psychology, Drexel University, Philadelphia, PA, USA, [2]Psychology, Elmhurst College, Chicago, IL, USA

Introduction: Sleep onset latency (SOL) is one of the most common insomnia complaints among young adults. Despite its prevalence, insomnia symptoms are often under-treated among college students. We measured the degree to which a brief psychoeducational program (Sleep 101) could improve insomnia symptoms, namely SOL. Previous analyses showed that dysfunctional beliefs and attitudes about sleep decreased among workshop participants compared to controls. Thus, decreases in unhelpful beliefs about sleep were also expected to correlate with hypothesized reductions in sleep onset latency.
Methods: The data and measures (SOL ratings from daily diaries and dysfunctional beliefs and attitudes about sleep-short form; DBAS-SF) for this study were extracted from the larger dataset on the efficacy of Sleep 101. Participants were comprised of 63 undergraduates in the sleep education group (who received education about behavioral and cognitive sleep strategies) and 57 in the monitoring group (who maintained sleep diaries only). All participants completed two weeks of baseline diary data and one week of trial data— daily diaries following the workshop week.

Results: Average SOL was significantly reduced in the education group from pre- (M = 26.07, SD = 20.53) to post-education (M = 20.73, SD = 14.69), t(42) = 2.88, p < .01, whereas average SOL remained unchanged in the monitoring group. Though prior analyses showed that DBAS-SF ratings decreased among education participants, decreases on DBAS-SF ratings and SOL ratings were not correlated.
Conclusion: The data suggest that a tailored, brief Sleep 101 workshop yielded improvement on both SOL and DBAS ratings among college students, supporting the use of cost-effective, brief educational programs delivered and tailored to college students. Further study could elucidate the relevance of DBAS and insomnia indices specifically among college students.

0678
CORRELATES OF INSOMNIA IN PATIENTS WITH SUSPECTED OSA

Cheng J[1], Ramos AR[1], Dib S[1], Abreu A[2], Shafazand S[2], Wohlgemuth WK[1], Wallace DM[1]
[1]Neurology, University of Miami, Miami, FL, USA, [2]Medicine, University of Miami, Miami, FL, USA

Introduction: Obstructive sleep apnea (OSA) and insomnia are the two most prevalent sleep disorders in the U.S. population. The aim of our study is to identify the correlates of insomnia in a population referred for evaluation of OSA.
Methods: We performed a cross-sectional analysis of consecutive patients referred to an academic center for OSA evaluation. Validated questionnaires were used to assess sleepiness, fatigue, restless legs syndrome (RLS) symptoms and socioeconomic factors. Insomnia was defined by a score ≥ 10 on the Insomnia Severity Index (ISI) and sleepiness by Epworth Sleepiness Scale (ESS) ≥ 10. Polysomnography was performed according to the practice parameters of the American Academy of Sleep Medicine. Chi-Square and t-test were used to evaluate proportions and means, respectively. Logistic regression was performed to predict insomnia.
Results: Two-hundred-eighty-four patients (50% men, 56% Hispanics) were included with median age of 59 ± 15 years. Seventy-three percent of the sample completed high school or higher education. Insomnia was present in 55% (n= 155) of the patients. Forty-six percent had daytime sleepiness, and 29% had RLS symptoms. Mean ISI, ESS and Fatigue Severity Scale scores were 10.3 ± 8.5, 9.0 ± 6.3, and 36.5 ± 16.2, respectively. Mean sleep hours was 6.0 ± 1.5 and the mean Apnea-Hypopnea Index (AHI) was 22 ± 16. We observed a univariate association between female gender (p=0.011), sleepiness (p=0.047), RLS symptoms (p=0.002) and AHI (p=0.002) with insomnia. In multivariate logistic regression, controlling for significant covariates, early awakenings (OR 3.1 95% CI 1.9-5.0), sleepiness (2.8, 1.1-6.8) and fatigue (2.5, 1.02-6.1) were the main correlates of insomnia, and this was not modified by AHI. Age, sex, ethnicity and education did not predict insomnia in multivariate analysis.
Conclusion: In a sleep clinic sample, co-morbid insomnia symptoms were prevalent with OSA. Understanding the determinants and correlates of insomnia can potentially impact OSA's long-term management.

0679
STRESS REACTIVITY IN INSOMNIA

Gehrman P[1,2], Barilla H[1], Hall MH[3], Buysse DJ[3], Perlis ML[1], Gooneratne N[4], Ross RJ[2,1]
[1]Department of Psychiatry, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA, USA, [2]Philadelphia VA Medical Center, Philadelphia, PA, USA, [3]Sleep Medicine Institute and Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA, [4]Division of Geriatric Medicine, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA, USA

Introduction: Insomnia is often precipitated by stress. As a stressor resolves sleep improves for some, but for others insomnia persists and becomes chronic. The reasons for these divergent pathways are unknown but individual differences in stress response systems are prime candidates for investigation. This study examined the role of stress reactivity in chronic insomnia, with the hypothesis that individuals with primary insomnia, compared to good sleepers, would demonstrate heightened reactivity during the night following an experimental stressor.
Methods: Twenty individuals with primary insomnia and twenty age- and gender-matched good sleepers completed three nights of laboratory polysomnography consisting of adaptation, baseline, and stress nights. On the stress night, participants were administered a brief, mild electric shock to the wrist before bed and told that they could receive up to three additional shocks during the night. Saliva samples were taken before bed on each night for analysis of cortisol and alpha amylase. Visual analog scales (VAS) of tense/peaceful, relaxed/anxious, and calm/nervous were completed each night.
Results: There was a trend towards an increase in cortisol level on the stress compared to the baseline night (.10(.15) vs. .06(.07), d=.39, p=.09), but no other statistically significant reactivity effects. The insomnia group reported significantly more tension (75.5(22.1) vs. 86.3(15.7), d=.57, p=.004). In the good sleepers only, increases in sleep latency correlated with increases in all VAS ratings.
Conclusion: Individuals with primary insomnia compared to good sleepers did not show evidence of greater stress reactivity in this experimental paradigm. The strength of the stressor may have been inadequate, or there may be no true group differences in stress reactivity. Analysis off power spectral measures and REM sleep phase activity may reveal more subtle effects. There may be a stronger relationship between pre-sleep stress and difficulty falling asleep in good sleepers than in individuals with chronic insomnia.
Support (If Any): MH079187.

0680
HEART RATE VARIABILITY IN PRIMARY CHRONIC INSOMNIA

Farina B[1], Dittoni S[2], Colicchio S[2], Testani E[2], Losurdo A[2], Gnoni V[2], Vollono C[2], Contardi A[1], Brunetti R[1], Della Marca G[2]
[1]Faculty of Psychology, European University, Rome, Italy, [2]Neurosciences, Catholic University, Rome, Italy

Introduction: Insonnia is a major cause of personal distress and it is associated with increased risk for psychiatric and medical disorders. Moreover, insomnia may be associated with increased cardio-vascular risk. Autonomic hyperarousal might be a pathogenic mechanism of chronic primary insomnia. The aim of this study was to investigate autonomic activity in patients with chronic primary insomnia, by means of heart rate variability (HRV) analysis, durin wake and in all sleep stages.
Methods: Eighty-five consecutive patients affected by chronic primary insomnia were enrolled; 38 men and 47 women, mean age 53.2±13.6. Patients were compared with a control group consisting of 55 healthy subjects matched for age and sex: 23 men and 32 women, mean age 54,18±13.94. Patients underwent an insomnia study protocol which included subjective sleep evaluation, psychometric measures, home-based

polysomnography with evaluation of HRV in wake before sleep, in all sleep stages and in wake after sleep.
Results: Patients showed modifications of HRV parameters, consistent with increased sympathetic activity, in wake before sleep and during stage N2. No significant differences between insomniacs and controls could be detected during slow-wave sleep, REM sleep and post-sleep wake.
Conclusion: Our results are consistent with the hypothesis that autonomic hyperarousal is a major pathogenic mechanism in primary insomnia and confirm that this conditions is associated with an increased cardiovascular risk.

0681

ARE INSOMNIA SUFFERERS' DAYTIME DEFICITS PRODUCTS OF SUBJECTIVE DISTORTIONS?

Edinger JD[1,2], Means MK[3,2], Krystal AD[2]
[1]Division of Sleep Medicine, National Jewish Health, Denver, CO, USA, [2]Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, Durham, NC, USA, [3]Psychology Service, VA Medical Center, Durham, NC, USA

Introduction: Efforts to objectively confirm insomnia sufferers' daytime complaints have produced equivocal findings. Hence, some cognitive models posit these complaints result from cognitive distortions and actual performance difficulties represent self-fulfilling prophesies. This study explored these possibilities.
Methods: Eighty-nine (48 women; MAge=49.8 yrs.) well-screened primary insomnia sufferers and 95 (48 women; MAge=47.0 yrs.) age- and gender-matched healthy controls completed 3 home and 3 lab nighttime PSGs, the Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS) and a 4-nap MSLT. Before each nap, participants also completed a battery of simple and complex attention tests. Correct and error response rates of each participant across trials were dependent measures. The insomnia and control groups were each subdivided into "alert" (MSLT mean onset latency > 8 minutes) and "sleepy" (MSLT mean onset latency < 8 minutes) groups for analyses. Correlations examined the association among performance scores, DBAS scores and PSG/MSLT findings.
Results: "Alert" participants had longer MSLT latencies (12.7 vs. 5.4 minutes) and were older (51.2 vs. 45.4, p=0.03) than "sleepy" subjects. The increased daytime alertness of "alert" participants was accompanied by greater nocturnal sleep disruption (i.e., lower sleep efficiencies: 83.5% vs. 86.2%, p=0.03), suggesting a 24-hour hyperarousal pattern. Age-adjusted ANCOVAs showed insomnia sufferers as a group logged fewer correct responses than controls (P=.001), whereas the hyperaroused insomnia subgroup made more attention errors than did alert controls (P=.007). Among controls, performance errors were inversely correlated with MSLT mean latencies (r=-.23; P=.02). Error rates among (r=-.25; P=.02) insomnia sufferers were inversely correlated with PSG sleep efficiency whereas correct response rates were positively correlated with PSG sleep efficiency (r=-.24; P=.03) and inversely correlated with the alertness/hyperarousal level shown on the MSLT (r=-.21; P=.05). Neither the DBAS total score nor the score on it's subscale assessing daytime symptom worries correlated with performance indices.
Conclusion: Attention tasks reveal actual performance deficits among insomnia sufferers relative to normal sleepers. These deficits appear to be associated with physiologic hyperarousal rather than cognitive distortions.
Support (If Any): This research was supported by Grants from the Department of Veterans Affairs Merit Review Program (Grant # 0009) and The National Heart, Lung and Blood Institute (Grant # R01-HL-073259-01).

0682

PREDICTORS OF PAIN IN PRIMARY INSOMNIA

Haack M[1,2], Kosuke A[5], Simpson N[4], Scott-Sutherland J[3,2], Lazarus M[5], Sethna N[3,2], Urade Y[5], Mullington JM[1,2]
[1]Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Harvard Medical School, Boston, MA, USA, [3]Children's Hospital, Boston, MA, USA, [4]Stanford University, Palo Alto, CA, USA, [5]Osaka Bioscience Institute, Osaka, Japan

Introduction: Individuals suffering from insomnia have been shown to experience more pain than healthy sleepers and present signs of inflammatory systems activation, which potentially may underlie the association between sleep and pain in insomnia. This study addressed the question whether the type of sleep disturbance, e.g. sleep onset or sleep maintenance difficulties, predicts the degree of pain and inflammation in primary insomnia.
Methods: Based on a 2-week actigraphy recording period, patients with primary insomnia (N=26) and without any comorbid psychiatric/medical disorders were categorized in those with a sleep onset problem (N=7; average sleep latency >30min daily) or a sleep maintenance problem (N=7, average wake time after sleep onset >30min daily), and compared to healthy sleepers (N=10). Subjective pain reports were assessed daily throughout a 2-week diary recording period.
Results: Compared to good sleepers, individuals with sleep onset insomnia, but not those with sleep maintenance insomnia, reported higher levels of pain ($p<0.05$). Within the insomnia group, sleep onset latency appeared to be correlated with pain reports (R=0.35, P=0.09), but not other sleep indices (e.g. sleep fragmentation, total sleep duration). Urinary prostaglandin E2 metabolite concentrations were positively associated with the degree of pain (R=0.42, p=0.08), but did not show an association with any sleep indices.
Conclusion: These preliminary findings suggest that individuals suffering from sleep onset insomnia are more vulnerable to increased pain. Besides, prostaglandins, further inflammatory and stress markers are currently analyzed to understand their role in the relationship between insomnia and pain.
Support (If Any): Sleep Research Society Foundation, Investigator-initiated grant from Sepracor, M01-RR-01032 from the National Center for Research Resources to the Harvard Clinical and Translational Science Center.

0683

MEMORY COMPLAINTS AND OBJECTIVE PERFORMANCE IN INDIVIDUALS WITH INSOMNIA

Fortier-Brochu E, Morin CM
Ecole de psychologie, Université Laval, Quebec, QC, Canada

Introduction: While a significant proportion of individuals with insomnia report memory problems, studies examining the relationship between these complaints and objective memory performance are scarce. The aim of this study was to examine differences in objective memory performance in individuals with insomnia with or without memory complaints.
Methods: Participants were 25 adults (mean age = 44.4; 56.0 % women) with primary insomnia who completed a battery of questionnaires and neuropsychological tests including the Multifactorial Memory Questionnaire (MMQ) and the California Verbal Learning Test - II (CVLT-II). The MMQ includes 3 scales assessing 1) contentment with memory, 2) subjective memory ability, and 3) use of memory strategies. Using the median score of the whole sample for each MMQ subscale as a cut-off score, participants were classified as being either satisfied (n=13) or dissatisfied (n=12) with their memory, having good (n=13) or poor (n=12) memory ability, and having to rely on memory strategies (n=12) or not (n=13). T-tests were computed to compare individuals with and without each type of memory complaint on CVLT-II standardized scores.

Results: All groups of participants with memory complaints performed significantly ($p<.05$) worse than those without complaints on long-delay percent retention. In addition, those reporting poor memory ability performed significantly worse than those with better memory ability on measures of delayed recall and recognition. Effect sizes for significant differences were in the large range ($-1.09 \leq d \leq -0.85$).
Conclusion: Individuals with insomnia who complained about their memory had poorer memory performance for long-term storage of verbal information than those not complaining. Complaints about the frequency of memory failures may be more sensitive to objective memory performance decrements than subjective reports of dissatisfaction with memory or necessity to rely on memory strategies.
Support (If Any): Supported by the Canadian Institutes of Health Research.

0684

IMPACT OF EXTENDED TIME IN BED IN PREDICTING SLEEP EFFICIENCY IN BOTH PATIENTS WITH INSOMNIA AND IN GOOD SLEEPERS

Swinkels C[1,2], David BM[4], Kloss JD[2], Gehrman P[3], Kremelberg D[5], Perlis M[3]
[1]MIRECC, Durham VAMC, Durham, NC, USA, [2]CoAS - Psychology, Drexel University, Philadelphia, PA, USA, [3]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [4]Psychology, Birmingham University, Edgbaston, United Kingdom, [5]Statistics, DK Consulting, New York, NY, USA

Introduction: According to the DSM-IV TR, Primary insomnia is characterized by sleep initiation and maintenance problems (and/or the complaint of non-restorative sleep) that occurs on 3-4 days per week and persists for at least 1 month. The former criterion suggests that better than average, if not good sleep, occurs on some periodic basis. To date, only three groups have evaluated night-to-night variability in patients with Insomnia and only one study did so using a good sleeper control group. Of these studies, two groups found that some, if not all patients with insomnia, tend to exhibit better than average (or good) sleep on a periodic basis (once every 1-3 days). There has been little focus on the contributing factors to the variability. Sleep extension (such as increased time in bed at night) is conceptualized as a maladaptive practice that perpetuates insomnia symptoms. The present study was undertaken to further characterize night-to-night variability in sleep continuity and the impact of time in bed (TIB) as a predictor of sleep disruption in both patients with Primary Insomnia and Good Sleepers.
Methods: The present study utilized an archival data set of 66 individuals (33 participants with insomnia (PIs) and 33 controls (GSs)). The first 110 days of diary data were utilized for a panel regression; a technique that allows multiple respondents of time series data to predict subsequent outcomes. In the present case: time in bed (TIB) over a series of 7 nights was used to predict sleep efficiency on the 8th night.
Results: TIB was found to significantly predict sleep efficiency in both subject groups such that greater TIB is associated with reduced sleep efficiency ($p < .05$).
Conclusion: Expanding time in bed, in both good sleepers and patients with insomnia, is a risk factor for poor sleep efficiency.

0685

FRAGMENTATION/CONSOLIDATION OF REST-ACTIVITY PATTERNS CORRELATES WITH SUBJECTIVE SLEEP QUALITY IN CHRONIC PRIMARY INSOMNIA

Lim AS[1], Haack M[2], Simpson N[2], Mullington JM[2]
[1]Neurology, University of Toronto, Toronto, ON, Canada, [2]Neurology, Beth Israel Deaconess Medical Center / Harvard Medical School, Boston, MA, USA

Introduction: Individuals with chronic primary insomnia experience subjective impairments of nighttime sleep and daytime functioning. However, it has proven difficult to identify objective phenotypes that correlate well with these subjective experiences, as most standard actigraphic and polysomnographic metrics correlate only weakly with subjective sleep symptoms. Developments that improve sensitivity and specificity of measurements of the consolidation of state have numerous potential applications in sleep disorders research. We hypothesized that fragmentation of rest and activity patterns may correlate with symptom severity in chronic primary insomnia.
Methods: We studied 14 individuals with chronic primary insomnia by ICSD-2 criteria and 14 age and sex matched controls. After screening to exclude medical and psychiatric comorbidities, all underwent 14 days of actigraphy in their usual environments, with quantification of rest and activity fragmentation using a recently developed state transition metric. Subjective sleep quality was assessed by the Pittsburgh Sleep Quality Index (PSQI).
Results: Rest fragmentation was positively correlated with PSQI scores in subjects with insomnia ($r=0.75$ $p=0.073$) but not controls ($r=0.30$ $p=0.28$) with higher levels of rest fragmentation being associated with lower subjective sleep quality. Meanwhile, PSQI scores were positively correlated with a tendency to sustain rather than fragment spontaneous motor activity in subjects with insomnia ($r=0.69$ $p=0.006$) but not controls ($r=0.16$ $p=0.8$).
Conclusion: Fragmentation/consolidation of rest-activity patterns is an objective marker of subjective symptom severity in chronic primary insomnia and may prove to be useful in investigations of the biological correlates of and potential treatments for this disorder.
Support (If Any): NIH Grants AG28324, HL07901(T32), RR025758; AAN Clinical Research Training Fellowship; and CIHR Bisby Fellowship.

0686

IS ILLNESS SEVERITY GREATER IN IDIOPATHIC INSOMNIA VS. ADULT-ONSET INSOMNIA?

Bremer EM[1,2], McKay GD[1,2], Jackson NJ[3], Gehrman P[1,2], Grandner MA[3], Perlis ML[1,2]
[1]Behavioral Sleep Medicine Program, University of Pennsylvania, Philadelphia, PA, USA, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [3]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Idiopathic insomnia, characterized by childhood onset and no discernible precipitating event, has not been sufficiently studied. The goal of the present analyses was to compare the symptom profiles of patients with childhood vs. adult onset of insomnia.
Methods: Participants with and without insomnia completed an online screening questionnaire. Of 1556 individuals who reported insomnia, 76(5%) reported that their insomnia was not brought on by a precipitating event and that symptoms began prior to age 13 and 1402(82.6%) reported that their symptoms began after age 21. These groups were compared on measures of sleep latency (SL) wake after sleep onset (WASO), time in bed, total sleep time (TST), insomnia severity and presence of daytime impairment. Sleep latency (SL) and wake after sleep onset (WASO) were assessed as minutes/night and number of nights/week. The product of these variables was used as a measure of insomnia severity. Time in bed (TIB) was calculated and total sleep time (TST) was both computed and determined from self-report. Linear regression analyses were conducted with covariates for sex, race/ethnicity, education, depression history, and chronic pain. Insomnia variables served as the predictor variables.
Results: There were no differences between those with idiopathic and adult-onset insomnia on most insomnia variables (all $p>0.05$). Patients with idiopathic insomnia spent less time in bed (0.6hrs,$p=0.002$), and had less TST based on calculations (47.67mins,$p=0.003$) or self-report (0.6hrs,$p=0.002$).
Conclusion: While the sleep initiation and maintenance problems associated with idiopathic insomnia may reflect greater chronicity (and may potentially be more related to organic factors), the present analysis

did not show this form of insomnia to be associated with greater illness severity. Interestingly, patients with this form of insomnia report spending less time in bed and less total sleep time.

Support (If Any): This study was supported by T32HL007713, R01AT003332, R01MH077900.

0687

SUBJECTIVE SLEEP QUALITY IS ASSOCIATED WITH FOOD PREFERENCE

Cheung IN, Reid KJ, McGee-Koch L, Zee P
Department of Neurology, Northwestern University, Chicago, IL, USA

Introduction: Objective measures of sleep quantity and quality have been associated with self-reported food preference and appetite regulation. Given that there is often a poor relationship between objective and subjective measures of sleep, it is unclear whether subjective sleep quality will also be associated with food preference and appetite regulation. Thus, the aim of the current study is to determine whether subjective measures of sleep quality are associated with food preference.

Methods: Participants included twenty-one adults age 55 years or older (19 females; mean age 61.6 ± 5.26 years; mean body mass index 26.5 ± 4.3 kg/m^2) with primary insomnia diagnosis for > 3 months, habitual sleep duration < 6.5 hours, sleep efficiency < 85%, and Pittsburgh Sleep Quality Index (PSQI) global score > 5. Participants self-reported ratings of sleep using the PSQI and preference for food types using the Visual Analogue Scale for Appetite (VAS-A). The PSQI is a self-rated questionnaire with 7 subscores and a global score that evaluate sleep quality over the past month. The VAS-A asks participants how much they would currently enjoy eating foods from 8 given food categories. Statistical comparisons were performed using Pearson's bivariate correlations.

Results: Mean PSQI global score was 9.24 ± 2.23. Poorer PSQI overall sleep quality subscore was associated with higher preference for salty foods ($r = 0.498$, $p = 0.02$). Preference for fruit and fruit juices was lower in participants with poorer PSQI sleep duration subscore ($r = -0.562$, $p < 0.01$) and worse PSQI habitual sleep efficiency subscore ($r = -0.512$, $p < 0.01$). Poorer PSQI daytime dysfunction subscore was correlated with lower preference for vegetables ($r = -0.748$, $p < 0.01$).

Conclusion: Subjective sleep quality is associated with preference for fruits, vegetables and salty foods. Subjective sleep measures could thus serve as an alternative method of assessing the influence of sleep quality on food preference. This study is limited to older adults with insomnia; further studies should be conducted to determine this relationship within the general population. Further studies are also warranted to determine associations between subjective sleep quality and actual food consumption.

Support (If Any): This research was supported by a National Institute of Aging grant P01 AG11412, General Clinical Research Center grant M01 RR00048, K23 HL091508, T32AG020506.

0688

ONSET AND MAINTENANCE INSOMNIA SUBTYPES - SUBJECTIVE INDICES

Nemeth E[1,3], Simpson N[4,1], Mullington JM[1,2], Haack M[1,2]
[1]Beth Israel Deaconess Medical Center, Boston, MA, USA, [2]Harvard Medical School, Boston, MA, USA, [3]Simmons College, Boston, MA, USA, [4]Stanford University, Palo Alto, CA, USA

Introduction: Epidemiological studies have shown that chronic insomnia is associated with a decrease in emotional and physical well being, including increased depression and anxiety. This study investigated whether subtypes of primary insomnia, i.e. sleep onset insomnia vs. sleep maintenance insomnia, differ with respect to their emotional well-being.

Methods: Based on a 2-week actigraphy recording period, patients with primary insomnia (N=26) and without any psychiatric/medical disorders were categorized in those with sleep onset insomnia (N=9; average sleep latency >30min daily) or sleep maintenance insomnia (N=7, average wake time after sleep onset >30min daily), and compared to healthy sleepers (N=10). Subjective emotional and physical well-being were assessed daily throughout a 2-week diary recording period, as well as through questionnaires.

Results: Compared to good sleepers, subjects with sleep onset insomnia, but not those with sleep maintenance insomnia reported increased levels of anxiety ($p<0.01$), stress levels ($p<0.05$) and decreased levels of emotional functioning ($p<0.05$).

Conclusion: These preliminary results suggest that subjects with sleep onset insomnia may be more vulnerable to decreased emotional well being than those with sleep maintenance insomnia.

Support (If Any): Funding from Sleep Research Society Foundation , Sepracor Investigator Initiated Grant and the Clinical Research Center (CTSC ULIRRO25758).

0689

PREDICTORS OF PRE-SLEEP AROUSAL: BAD THOUGHTS OR NEGATIVE FEELINGS?

Hantsoo L, Khou C, Ong JC
Psychology, Rush University Medical Center, Chicago, IL, USA

Introduction: Elevated pre-sleep arousal has been consistently associated with insomnia yet the cognitive mechanisms involved in sleep-related arousal remain unclear. The purpose of this study was to examine predictors of pre-sleep arousal from a set of variables that included self-reported affect, sleep-related cognitions, locus of control, and demographic variables.

Methods: Cross-sectional data were analyzed for 123 participants (White=57%, Black=33%, Other=10%) who completed a set of baseline questionnaires as part of an insomnia treatment study that included the Beliefs and Attitudes about Sleep (BAS), Pre-Sleep Arousal Scale (PSAS), Positive and Negative Affect Schedule (PANAS), Sleep Locus of Control (SLOC) and demographic information. A majority of the sample was female (70%) with an average age of 44.8 years (SD =13.5). All participants met ICSD-2 criteria for psychophysiological insomnia and no exclusion criteria were employed for these analyses.

Results: A hierarchical regression was conducted with a set of independent variables (gender, BAS, SLOC, and the negative affect subscale on the PANAS) that were empirically selected based on bivariate correlations with PSAS serving as the dependent variable. Gender ($\beta=-2.22$, $p=0.005$) and Negative Affect ($\beta=0.502$, $p<0.001$) were found to be significant predictors of PSAS. Separate regression analyses conducted for each gender revealed that for women, greater negative affect was associated with greater PSAS ($\beta=0.539$, $p<0.001$), while for men, higher SLOC was associated with greater PSAS ($\beta=0.424$, $p=0.021$).

Conclusion: These data indicate that gender moderates the relationship between cognitions and pre-sleep arousal in individuals with insomnia. Among women, negative emotions are related to increased pre-sleep arousal while for men, the degree of control over sleep is related to increased pre-sleep arousal. These findings suggest that men and women might require different cognitive targets when addressing pre-sleep arousal.

0690

INFORMATION PROCESSING DURING SLEEP AMONG INSOMNIA SUBTYPES: PRELIMINARY DATA

Ceklic T[1,2], Turcotte I[1,2], Lefrancois J[1,2], Pedneault-Drolet M[1,2], Bastien CH[1,2]
[1]School of Psychology, Laval University, Quebec, QC, Canada, [2]Centre de recherche Universite Laval Robert-Giffard, Quebec, QC, Canada

Introduction: The neurocognitive and psychobiological models of insomnia respectively suggest that insomnia is linked to cortical hyperarousal and difficulties inhibiting this activation during sleep. Activation translates in enhanced information processing, which can be measured with event-related potentials (ERPs). Few studies reported evidence of

enhanced information processing during sleep in insomnia individuals compared to good sleepers (GS). One study even reported information processing differences between individuals suffering from psychophysiological (IPS) and paradoxical (IPA) insomnia. The objective of this study is to compare ERPs among insomnia subtypes including IPS, IPA and idiopathic insomnia individuals (INSi).
Methods: Nine GS (mean age 30.9 years, SD=3.6), nine IPS (mean age 31.1 years, SD=2.7), nine IPA (mean age 31.1 years, SD=7.1) and three INSi (mean age 31.0 years, SD=3.0) underwent four PSG nights in the sleep laboratory. ERPs were recorded all night on Night4 using an oddball paradigm. N1, P2 and N350 behaviours were measured during early and late-night stage 2 sleep, SWS and REM sleep for both standard and deviant tones. Mixed models ANOVAs were used to compare the amplitude (μV) and latency (ms) for each ERP.
Results: Only a few marginally significant results could be observed. All night N350 amplitude differed among insomnia subtypes ($p = 0.09$) with IPA presenting the largest amplitude (-7.01), followed by INSi (-6.37), IPS (-4.92) and GS (-3.45). Also, INSi presented a larger P2 than GS during early-night stage 2 ($p = 0.09$) while IPA presented a higher P2 than GS during REM sleep ($p = 0.06$).
Conclusion: Results suggest that individuals suffering from insomnia may present difficulties inhibiting cortical activation during sleep, as stated by the psychobiological model, and that those difficulties may vary among the different subtypes. However, these preliminary results must be interpreted with caution considering that the small sample size (especially for idiopathic insomnia individuals) limits statistical power.
Support (If Any): CIHR (#86571 to CB).

0691
INSOMNIA AND PERFORMANCE: ERPS FROM A GO/NOGO PROTOCOL
Bastien CH, Turcotte I
Laval University, Quebec, QC, Canada

Introduction: Insomnia individuals often complain of decreased performance during the day. However, objective measures such as neuropsychological testing often provide contradictory results. Our objective is to study daily performance using finer and more sensitive measures, ERPs. Specifically, N2 (linked to inhibition) and P3 (linked to stimulus evaluation or categorization) will be measured during a Go/NoGo protocol in both insomnia individuals and good sleeper controls.
Methods: 31 individuals suffering from either psychophysiological insomnia (Psy-I, N=11) or paradoxical insomnia (Para-I, N=10) were compared to good sleepers (GS, N=10) on a Go/NoGo protocol during which standard (STD, probability=.8) and deviant (DEV, probability=.2) 70 dB tones were presented. N2 and P3 behaviors were measured during both an easy (E) and a difficult (D) task: GoE (STD=1KHz;DEV=2KHz), NoGoE (STD=1KHz;DEV=2KHz), GoD (STD=1KHz;DEV=1100 Hz) and NoGoD (STD=1KHz;DEV=1100 Hz). All participants spent 4 consecutive nights in the sleep laboratory and ERPs were recorded on the mornings following the second and third nights.
Results: Mixed model analysis revealed no significant group effects for neither ERPs' amplitude nor latency (>.05). However, a significant Group X Protocol interaction was found for N2 amplitude [$F(2, 67.88) = 6.47$, $p < .01$]. More precisely, N2 was larger in Para-I than Psy-I and GS during the NoGoE paradigm. Results also showed that P3 amplitude [$F(1, 261.03) = 18.74$, $p < .01$] was generally higher on the first test morning than on the second one during the NoGoE task.
Conclusion: Insomnia individuals appear to differ in their ability to cortically inhibit auditory stimulation, and especially when no behavioral response is required. In this regard, paradoxical insomnia individuals display more cortical arousal and also appear to show greater signs of inhibition than psychophysiological ones and good sleepers. These results still have to be interpreted according to quality of sleep, both objective and subjective.
Support (If Any): Canadian Institute of Health Research (#86571).

0692
ASSOCIATIONS BETWEEN PSG-DEFINED SLEEP AND SLEEP-RELATED ATTENTIONAL BIAS
Kyle SD[1], MacMahon K[1], Perlis ML[2], Gehrman P[2], Espie CA[1]
[1]University of Glasgow Sleep Centre, Institute of Neuroscience & Psychology, University of Glasgow, Glasgow, United Kingdom, [2]University of Pennsylvania, Philadelphia, PA, USA

Introduction: Sleep-related attentional bias has been proposed to play a role in the aetiology and maintenance of chronic insomnia disorder. While several studies show a differential attentional bias to sleep-related stimuli in insomnia patients relative to controls, there has been little investigation of the relationship between objective sleep and pre- and post-sleep assessments of attentional processing. Here we report preliminary findings from a larger study on the associations between objective sleep-related attentional bias and PSG-defined sleep.
Methods: Twenty-four patients with well-defined Psychophysiological Insomnia [14 females: 10 males; mean age= 46(11.2)] stayed in the lab for two nights of PSG. On the second night participants completed a computerized battery of attentional tasks, 2 hours prior to habitual bedtime and 2 hours post-rising time. Four computerised tasks were completed, but for the purpose of the present report we focus on the emotional Stroop, a relative measure of attentional processing (neutral versus sleep/mood stimuli), which permits within-subject analyses. Stroop interference scores were computed for both mood and sleep-related words (relative to neutral) for each testing session. Correlations were computed between interference scores and PSG-derived sleep variables.
Results: There were no associations between sleep continuity variables and attentional bias (morning or evening). There were positive associations between percentage SWS (on both nights 1&2) and sleep-related interference, with reduced SWS associated with greater next-day interference (night 1: $r=.50$, $p<.05$; night 2: $r=.44$, $p<.05$). Similar findings, though non-significant and weaker in magnitude, were also reported for mood-related word interference (night 1: $r=.40$, $p=.07$; night 2: $r=.34$, $p=.13$). Finally, there was a trend for mood-related word interference (in the evening) to be associated with lower levels of SWS during the subsequent sleep period ($r=.41$, $p=.06$).
Conclusion: Lower levels of SWS appear to modestly relate to next-day assessments of sleep-related attentional bias and to pre-sleep mood-related attentional bias. Due to the small sample size and within-subjects design these results are necessarily preliminary.
Support (If Any): National Institutes of Health.

0693
AGE MODERATES DAY TO DAY VARIABILITY IN THE RELATIONSHIP BETWEEN SLEEP AND PHYSICAL ACTIVITY AMONG WOMEN WITH INSOMNIA
Baron KG, Reid KJ, Clough D, Zee P
Neurology, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA

Introduction: Insomnia is prevalent in older adults and previous studies have shown that exercise can improve sleep, mood, and quality of life. However, patients report individual variability in the effects of exercise on their sleep. This study aimed to evaluate the day to day relationship between exercise, subjective and objective sleep quality.
Methods: This study is a sub-analysis of a 16 week exercise intervention for sedentary older adults with primary insomnia. Eligibility for the study included a diagnosis of primary insomnia by clinical interview and a Pittsburgh Sleep Quality Index (PSQI) score > 5. During the intervention, participants engaged in a minimum of 30 min of aerobic physical activity > 3 times per week. Demographic and sleep quality questionnaires were completed at baseline. Actigraphy, sleep and physical activity logs were completed throughout the study. Data were analyzed using multilevel models. Exercise variables included: exercise session (yes or

no) and duration. Sleep variables included subjective sleep quality and sleep duration, sleep efficiency, wake after sleep onset calculated by actigraphy. Models were constructed to predict sleep from daily exercise and next day exercise from sleep each night. Between subjects variables (age, baseline sleep quality) were tested at level 2 to explain individual differences in the day to day relationships (level 1).
Results: Participants included 11 women (age M= 61.3 SD=4.2, PSQI M=10.4, SD= 2.1). Average number of physical activity sessions was 58 (SD=18.1) and average session duration was 33.6 SD=4.9 minutes. Treadmill was the most common activity (65% of sessions). There was significant variability in the intraindividual day to day relationships between physical activity and sleep, and age explained some of this variability. Participation in physical activity was more strongly related to subjective ratings sleep quality that night as age increased (p=.005). Age was also associated with a stronger relationship between sleep efficiency at night and longer next day physical activity duration (p=.02).
Conclusion: There is significant variability in the day to day relationships between sleep and physical activity. Age may be an important factor in the short-term benefits of exercise. Greater understanding of individual differences in the exercise-sleep relationship may help target treatment and also identify those who are at risk for discontinuing exercise prematurely due to lack of perceived benefits in the short-term.
Support (If Any): P01 AG11412, 1K23HL109110-01.

0694

CIRCADIAN VARIATION IN THE TONE AND QUALITY OF THOUGHTS: SLEEP MAINTENANCE INSOMNIACS VERSUS GOOD SLEEPING CONTROLS

Lushington K[1], Van Dongen H[2], Lack LC[3], van den Heuvel CJ[4]
[1]School of Psychology, Social Work and Social Policy, University of South Australia, Magill, SA, Australia, [2]Sleep and Performance Centre, Washington State University, Spokane, WA, USA, [3]School of Psychology, Flinders University of South Australia, Bedford Park, SA, Australia, [4]Research Management, University of Adelaide, Adelaide, SA, Australia

Introduction: To date, the examination of the quality and tone of thoughts affecting the sleep of insomniacs is based on data typically collected in the morning after a sleep episode, i.e. retrospective recall with its accompanying limitations. An alternative approach which has yet to be fully explored is to collect in-vivo measures of mental activity across the sleep period.
Methods: Sixteen (11F, 5M) good sleeping controls [mean (SD) age = 65.4 (7.4)y] and sixteen (11F, 5M) insomniacs [64.3 (7.2)y] underwent four consecutive nights of PSG (screening, adaptation and two baseline nights) followed by a 26h constant routine protocol where subjects were kept in bed but awake (a methodology ideal for controlling for the confounding impact of sleep on recall). Subjects completed hourly 10pt VAS assessing: (1) Thought recall (difficult - easy); (2) Thought monitoring (very little- very much); (3) External awareness (very little - very much); (4) Control of thoughts (very little - very much); (5) Reality orientation of thoughts (dreamlike - real); (6) Modality of thoughts (internal dialogue - images); (7) Sequencing of thoughts (repeated themselves - followed from one item to the next); and (8) Pleasantness of thoughts (unpleasant - pleasant).
Results: ANOVA tests revealed significantly higher levels of sequential thinking in insomniacs, significant time-of-day effects for the control, self-monitoring, external awareness, reality, sequencing, recall and pleasantness of thoughts, but no significant group by time-of-day interactions.
Conclusion: Insomniacs were more likely to report sequential thinking which was evident both during the day and especially at night suggesting that cognitive therapy targeted at sequential thinking may be of therapeutic benefit.

0695

ASSOCIATIONS OF INSOMNIA SYNDROME AND SYMPTOMS ON DREAM CONTENT: AN EXPLORATORY STUDY

Pérusse AD[1], Ouellet D[1], Ellis JG[3], De Koninck J[4], Savard J[1], Bastien CH[1,2]
[1]Ecole de psychologie, Universite Laval, Quebec, Qc, QC, Canada, [2]Centre de recherche Université Laval Robert-Giffard, Quebec, Qc, QC, Canada, [3]Northumbria University, Newcastle, United Kingdom, [4]School of psychologie, University of Ottawa, Ottawa, ON, Canada

Introduction: Insomnia syndrome (SYN) describes individuals meeting full diagnostic criteria for insomnia (DSM-IV-TR), whereas insomnia symptoms (SX) typify individuals reporting one or more symptoms without meeting full criteria. Although recent research has provided some clinical characteristics for SYN and SX, little is known about their mental activity during sleep. Our present objective is to document dream content in SYN and SX compared to good sleepers (GS).
Methods: 14 SYN [Mage=27.6, 54 dreams], 8 SX [Mage=24.9, 27 dreams] and 8 GS [Mage=27.1, 19 dreams] completed dream questionnaires for one week. Emotions linked to dreams were also documented. Participants reported recall capacity and vividness in addition to joy, happiness, apprehension, anger, sadness, confusion, fear, anxiety and pleasantness of dreams on a Likert scale.
Results: Kruskal-Wallis analyses showed main group effects (ps≤ .05) for recall vividness, apprehension, confusion, fear, anxiety, pleasantness and unpleasantness. Post-hoc analyses revealed that SX reported significantly more apprehension (p≤ .001), confusion (p≤ .001), fear (p≤ .03), anxiety (p≤ .004) and unpleasant content (p≤ .01) than GS. Recall vividness, confusion and pleasant content were significantly (ps≤ .05) higher in SYN's compared to GS. Finally, SX reported significantly more fear (p≤ .032) and anxiety (p≤ .001) than SYN.
Conclusion: While dream recall and vividness is greater in SYN than in SX, dream content of SX is more negative than that of both SYN and GS. The higher degree of recall vividness of SYN could be related to cortical activation typically observed in SYN. The greater negative content of dreams of SX is surprising but dream characteristics could be related to their waking stress levels. The theory of continuity between waking and dreaming would suggest a positive relationship. However, it may be that the negative content of dreams has a negative impact of the waking experience of SX and exacerbates their waking distress.
Support (If Any): Supported by les Fonds de la Recherche en Santé du Québec and the Canadian Institutes of Health Research (# 86571).

0696

NOCTURNAL AUDITORY STIMULI PRODUCES SUBJECTIVE BUT NOT OBJECTIVE SLEEP DISCREPANCIES IN GOOD SLEEPERS

Sharman RL[1], Bastien CH[2,1], Perlis ML[3,1], Wetherell MA[1], Ellis JG[1]
[1]Northumbria Centre for Sleep Research, Northumbria University, Newcastle upon Tyne, United Kingdom, [2]School of Psychology, Laval Universite, Quebec City, QC, Canada, [3]Department of Psychiatry, University of Pennsylvania, Philadelphia, PA, USA

Introduction: A key characteristic of insomnia, suggested by the Neurocognitive model, is that increased sensory and information processing at sleep onset and during NREM sleep affects the individual's ability to perceive sleep "as sleep" and alters perceptions of sleep continuity. In the present study, good sleeper subjects were assessed for the effects of salient ("night noises") and non-salient (white noise) auditory stimuli on sleep continuity.
Methods: Following adaptation and baseline nights, good sleepers (n=19 age 23±3.19) were played sound stimuli (a range of 30 salient and the white noise) at a 40dB level, five minutes after onset of stage 2 sleep via ear buds. Each noise was administered for 3 seconds with an interstimulus interval of 7 sec for 5 minutes (i.e., 30 stimuli / 5 min) followed

by a 100 sec stimulus of white noise then a 100 sec period of quiescence. Following the quiescence the next sound stimuli would begin from the playlist. The playlist repeatedly administered sounds in a set order until 1 hour prior to the subjects habitual wake time. Acoustic stimuli were not played during waking intervals. Subjects were not aware that sounds were to be played during the study.
Results: There were no significant differences between baseline and experimental night on PSG measures of sleep continuity (SOL, WASO, NWAK, TST, SE%). Subjective reports differed between baseline and experimental nights (as assessed by sleep quality and mood diaries) with subjects reporting significantly increased NWAK ($t(17)=2.521$ $p<0.05$) and WASO ($t(16)=2.13$ $p<0.05$) on experimental nights. Additionally, subjects reported a decreased TST ($t(16)=2.619$ $p<0.05$) and that their sleep was more disturbed ($t(16)=4.96$ $p<0.01$) compared to baseline nights.
Conclusion: The results suggest that noise during the night produces a subjective change in perceptions of sleep continuity. Future research will evaluate whether these effects are related to Beta EEG activity and/or memory performance.

0697

MULTIPLE-SYMPTOM INSOMNIA AS COMPARED TO SINGLE-SYMPTOM INSOMNIA

Beqiri E[1,2,3], Bremer EM[2,3], Jackson NJ[4], Grandner MA[4], Gehrman P[2,3], Perlis ML[2,3]
[1]Psychology, University of the Sciences, Philadelphia, PA, USA, [2]Behavioral Sleep Medicine Program, University of Pennsylvania, Philadelphia, PA, USA, [3]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [4]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Symptoms of insomnia include difficulty initiating sleep, difficulty maintaining sleep, and early morning awakenings. To date, very few studies have evaluated illness severity, clinical course, or treatment outcome while taking into account these subtypes. As part of an initial effort to do so, the present analysis addresses the question of whether patients with multiple symptoms experience greater illness severity than those with only one.
Methods: An online questionnaire was used to screen potential study participants. Respondents completed items related to standard sleep variables, daytime impairment, and sleep sufficiency. Sleep latency (SL) and wake after sleep onset (WASO) were assessed in minutes/night and number of nights/week, with overall severity computed as minutes/night*nights. Insomnia was defined as sleep latency (SL) or wake after sleep onset (WASO) >30 minutes plus daytime impairment. Daytime impairment was based on single-item endorsement/ Linear regression analyses, adjusted for age, sex, race/ethnicity, and education, were conducted with type of insomnia (Multiple-symptom vs. single-symptom insomnia) as predictors and mean SL and WASO, Symptom Severity and daytime impairment as outcomes.
Results: Of n=689 respondents over the past 8 months, n=512 reported that they had a problem initiating sleep, maintaining sleep, or waking too early. The majority of respondents (91%) reported more than one symptom. Multi-symptom, compared to single-symptom, presentation was associated with increased SL (28.2mins), WASO (27.6mins), greater overall insomnia severity (410.8mins/wk) and more frequent complaints regarding daytime impairment (36.7% more frequent). All reported effects were significant at $p<0.05$.
Conclusion: Multiple-symptom insomnia, as compared to single-symptom insomnia, is associated with greater illness severity.
Support (If Any): This study was supported by T32HL007713, R01AT003332, R01MH077900.

0698

IS SUBJECTIVE DAYTIME IMPAIRMENT IN INSOMNIA RELATED TO INSOMNIA SEVERITY OR SLEEP DURATION?

Ramirez A[1,2], Gehrman P[1,2], Jackson NJ[3], Grandner MA[3], Perlis ML[1,2]
[1]Behavioral Sleep Medicine Program, University of Pennsylvania, Philadelphia, PA, USA, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [3]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Current diagnostic criteria for insomnia include daytime impairment. While conceptually sensible, it is unclear whether this criterion is associated with insomnia severity or sleep duration. The current analysis explores this association.
Methods: Participants with and without insomnia completed an online screening questionnaire. Of respondents n=1698 complained of insomnia and provided complete data for analysis over the past 32 months. This questionnaire asks about sleep and physical and mental health. The presence of daytime impairment was assessed in a binary fashion. Sleep latency (SL) and wake after sleep onset (WASO) were assessed as minutes/night and as the number of nights/week of a problem. The combination of severity of SL and WASO (average minutes and frequency) was used as an overall index of insomnia severity. Time in bed (TIB) was calculated and total sleep time (TST) was both calculated and self-reported. Linear regression analyses, with daytime complaint as predictor, were adjusted for age, sex, race/ethnicity, education, depression history, and chronic pain.
Results: 86% of those reporting insomnia reported daytime impairment. Overall, daytime impairment was not a significant predictor of SL or WASO duration or severity or insomnia severity ($p>0.05$). However, those with daytime impairment exhibited less TIB (13.4mins,$p=0.031$), and both calculated (23.6mins,$p=0.017$) and self-reported (13.3mins,$p=0.033$) TST.
Conclusion: The results of this study indicate that daytime impairment complaints are not simply a function of insomnia severity. They are, however, related to sleep duration and time in bed, suggesting that the complaint has more to do with insufficient sleep duration rather than inadequate sleep quality.
Support (If Any): This study was supported by T32HL007713, R01AT003332, R01MH077900.

0699

INSOMNIA SEVERITY INDEX AND SLEEP PERCEPTION: A POPULATION-BASED STUDY

Lucchesi LM, Ribeiro Pinto Junior L, Castro LS, Tufik S, Bittencourt LA
Psicobiologia, Universidade Federal de São Paulo, São Paulo, Brazil

Introduction: Even though sleep misperception is common among people with insomnia complaints, it has been poorly investigated. Therefore, our goal was to measure if sleep misperception correlates with insomnia severity and how individuals with different levels of insomnia would perceive their sleep compared to those without insomnia.
Methods: A total of 1042 individuals (mean age 42.34±14.39, 55.6% women) representing the adult population of Sao Paulo city, Brazil, were interviewed. They underwent a full-night polysomnography (PSG) registered at the sleep laboratory and answered the Insomnia Severity Index(ISI).The sleep perception index was determined by the ratio between the perceived amount of sleep on the morning following PSG and the total sleep time registered objectively through the night. Individuals with an index below the percentile 25 were categorized as underestimating sleep. The ISI score classified individuals as having non-clinical insomnia (0-7), subthreshold insomnia (8-14) and moderate-to-severe insomnia (15-28).
Results: The mean sleep perception index for the total sample was 1.03±0.34. The mean ISI was 7.89±6.08. A modest but significant negative correlation was found between both indexes ($r= -0.13$; $p<0.001$).

The mean sleep perception decreased with increasing levels of insomnia severity (1.05±0.38, 1.02±0.28 and 0.96±0.28; p=0.01). The frequency of individuals underestimating sleep was accordingly higher as insomnia severity levels increased (19.5%, 21.9% and 33.3%; p=0.004).
Conclusion: Our findings suggest that the ISI does correlate with the sleep perception index and that the more severe is the insomnia, the more individuals may underestimate the amount of their sleep.
Support (If Any): AFIP, FAPESP, CEPID.

0700

DO PATIENTS WITH INSOMNIA GET LESS SLEEP THAN SUBJECTS WITHOUT INSOMNIA?

Berkowitz Sturgis EK[1,2], Jackson NJ[3], Gehrman P[1,2], Grandner MA[3], Perlis ML[1,2]
[1]Behavioral Sleep Medicine Program, University of Pennsylvania, Philadelphia, PA, USA, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [3]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Insomnia is commonly defined in terms of sleep initiation and maintenance difficulties (and/or problems with non-restorative sleep). While quantitative criteria are often applied to the assessment of sleep continuity disturbance, it is rare that a threshold value is specified for total sleep time. Presumably, this is because of the potential confounds of 1) the natural and normative occurrence of short sleep and 2) the inability to know what a given individual's sleep need is and thereby knowing if the individual is getting less sleep than is needed. Given this, little is known about whether patients with insomnia get less sleep than subjects without insomnia. The present analysis addresses this issue.
Methods: Participants with and without insomnia completed an online screening questionnaire that asked about sleep and overall health. Subjects (n=679) over the past 32 months were asked whether they had a difficulty with sleep onset latency (SL), wake after sleep onset (WASO), and/or early morning awakenings (EMA). Total sleep time (TST) was determined by computation and self-report. Linear regression analyses were conducted with covariates for sex, race/ethnicity, education, depression history, and chronic pain. Insomnia variables served as the predictor variables.
Results: Overall, problems with both SOL and WASO predicted less sleep. Lower self-reported TST was associated with problems in SOL (0.82hrs) and WASO (0.44hrs), but not EMA. Lower computed TST was associated with problems in SOL (101.04mins) and WASO (57.59mins), but not EMA. All reported effects were significant at $p<0.05$.
Conclusion: These data suggest that sleep initiation and maintenance problems (SL & WASO but not EMA) are associated with reduced total sleep time.
Support (If Any): This work was supported by T32HL007713, R01AT003332, and R01MH077900 .

0701

INSOMNIA SYMPTOMS AND PROBLEMATIC SLEEP DURATION

Berkowitz Sturgis EK[1,2], Jackson NJ[3], Gehrman P[1,2], Grandner MA[3], Perlis ML[1,2]
[1]Behavioral Sleep Medicine Program, University of Pennsylvania, Philadelphia, PA, USA, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [3]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: The degree to which complaints regarding sleep duration relate to the experience of insomnia symptoms is unclear. Endorsements of having "a problem" with sleep duration have not been previously explored relative to sleep continuity measures and insomnia symptoms.
Methods: Participants with and without insomnia completed an online screening questionnaire consisting of questions related to sleep and overall health. Subjects (n=679) over the past 32 months were asked if their sleep duration was "a problem". Presence of daytime impairment was assessed in a binary fashion. Sleep latency (SL) and wake after sleep onset (WASO) were assessed as minutes/night and number of nights/week of a problem. Severity of SL and WASO were coded as minutes/night*nights and the sum of these variables was used as a measure of overall insomnia severity. Time in bed (TIB) was calculated and total sleep time (TST) was both computed and self-reported. Linear regression analyses, with sleep duration problems, were adjusted for age, sex, race/ethnicity, education, depression history, chronic pain, and self-reported insomnia status. To determine whether problematic sleep duration is better predicted by insomnia severity or computed TST, logistic regressions included likelihood of problematic sleep duration as outcome and insomnia severity and calculated TST as predictors.
Results: Those who endorsed problems with sleep duration reported greater: SL in minutes (17.5), WASO in minutes (22.2), insomnia severity in minutes/week (300.3), and likelihood of daytime impairment (21.81%). Endorsement of problems with sleep duration was also associated with decreased likelihood of sufficient sleep (29.90%), as well as decreased TIB (1.44hrs), computed and self-reported TST(126.14 and 86.4 minutes, respectively). In logistic regression, problematic sleep duration was predicted by insomnia severity (OR=1.003) and computed TST (OR=0.988), though when these terms were evaluated simultaneously, only the TST effect remained. All reported effects were significant at $p<0.01$.
Conclusion: Those who endorse problematic sleep duration report increased insomnia symptoms in addition to reduced sleep time and time in bed. Both TST and insomnia severity are predictive of problematic TST, but the effect of insomnia severity is accounted for by the effect of TST when these variables are evaluated simultaneously.
Support (If Any): This work was supported by T32HL007713, R01AT003332, and R01MH077900 .

0702

RECRUITMENT STRATEGIES: WHAT METHODS YIELD THE MOST POTENTIAL PARTICIPANTS?

Barilla HE[1], Waldron EA[1,2], Plaksin JR[3], Segal AG[1,4], Findley J[1], Gehrman P[1,5], Jackson NJ[6], Grandner MA[6], Perlis ML[1]
[1]Behavioral Sleep Medicine Program, University of the Pennsylvania, Philadelphia, PA, USA, [2]Department of Psychology, Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA, [3]School of Medicine, New York University, New York, NY, USA, [4]Department of Psychology, Drexel University, Philadelphia, PA, USA, [5]Philadelphia VA Medical Center, Philadelphia, PA, USA, [6]Center for Sleep and Circadian Neurobiology, Division of Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Human subject recruitment is a crucial component of the conduct of clinical research. It has been suggested that using a combination of recruitment methods to accrue the target study sample is essential. Active (i.e. interpersonal communication) rather than passive (i.e. mass mailings) approaches may be more effective recruitment strategies. This analysis examines a variety of recruitment methods implemented in the greater Philadelphia area.
Methods: Participants with and without insomnia completed an online screening questionnaire. 2911 individuals (1715 with insomnia) responded to the survey over 32 months. 2794 participants identified where they learned of the study (craigslist.org, healthcare settings, City-paper, internet ads, diner placemats, Metro-paper, public transportation, university website, flyers/posters, friends/referrals, large-format posters, internet searches, magazines/newspapers, direct-contact, radio, TV, and other). Of these, 1234 were study eligible. Logistic regressions evaluated whether any recruitment strategies significantly differed from craigslist on eligibility outcomes as a control participant or a participant with insomnia. A Chi-Square global test for differences among recruitment strategies was conducted for each of these three outcomes.

Results: The majority of respondents came from craigslist (53.4%), with the next most popular routes being friends/referrals (10.8%) and university website (5.3%). Global tests for differences among recruitment strategies were significant ($p<0.05$). For controls, healthcare settings and metro-paper were less effective than craigslist (24% and 18%, respectively, $p<0.05$). For insomnia, healthcare settings were 25% more effective ($p=0.006$) and direct contact was 33% more effective ($p=0.009$). Taken together, no recruitment paths were significantly more/less effective than craigslist except TV, which was 28% less effective overall ($p=0.003$).
Conclusion: Overall, craigslist was an effective recruitment path that was highly cost-effective. Other lessons learned were that 1) healthcare settings and direct contact (e.g. friends) are effective for recruiting individuals with insomnia, but not controls, 2) the metro-paper was less effective for controls, and 3) TV advertisement were the least effective.
Support (If Any): This work was supported by T32HL007713, R01AT003332, and R01MH077900.

0703

ETHNIC DISPARITIES IN SLEEP DISORDERS AND DAYTIME FUNCTIONING AMONGST COLLEGE STUDENTS

Ruiter ME[1], Lichstein KL[2]
[1]Medicine, The University of Alabama at Birmingham, Birmingham, AL, USA, [2]The University of Alabama, Tuscaloosa, AL, USA

Introduction: There is a dearth of information on the prevalence of sleep disorders amongst college students, a population commonly experiencing poor sleep quality and dissatisfaction. Also, few studies have determined sleep disorder prevalence across ethnicity. The aim of the present study was to examine ethnic differences in sleep disorders and daytime functioning in a college student sample.
Methods: 1,540 undergraduate college students, aged 18-25 (1,285 Caucasian-Amer¬icans (CA), 255 African-Americans(AA)), completed the Global Sleep Assessment Questionnaire (GSAQ), the Insomnia Severity Index (ISI), demographic information, and ICSD-II insomnia disorder criteria. Using the GSAQ, sleep disorders were identified if symptoms of a sleep disorder were experienced usually or always in the past four weeks. Between-subjects t-tests, Chi-square tests and two-way ANCOVA were conducted.
Results: AA were more likely to report frequent loud snoring (8.6% vs. 5.4%), whereas CA reported more frequent nightmares and parasomnias (6.9% vs. 3.5%), ps <.05. There were no ethnic differences in insomnia diagnosis (14.2% CA, 14.5% AA), ISI, apneic events (both 1.6%), RLS (8.2% CA, 8.6% AA), and PLMD (8.0% CA, 7.5% AA). CA reported more daytime functioning domain impairments than AA, $p = .001$. CA were more likely to report fatigue, daytime sleepiness, poor motivation, and neurocognitive deficits. A two-way ANCOVA revealed an interaction between ethnicity and sex on early morning awakenings, with AA women reporting as most severe, after controlling for confounders, $p < .05$. Of participants with an insomnia disorder, CA reported their insomnia was more interfering, and created more daytime functioning domain impairments, particularly neurocognitive problems, compared to AA, ps < .05.
Conclusion: There were no ethnic differences in sleep disorder prevalence with the exception of more snoring in AA, more early morning awakenings amongst AA women, and more parasomnias in CA. CA reported their sleep problems interfered with their daytime functioning to a greater extent than did AA.

0704

WHAT EVENTS SERVE AS PRECIPITATING FACTORS FOR CHRONIC INSOMNIA AND ARE SOME EVENTS ASSOCIATED WITH GREATER ILLNESS SEVERITY?

Bremer EM[1,2], Beqiri E[1,2], Ramirez A[1,2], Grandner MA[3], Jackson NJ[3], Gehrman P[1,2], Perlis ML[1,2]
[1]Behavioral Sleep Medicine Program, University of Pennsylvania, Philadelphia, PA, USA, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [3]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Current theories of insomnia posit perpetuating factors as the cause for the progression from acute to the chronic phase of the disorder. Yet, the precipitating events which initiate this process have rarely been the subject of systematic study. The present analysis provides an overview of the types of events that are reported as being associated with new onset insomnia.
Methods: Participants with and without insomnia completed an online screening questionnaire. Participants who endorsed insomnia were asked to describe a precipitating event. The events were sorted into the following categories: job, relationship, family, death of loved one, medical illness, psychiatric illness, traumatic event, major life event, medication, circadian/sleep, military, reproductive, legal, financial, menopause, or other. Insomnia-related outcomes included sleep latency (SL) as mins/night, wake after sleep onset (WASO) mins/night and insomnia severity (sum of SL x frequency and WASO x frequency), daytime impairment (yes/no) and self-reported total sleep time (TST). Regression analyses, with insomnia variable as outcome, and specific events as predictors, were adjusted for demographics/socioeconomics and history of depression and pain.
Results: Of respondents with self-reported insomnia (n=1699), 26.4% identified a precipitating event. Of those that reported precipitants, the most prevalent were: job (18%), medical illness (16%), relationship (12%), psychiatric illness (11%) and life event (10%). Financial events were associated with greater insomnia severity (346.8mins/wk) military and legal events were associated with increased SL and WASO in minutes/night (95.5 and 18.6, respectively) and increased severity (370.2 and 685.5, respectively). Increased WASO severity was found for financial events (202.9mins/wk). All reported events were significant at $p<0.05$.
Conclusion: Surprisingly, the majority of individuals with insomnia did not identify precipitating events. Of those that were reported, certain events, such as financial, military and legal events, were associated with worse insomnia symptoms. Future research should evaluate what factors predict whether precipitating events are recalled.
Support (If Any): This work was supported by T32HL007713, R01AT003332, and R01MH077900.

0705

DO THE TERMS "SLEEPY", "TIRED", AND "FATIGUED" HAVE DIFFERENT MEANINGS FOR THOSE WITH INSOMNIA?

Lack LC, Sukovic A, Wright H
Psychology, Flinders University, Adelaide, SA, Australia

Introduction: The terms sleepy, tired, and fatigued are often used interchangeably but sometimes at a cost. For example, a behavior therapy instructs to go to bed only when sleepy but may not be effective if the patient goes to bed when fatigued and not sleepy. Recently it has been suggested that questionnaires of daytime fatigue be used in the treatment of chronic insomnia since fatigue, rather than sleepiness, is a prominent daytime symptom. The aim of the present study was to quantify the meaning of sleepy, tired, and fatigued using the Semantic Differential Technique and to compare them in good and poor sleepers.
Methods: A principal components analysis was used to derive a set of 13 polar opposite scales (e.g. pleasant-unpleasant, active-passive, light-

heavy) on the basis of their high loadings on the three most significant orthogonal components described as evaluative, activity, and potency. The concepts of "sleepy", "tired", and "fatigued" were then rated using these 13 scales by 125 young adult university students, half of whom were poor sleepers with a PSQI score >6.

Results: Fatigued was judged as more negative, active, and potent than sleepy with tired rated intermediately but closer to fatigued. There were no differences in these ratings between the good and poorer sleepers. The quantified meanings of these terms could also be viewed in 3-Dimensional space and the direct spatial distance between them calculated. There was a significant distance between sleepy and fatigued in this semantic space.

Conclusion: This semantic differential technique showed a considerable difference in the meanings of sleepy and fatigued. In this study we found no difference between good and poor sleepers in these meanings. However, clinically diagnosed chronic insomniacs should also be studied. In any case these results highlight the need for sleep researchers and clinicians to use separate measuring scales for sleepy and fatigued.

0706

A QUANTITATIVE APPROACH TO DISTINGUISHING OLDER ADULTS WITH INSOMNIA FROM GOOD SLEEPER CONTROLS

Levenson JC[1,2], Troxel WM[2], Begley A[2], Hall MH[2], Germain A[2], Monk TH[2], Buysse DJ[2]

[1]Department of Psychology, University of Pittsburgh, Pittsburgh, PA, USA, [2]Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Insomnia is a debilitating and highly prevalent disorder, particularly in older adults. Despite substantial research in this area, few studies have utilized empirically-defined quantitative parameters in order to discriminate individuals with insomnia from healthy controls, and even when such parameters have been utilized they vary among studies. Recent work has begun to establish quantitative criteria for insomnia, but consensus has not yet been reached. The purpose of this study was to identify the optimal quantitative thresholds determined from actigraphy or sleep diary that differentiated older adults (>60 years) with insomnia from "good sleeper" controls.

Methods: 144 participants (79 insomnia (35% male), 65 control (31.7% male); mean age=71.7 years (7.2)) completed at least 7 nights of sleep diary and actigraphy. Receiver Operating Characteristic curve analyses and the Youden Index were used to identify optimal threshold values. Sleep onset latency (SOL), wake time after sleep onset (WASO), sleep efficiency (SE), and total sleep time (TST) were examined for each of the measurement methods.

Results: Sleep diary measures produced areas under the curves (AUC) in the moderate to high range (0.84-0.97), whereas actigraphy performed poorly at discriminating the two groups (AUC 0.58-0.61). The Youden Index identified SOL=18 minutes, WASO=21 minutes, SE=92%, and TST=388 minutes as the sleep diary measures that yielded the highest sensitivity and specificity values. Medication use did not change the findings.

Conclusion: Sleep diary parameters discriminated individuals with insomnia from good sleepers while actigraphy did not. These quantitative criteria are similar to those reported by other investigators using different methods and samples, including younger adults. The results suggest that the sleep diary, an inexpensive self-report sleep measure, may be used in clinical and research settings to identify older adults with and without insomnia.

Support (If Any): AG20677, HL093220, MH024652, AG13396 and RR024153.

0707

IS THE FORD INSOMNIA RESPONSE TO STRESS TEST (FIRST) ASSOCIATED WITH INSOMNIA FOLLOWING THE TRANSITION TO COLLEGE?

Roane BM[1,2,3], Seifer R[1,3], Carskadon MA[1,2,3]

[1]Department of Psychiatry and Human Behavior, Warren Alpert Medical School of Brown University, Providence, RI, USA, [2]Sleep for Science Research Laboratory of Brown University, Providence, RI, USA, [3]E.P. Bradley Hospital, Providence, RI, USA

Introduction: The FIRST questionnaire measures predisposition to stress-induced sleep disturbance (Drake et al., SLEEP, 2004a) with scores predicting incident chronic insomnia in adults at 12-month follow-up (Drake et al., SLEEP, 2004b). Students experience a known life-stressor with the transition to college and subsequent daily stressors with exams and projects throughout the semester. Applying the behavioral model perspective for insomnia, these stressors should serve as triggers for insomnia in those students predisposed to insomnia. As such, we hypothesized that higher FIRST scores would be associated with self-reported insomnia in first-semester college students.

Methods: High school seniors completed a survey that included the FIRST after college acceptance, online sleep diaries for approximately 9 weeks after enrolling at Brown University, and a final survey containing the 5-item Women's Health Initiative Insomnia Rating Scale (WHIIRS) during week 9. Analyses included 181 students (ages 18-21, mean=18.6 years, 96 females). Exclusion criteria were insomnia in high school and less than 50% completed sleep diaries weekly. Variables included sex, FIRST total score, WHIIRS individual and total scores, and calculated mean sleep onset latency (SOL) 4-weeks before final survey. Regression analyses evaluated if sex and FIRST total scores were associated with WHIIRS individual scores, WHIIRS total score, and SOL.

Results: Higher FIRST was associated with higher scores on the WHIIRS difficulty falling asleep (item 1; adjusted R-squared=.03, p=.028) and WHIIRS sleep quality (item 5; adjusted R-squared=.04, p=.002) independent of sex. The FIRST did not predict WHIIRS Items 2, 3, 4, or Total. The FIRST was also associated with SOL (adjusted R-squared=.04, p=.016).

Conclusion: The FIRST accounted for a small amount of variance for two WHIIRS items, but not the WHIIRS total score. The FIRST may have limited utility in predicting stress-induced insomnia in this age group due to the numerous intrinsic and environmental factors that contribute to insomnia onset.

Support (If Any): Support received from the National Institute of Mental Health (MH079179) and the Sleep Research Society Foundation Elliot D. Weitzman, M.D. Research Grant.

0708

SEVERITY OF STRESSFULNESS OF MAJOR LIFE EVENTS AND INSOMNIA SYMPTOMS IN WOMEN AND MEN

Hagen EW[1], Friedman EM[1], Hale L[2], Salzieder N[1], Peppard PE[1]

[1]Population Health Sciences, Univ of Wisconsin, Madison, WI, USA, [2]Preventive Medicine, Stony Brook University, Stonybrook, NY, USA

Introduction: Stressful life events are associated with insomnia. However, little research to date has investigated whether the perceived severity of life-events is associated with insomnia—and whether this association varies by gender. Using data from the Retirement and Sleep Trajectories study (REST - a collaborative project with the Wisconsin Sleep Cohort study), we investigated whether women and men rate severity of life-events differently, and whether the association between severity and insomnia varied by sex.

Methods: 1614 REST subjects (52% female, ages 49-83 years) provided mailed-survey data assessing sleep, health, and sociodemographic factors including an inventory of major life-events (e.g., death of spouse) experienced in the previous year. Insomnia symptoms included difficulty falling asleep, night-waking with difficulty returning to sleep, waking

repeatedly, and waking too early in the morning 5 or more times/month. Subjects rated life-events on a 5-point scale of perceived stressfulness from "not at all stressful" to "extremely stressful." Logistic and linear regression models estimated associations between stress ratings, and: (i) any insomnia symptom, and; (ii) number of insomnia symptoms. Interactions between sex and stress ratings were also examined. Models were adjusted for age, marital status, education, and alcohol consumption.
Results: Women were more likely than men to report difficulty falling sleep (23% vs. 14%, p<0.0001) and night-waking with difficulty returning to sleep (29% vs. 20%, p<0.0001). Men and women reported similar numbers of life-events (overall mean [SD]=2.6[2.3]); however, women rated events as more stressful (p<0.0001). Average stress rating was associated with any (p<0.001) and number (p<0.0001) of insomnia symptoms for women; there was no significant association in men.
Conclusion: Insomnia was associated with the severity of stressfulness of life-events in women but not men. This may partly explain why insomnia symptoms are found more commonly in women.
Support (If Any): R01AG036838-01A1; R01HL62252.

0709

CORTISOL RESPONSIVITY IN INDIVIDUALS VULNERABLE TO INSOMNIA

Drake C, Koshorek J, Gable M, Rojas A, Roth T
Sleep Disorders & Research Ctr, Henry Ford Hospital, Detroit, MI, USA

Introduction: Insomnia is associated with physiological reactivity. However, it remains unclear if increased reactivity to stress represents a marker existing before illness or an illness consequence. This study sought to determine if vulnerable individuals have increased daytime physiological reactivity to a standardized psychosocial stress challenge.
Methods: Twenty-two non-insomniacs were recruited to assess reactivity to the Trier Social Stress Test (TSST). Individuals were median split into High (4M, 8F; 47.3 ± 2.6 years) and Low (6M, 4F; 47.1± 4.3 years) insomnia vulnerability based on the Ford Insomnia Response to Stress Test (FIRST). Subjects with sleep/psychiatric/medical disorders were excluded. Salivary cortisol and alpha amylase (AA) (12 assays in 5-10 min intervals) and cardiovascular measures (systolic diastolic blood pressures and heart rate) were collected before, during, and following the TSST. ANCOVAs were used to test for differences in HPA and ANS reactivity covarying for gender, age, and BMI.
Results: There were no group differences at baseline (cortisol, AA, SBP, DBP, HR; p>.10). The TSST increased cortisol, AA, SBP, and HR (p<.05). Critically, Group x Time interactions were present for cortisol (p<.001), and heart rate (p=.003). Cortisol was significantly attenuated in those vulnerable to insomnia at peak response post-TSST (High FIRST = 5.0 ± 3.3nmol/L, Low FIRST = 13.4 ± 7.0 nmol/L, p=.006) and throughout the 40 minute recovery period (p<.05). Heart rate response was also attenuated in vulnerable individuals during the TSST (High FIRST = 76.3 ± 12.5 bpm, Low FIRST = 90.8 ± 10.0 bpm, p=.01) returning to baseline following recovery (High FIRST = 69.9 ± 12.4 bpm, Low FIRST = 73.2 ± 8.4 bpm, p=.33). Although not significant, AA trended similarly.
Conclusion: Contrary to expectations, cortisol and heart rate responses are attenuated in individuals vulnerable to insomnia. The lack of significance in AA suggests differences in reactivity in different arousal systems.
Support (If Any): 5RO1MH082785.

0710

ASSOCIATION OF RETIREMENT STATUS AND INSOMNIA SYMPTOMS IN THE WISCONSIN SLEEP COHORT STUDY

Harden CM[1], Hagen EW[1], Finn L[1], Hale L[2], Peppard PE[1]
[1]Population Health Sciences, Univ of Wisconsin, Madison, WI, USA, [2]Preventive Medicine, Stony Brook University, Stonybrook, NY, USA

Introduction: Few studies have investigated whether retirees have different sleep quality from their employed counterparts. We examined the relationship between retirement status and four insomnia symptoms among participants of the Wisconsin Sleep Cohort Study (WSC).
Methods: Retirement and insomnia information was collected via mailed surveys. Up to two data points from 1188 WSC participants were used for this analysis. Retirement status was coded as a dichotomous predictor variable (fully retired vs. not). Four insomnia symptoms were examined as separate outcomes: 1) difficulty falling asleep, 2) waking repeatedly, 3) waking too early, and 4) difficulty falling back asleep after waking during the night. Participants indicated frequency of experiencing symptoms on a 5-point scale. Responses were collapsed into dichotomous categories (<5 or ≥5 night/month) for each of the insomnia symptoms. Generalized estimating equations were used to assess the odds of having individual insomnia symptoms based on retirement status adjusting for age, sex, usual sleep duration, typical time spent napping, cardiovascular disease, stroke, hypertension, emphysema and diabetes.
Results: Participants' mean age was 62 years (range: 42-80); 55% were men, and 48% reported being fully retired. Prevalence of the 4 insomnia symptoms ranged from 12 to 35%. Adjusting for age, sex, sleep duration, napping, diabetes, and stroke, the odds ratios (95% CI) for difficulty falling to sleep, waking repeatedly, difficulty falling back to sleep and waking too early were 2.3 (1.5-3.6), 1.4 (1.1-1.8), 1.5 (1.1-2.1), 1.1 (0.8-1.5), respectively, for fully retired compared to not retired individuals. Retired individuals had longer typical sleep duration and napped more than non-retired individuals, but adjusting for these factors did not attenuate these relationships.
Conclusion: Retired individuals were more likely to report three of the four insomnia symptoms; differences in sleep duration and napping did not explain the association. Difficulty falling asleep was most strongly associated with retirement.
Support (If Any): R01AG036838-01A1; R01HL62252.

0711

OBJECTIVE INSOMNIA BUT NOT SLEEP STATE MISPERCEPTION IS ASSOCIATED WITH OVERNIGHT DETERIORATION OF ENDOTHELIAL FUNCTION

Pillar G[1,2], Daniel I[1]
[1]Sleep Lab, Rambam Medical Center and Technion, Haifa, Israel, [2]Sleep Clinic, Clalit Health Cervices, Haifa, Israel

Introduction: Insomnia is associated with cardiovascular morbidity potentially via activation of the stress system. However, about 15% of the patients who complain of insomnia may have sleep state misperception, with normal objective sleep. Endothelial function is a predictor of ischemic heart disease. We hypothesized that objective insomnia but not sleep state misperception will lead to overnight deterioration of endothelial function.
Methods: 29 patients complaining of insomnia (17 with objective insomnia and 12 with sleep state misperception) were studied. All underwent evening and morning assessment of blood pressure and endothelial function (reactive hyperemia test, EndoPAT, Itamar-Medical), full night in lab PSG, and morning urinary catecholamine levels.
Results: The insomnia group had a total sleep time of 292±64min compared to 328±66min of the misperception group. The subjective estimated sleep time was 275±85min for the insomniacs, compared to 162±106min of the misperception group (p<0.005). While in the insomnia group the endothelial function deteriorated during the night (-0.24±0.48), in the misperception group it improved during the night

(0.25±0.49, p<0.05). Urinary Dopamine /Creatinine levels for the insomnia and misperception groups were 199.8±55.4 vs 164.08±33.26 respectively, p<0.05.
Conclusion: This study shows that in patients with objective insomnia endothelial function deteriorates during the night and their morning urinary dopamine levels are increased compared to patients with insomnia complaints but substantially better objective sleep, in whom endothelial function improved over the course of the night. These results suggest that patients with objective insomnia are at greater risk for cardiovascular complications compared to those with sleep state misperception.

0712

EVALUATION OF COUNTY OF RESIDENCE ON INSOMNIA SEVERITY

Waldron EA[1,2], Barilla HE[1], Segal AG[1,3], Plaksin JR[4], Findley J[1], Gehrman P[1,5], Grandner MA[6], Jackson NJ[6], Perlis ML[1]
[1]Behavioral Sleep Medicine Program, The University of Pennsylvania, Philadelphia, PA, USA, [2]Department of Psychology, Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA, [3]Department of Psychology, Drexel University, Philadelphia, PA, USA, [4]School of Medicine, New York University, New York, NY, USA, [5]Philadelphia VA Medical Center, Philadelphia, PA, USA, [6]Center for Sleep and Circadian Neurobiology, Division of Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Insomnia has been shown to be associated with sociodemographic factors including health, race/ethnicity and socioeconomics. Given regional variation in these factors, it is possible that the severity of insomnia may vary. The present analysis explores this possibility by county of residence within the Philadelphia metropolitan region, including urban, suburban, and rural areas.
Methods: Participants with or without insomnia completed an online screening questionnaire comprised of 5 sections to gather information including: demographics, sleep/insomnia, intrinsic sleep diagnoses, health, and chronic pain. 2552 participants provided sufficient information related to their sleep to conduct comparison analyses (counties with <5 subjects were excluded). Insomnia symptoms were sleep latency (SL) in minutes/night, WASO minutes/night, overall insomnia severity (sum of SL x nights per week and WASO severity x nights per week), daytime impairment, self-report of sufficient sleep, time in bed, and total sleep time. Chi-square global tests for differences evaluated whether each insomnia variable was differentially distributed across counties. Linear regression analyses with insomnia variables as outcome and 16 local counties as predictors were adjusted for age, sex, race/ethnicity and education.
Results: Significant differences among counties were found for time in bed, calculated total sleep time, and self-reported total sleep time. When individual counties were examined relative to Philadelphia County, several counties reported less time in bed and total sleep time (Berks, Mercer, and Newcastle), Camden demonstrated less sleep sufficiency, Lancaster demonstrated increased SL and insomnia severity, Mercer demonstrated elevated insomnia severity, and Gloucester demonstrated increased WASO and WASO severity.
Conclusion: Insomnia symptoms and sleep duration vary significantly by county. These preliminary results need to be further explored in larger, more representative samples that examine the ways in which these counties differ from each other and how these regional differences may account the observed differences.
Support (If Any): This work was supported by T32HL007713, R01AT003332, and R01MH077900.

0713

DIFFERENCES IN INSOMNIA SYMPTOM SEVERITY AMONG PRIMARY INSOMNIA, INSOMNIA COMORBID WITH DEPRESSION OR INSOMNIA COMORBID WITH CHRONIC PAIN

Waldron EA[1,2], Byrne M[1,3], Barilla H[1], Gehrman P[1,4], Findley J[1], Grandner MA[5], Jackson NJ[5], Perlis ML[1]
[1]Behavioral Sleep Medicine Program, The University of Pennsylvania, Philadelphia, PA, USA, [2]Department of Psychology, Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA, [3]Department of Behavioral and Social Sciences, University of the Sciences, Philadelphia, PA, USA, [4]Philadelphia VA Medical Center, Philadelphia, PA, USA, [5]Center for Sleep and Circadian Neurobiology, Division of Sleep Medicine, Department of Medicine, The University of Pennsylvania, Philadelphia, PA, USA

Introduction: Insomnia usually occurs co-morbidly with many different medical and psychiatric conditions. The present analysis looks at insomnia severity as it varies amongst patient groups and as compared to good sleepers.
Methods: An online questionnaire was used to screen potential study participants. Respondents completed items related to standard sleep variables, daytime impairment due to insomnia, and sleep sufficiency. Sleep latency (SL) and wake after sleep onset (WASO) were assessed in minutes/night and number of nights/week, with overall severity computed as minutes/night*nights. Total sleep time (TST) was determined by computation and self-report. Insomnia was defined as SL or WASO >30 minutes plus daytime impairment. Of n=2911 respondents over the past 32 months, n=731 reported only insomnia (Primary Insomnia: PI), n=638 had Insomnia Comorbid with Depression, n=372 had Insomnia Comorbid with Pain, and n=936 were Good Sleepers (GS). Linear regression analyses, with insomnia variables as predictors, were adjusted for age, sex, race/ethnicity, and education.
Results: Relative to PI, GS demonstrated fewer insomnia symptoms and increased sleep duration. Overall, insomnia comorbid with pain demonstrated the most severe symptoms, followed by those comorbid with depression, followed by PI. Relative to PI, pain comorbidity demonstrated increased SL (15.5mins) and severity (104.5mins/wk), WASO (11.9mins) and severity (90.3mins/wk), insomnia severity (195.7mins/wk), daytime impairment (19.09%), and decreased sleep sufficiency (10.5%), time in bed (0.5hrs), and computed and self-report TST (56.1mins and 29.4mins, respectively). Relative to PI, insomnia comorbid with depression demonstrated increased SL (8.0mins) and severity (49.5mins/wk), insomnia severity (56.1mins/wk), daytime impairment (19.4%), and decreased sleep sufficiency (9.4%) and computed TST (16.14mins). All reported effects were significant at p<.05.
Conclusion: Comorbid insomnia with pain presented with the most severe symptoms, followed by comorbid insomnia with depression, followed by primary insomnia. Future studies should extend the present findings using prospective measures (sleep diaries) and/or validated instruments for sleep, depression and pain.
Support (If Any): This work was supported by T32HL007713 and R01AT003332, and R01MH077900.

0714

EFFICACY OF A COGNITIVE-BEHAVIORAL TREATMENT FOR INSOMNIA AMONG AFGHANISTAN AND IRAQ (OEF/OIF) VETERANS WITH PTSD

Ochsner Margolies S[1,2], Rybarczyk B[1], Vrana S[1], Lynch J[2]
[1]Psychology, Virginia Commonwealth University, Richmond, VA, USA, [2]Hunter Holmes McGuire Veterans Affairs Medical Center, Richmond, VA, USA

Introduction: Sleep disturbances are a core and salient feature of PTSD and can maintain or exacerbate associated symptoms. Recent research demonstrates that cognitive-behavioral sleep-focused interventions im-

prove sleep disturbances as well as PTSD symptoms. The present study is a randomized clinical trial comparing Cognitive Behavioral Therapy for Insomnia (CBT-I) to a waitlist control group. The study: 1) compared subjective measures of sleep amongst veterans assigned to a treatment group (CBT-I) or a waitlist control group; (2) examined the influence of the intervention on measures of PTSD, mood and daytime functioning (3) examined the effect of CBT-I using objective measures of sleep.
Methods: Study participants were (n = 40) combat veterans who served in Afghanistan and/or Iraq (OEF/OIF). Participation in the treatment condition included four CBT-I sessions: sleep restriction, stimulus control, cognitive restructuring, sleep hygiene and imagery rehearsal therapy. Measures were completed at baseline and posttreatment.
Results: Veterans who participated in CBT-I reported improved sleep (sleep efficiency, $p < .001$; sleep latency, $p < .001$; WASO, $p = .01$; ISI, $p < .001$; PSQI, $p < .001$) reduction in PTSD symptoms and nightmares (PTSDSS, $p < .001$; PSQI-A, $p = .01$); and reduction in depression and distressed mood compared to their waitlist counterparts (PHQ, $p = .001$; POMS, $p < .01$) . Veterans in the treatment group also reported improved objectively measured sleep quality between baseline and posttreatment as measured by actigraphy.
Conclusion: These data suggest that CBT-I is an effective treatment for insomnia, nightmares and PTSD symptoms in OEF/OIF veterans with combat related PTSD and should be used as an adjunctive therapy to standard PTSD treatment.
Support (If Any): This project was funded by the United States Department of Veterans Affairs Predoctoral Rehabilitation Research Fellowship Program. The authors' views or opinions do not necessarily represent those of the Department of Veterans Affairs (VA).

0715

HEALTH ANXIETY AND COGNITIVE PROCESSES AS RISKS FOR INSOMNIA IN WOMEN WITH AND WITHOUT BREAST CANCER

Rissling M[1], Natarajan L[2], Cornejo M[3], Ancoli-Israel S[3,4]
[1]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, San Diego, CA, USA, [2]Family & Preventative Medicine, University of California San Diego, San Diego, CA, USA, [3]Psychiatry, University of California San Diego, San Diego, CA, USA, [4]Medicine, University of California San Diego, San Diego, CA, USA

Introduction: Breast cancer patients have a high incidence of co-morbid chronic insomnia which frequently persists into survivorship. The mechanism behind this insomnia is poorly understood, yet maladaptive responses to the sleep disturbance resulting from an acute stressor are implicated in cognitive models of insomnia. Evidence suggests that health anxiety, pre-sleep cognitive arousal and compensatory sleep effort may predispose and/or perpetuate psychophysiological insomnia. These mechanisms have not been examined in patients with breast cancer, but if present, may be used to identify individuals at risk for developing chronic insomnia as well as inform intervention.
Methods: Twenty women recently diagnosed with breast cancer and scheduled for adjuvant chemotherapy (age M = 54.6, SD = 7.9, range = 36-64) and 20 healthy age-matched women without history of breast cancer (age M = 53.6, SD = 7.5, range = 38-69) completed self-assessments and 72-hour wrist actigraphy on two occasions:(a) baseline, which for breast cancer patients was prior to start of chemotherapy (BL); and (b) at a subsequent occasion during or yoked to the last week of cycle 4 of chemotherapy (C4).
Results: Two-factor ANOVA revealed that at BL and C4 both groups reported similar levels of insomnia in addition to health anxiety, pre-sleep cognitive arousal and compensatory sleep effort. Actigraphic sleep and menopausal symptoms were also similar. Linear regression-based mediation analyses revealed that at BL, both groups demonstrated an association between health anxiety, compensatory sleep effort and insomnia. At C4, both groups demonstrated an association between compensatory sleep effort, pre-sleep cognitive arousal and insomnia. Additionally, compensatory sleep effort mediated links between health anxiety and insomnia, and pre-sleep cognitive arousal and insomnia.
Conclusion: The results validate cognitive models of insomnia and provide support for targeting health anxiety, pre-sleep cognitive arousal and compensatory sleep effort as risk factors for insomnia in women with and without breast cancer.
Support (If Any): CBCRP 15GB-0024, NCI CA112035 and the Moores UCSD Cancer Center.

0716

THE ROLE OF SLEEP EFFORT IN REDUCING DEPRESSIVE SYMPTOMS FOR INDIVIDUALS PARTICIPATING IN COGNITIVE-BEHAVIORAL THERAPY FOR INSOMNIA (CBT-I)

Dowdle C[1,3], Suh S[2], Nowakowski S[3], Ong JC[4], Siebern AT[3], Manber R[3]
[1]Psychology, PGSP-Stanford PsyD Consortium, San Francisco, CA, USA, [2]Psychiatry, Korea University, Seoul, Republic of Korea, [3]Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Palo Alto, CA, USA, [4]Psychiatry, Rush University Medical Center, Chicago, IL, USA

Introduction: The voluntary effort to control one's sleep, also known as sleep effort (SE), has been shown to affect insomnia symptoms. Cognitive behavioral therapy for insomnia (CBT-I) improves symptoms of depression among insomnia patients. To the best of our knowledge, no study has yet examined how sleep effort is associated with change in depression symptoms in individuals participating in a CBT-I.
Methods: One hundred and eighty six participants (44.1% male, average age=50.61) completed group CBT-I and completed the Glasgow Sleep Effort Scale (GSES) at baseline. Participants also completed the Beck Depression Inventory (BDI) pre and post CBT-I. Participants were divided into groups of high (n=101) and low sleep effort (n=85) based on the median score of the GSES (8.12).
Results: At baseline, BDI scores were higher among patients in the High SE group compared to the Low SE group. Repeated measures ANOVA with SE grouping as between-subjects variable and BDI pre-post CBT-I as the within subjects variable revealed a significant main effect for time [$F(1, 61)=51.60$, $p<.001$] and group [$F(1, 61)=7.94$, $p=.006$], but no significant interaction effect.
Conclusion: CBT-I was equally effective in both groups in reducing depressive symptoms, but those in the High SE group had greater depressive symptoms at pre- and post-treatment. This suggests that sleep effort is an important factor to consider in the treatment for insomnia, especially in individuals who are more depressed.

0717

HYPERTENSION PREVALENCE AND SEVERITY IN RELATION TO INSOMNIA SYMPTOM PATTERN

Mansoor E, Koshorek J, Roth T, Seto J, Drake C
Sleep Disorders & Research Ctr, Henry Ford Hospital, Detroit, MI, USA

Introduction: Insomnia is associated with multiple comorbidities including hypertension. This study was aimed at determining if insomnia increases the risk of hypertension independent of other conditions and if different patterns of insomnia symptomatology have differential association with hypertension risk and severity.
Methods: This is a cross-sectional study of 5,314 subjects (n = 1,661 insomnia [Research Diagnostic Criteria] and 3,653 controls) who completed an internet based questionnaire for patterns of insomnia symptoms, presence and severity of hypertension and sleep and health habits. Controls were compared to insomniacs for prevalence of hypertension. In the insomnia group symptoms of sleep latency (SL) and number of awakenings (NAWK) were studied to determine their relationship to hypertension. All subjects with hypertension (n = 1,590) were stratified by severity of hypertension based on duration of hypertension and number

of antihypertensive medications. Sleep latency and number of awakenings were used as predictors of hypertension and severity using multiple logistic regression controlling for age, gender, and BMI.
Results: Prevalence of hypertension was greater in insomniacs compared to normal sleepers OR=1.16 (95% C.I.=1.004-1.34, P=0.04). Among insomniacs increased risk of hypertension was associated with increased number of awakenings OR=1.14 (95% C.I.=1.03-1.27, P=0.01) and sleep latency OR=1.004 (95% C.I.=1.001-1.007, P=0.01). In subjects with hypertension, NAWK was a predictor of hypertension severity score (P=0.04) independent of sleep latency (P=.89).
Conclusion: Hypertension is more prevalent among insomniacs than normal sleepers. Both sleep maintenance and sleep latency symptoms are associated with clinically meaningful risk of hypertension. However, increased sleep maintenance disturbance (i.e., awakenings) is the sole predictor of severity of hypertension. Longitudinal studies will be required to determine if this relationship is causally mediated.
Support (If Any): This study was supported by an investigator initiated grant (CD) from Merck, Inc. and NIMH Grant MH082785 (CD).

0718

TELEHEALTH DELIVERY OF CBT-I IN VETERANS

Gehrman P[1,2], Girsh L[1], McCloskey S[1], Kuna ST[1,3]
[1]Philadelphia VA Medical Center, Philadelphia, PA, USA, [2]Department of Psychiatry, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA, USA, [3]Department of Medicine, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA, USA

Introduction: Insomnia is prevalent in Veterans, particularly those with PTSD and other comorbid psychiatric and medical disorders. Cognitive behavioral therapy for insomnia (CBT-I) is highly efficacious and effective but many patients do not have access to this treatment. Video telehealth technology has the potential to increase access to care and can reach even those in rural or remote locations. It is not known whether use of this treatment modality is associated with clinical outcomes comparable to those for in-person treatment.
Methods: Veterans received group CBT-I over six sessions that met every other week. The provider was at a VA medical center and the patients were at a distant outpatient clinic with a group co-leader. Standard CBT-I interventions were delivered including stimulus control and sleep restriction. Participants completed the Insomnia Severity Index (ISI) in the first and last session. Completion of the ISI was voluntary.
Results: Seventeen Veterans completed the ISI at both time points. The sample consisted of 16 males and had a mean (SD) age of 55.9 (13.2). All participants had at least one mental health diagnosis, fifteen of whom were diagnosed of PTSD. The ISI score decreased from a pre-treatment mean (SD) of 19.8 (3.9) to 12.8 (5.1) at post-treatment with a mean decrease of 6.5 (4.0) points. This change was statistically significant on a paired samples t-test ($p<0.05$). The post-treatment mean is below 14, the standard cutoff used as an indication of clinically significant insomnia.
Conclusion: This pilot effectiveness study in a clinic sample provides preliminary evidence that CBT-I delivered using video telehealth technology can produce clinically significant outcomes. The magnitude of treatment gains were comparable to those reported from in-person treatment. Further research is needed to formally evaluate the effectiveness of this treatment modality.

0719

AGE-RELATED EFFECTS ON CIRCADIAN PHASE IN THE SLEEP OF DEPRESSED INSOMNIACS

McCall W[1], Gonzales C[2], Shannon W[2], Deych E[2], Farris S[1], Xian H[2]
[1]Dept Psychiatry and Behavioral Medicine, Wake Forest University Health Sciences, Winston-Salem, NC, USA, [2]Department of Medicine Division of General Medical Sciences, Washington University School of Medicine, St Louis, MO, USA

Introduction: Compared with young adults, healthy older adults go to bed earlier and wake up earlier. We examined whether an age-related phase advance was present in older depressed insomniacs.
Methods: Fifty-eight medication-free depressed outpatients with insomnia and no primary sleep disorders, underwent one week of prospective sleep diaries and actigraphy. Differences between two age groups with a median split at 44 years old were tested by t-tests. Actigraphy data was analyzed by functional data analysis (FDA) and functional linear models to examine differences in activity levels between age groups. The bathyphase for each subject was fitted by cosine function with 24 hour cycle time.
Results: The 29 younger patients (32.0 +/- 7.9 years) and the 29 older patients (52.2 +/- 5.6 years) were comparable in Hamilton Rating Scale for Depression scores (26.6 versus 27.3) and Insomnia Severity Index scores (20.6 versus 21). Compared with younger patients, the older patients had an earlier median sleep diary-determined bedtime than the younger patients (10:53 PM versus 11:28 PM, $p<0.05$), and an earlier actigraphic FDA-determined bathyphase (2:13 AM versus 3:43 AM, $p<0.01$). Patterning of actigraphic data differed, by age, between 10 PM and 2 AM ($p<0.05$).
Conclusion: Compared with younger depressed insomniacs, older depressed patients have a phase advance in bedtime and actigraphic rhythms, similar to reports in older versus younger healthy sleepers. Less trouble with sleep onset and more trouble with early morning awakening would therefore be expected in older depressed insomniacs. Treatment implications for older depressed insomniacs include a need to (1) temper expectations regarding final wake up, (2) set earlier wake up times as part of CBT-I, and (3) use medications that treat EMA.
Support (If Any): Mini Mitter; Sunovion.

0720

ZOLPIDEM IS ASSOCIATED WITH INCREASED RISK OF INPATIENT FALLS

Kolla B[1], Lovely J[2], Mansukhani MP[1], Morgenthaler TI[1]
[1]Sleep Medicine, Mayo Clinic, Rochester, MN, USA, [2]Hospital Pharmacy Services, Mayo Clinic, Rochester, MN, USA

Introduction: Falls in the hospital setting are associated with significant morbidity and a prolonged stay. Healthy volunteers exhibit a significant impairment in balance after a single dose of zolpidem. Higher rates of zolpidem use were reported in patients attending a fall clinic. If zolpidem, the most commonly prescribed sedative/hypnotic in the inpatient setting, is associated with falls, its use may impact greater danger to patients.
Methods: We identified all falls in inpatients >18 year old, in the non-ICU setting and recorded hypnotics and other medications administered within 24 hours prior to their fall. We compared the fall rate between inpatients who were administered zolpidem and inpatients in whom zolpidem was prescribed but not administered. Among the inpatients who experienced a fall, we compared the group that received zolpidem to the group that did not receive zolpidem in the 24 hours preceding the fall.
Results: In 2010, 64/672 (9.5%) patient falls were associated with zolpidem administration within the last 24 hours. A total of 21,354 doses of zolpidem were administered revealing a 0.299% risk of falling per dose administered. The fall rate among patients who were prescribed and received zolpidem was significantly greater than among patients who were prescribed but did not receive zolpidem (3.06% Vs 0.68%;

p<0.001). The absolute risk increase was 2.38% and number needed to harm 43. Patients on zolpidem who experienced a fall were no different from other patients who fell in age, narcotic, sedative antidepressant, antidepressant, antipsychotic, benzodiazepine and antihistamine use.
Conclusion: Patients who were prescribed and received zolpidem were at a significantly increased risk of falling. Among patients who fell, the group who received zolpidem were no different than the group that did not receive zolpidem.

0721

COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN STABLE HEART FAILURE: FEASIBILITY, ACCEPTABILITY AND PRELIMINARY EFFICACY

Redeker NS[1], Andrews L[1], Cline J[1], Jacoby D[2], Jeon S[1], Paceill J[1], Heaney B[1], Knechel N[1], Mehta S[1], Mohsenin V[3]
[1]School of Nursing, Yale University, New Haven, CT, USA, [2]Department of Internal Medicine/Section of Cardiovascular Medicine, Yale University School of Medicine, New Haven, CT, USA, [3]Department of Internal Medicine/Section of Pulmonary & Critical Care Medicine, Yale University School of Medicine, New Haven, CT, USA

Introduction: Insomnia is common and associated with poor quality of life in patients with heart failure (HF). The purpose of this study was to evaluate the feasibility, acceptability, and preliminary efficacy of cognitive behavioral therapy for insomnia (CBT-I) in patients with stable HF.
Methods: In this clinical trial, patients with stable HF were randomized in groups to four bi-weekly sessions of CBT-I or a HF education class that was identical in group format, frequency and duration (attention control - AC). Patients were telephoned on alternate weeks. Outcomes included insomnia severity (primary outcome), dysfunctional beliefs and attitudes about sleep, fatigue, sleepiness (Epworth scale), physical function (SF-36), anxiety (STAI-state), and depression (CESD) assessed at the end of the 7 week treatment. Feasibility and acceptability were evaluated via survey.
Results: The sample included 35 patients with stable NY Heart Class II-III HF (20/55% women; 9/24% African American; 27/76% White). There were 20 patients (M age = 65.34 +13.54) in the CBT-I and 15 in the AC group (M age = 57.63 + 17.2), p = .1540. Insomnia severity improved by 7 points in the CBT-I, compared with a 1.71 change in the AC condition (Cohen's d = 1.38). There was a large improvement in dysfunctional beliefs and attitudes about sleep (d = 0.86) and small-medium effects on fatigue (d = 0.36) and physical function (d = 0.43). Acceptability and satisfaction with the CBT-I and AC workbooks, scheduling, effectiveness, and group leaders rating from 7.75-10 (scale of 1-10/10 = high). 95% of participants completed treatment.
Conclusion: CBT-I is acceptable, feasible and has preliminary short-term efficacy as a treatment for insomnia and insomnia-related fatigue in patients with HF. Further study is needed of its longer-term effects on insomnia and daytime function in this vulnerable group of patients.
Support (If Any): NIH NR011387.

0722

EXAMINATION OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN PERIMENOPAUSAL WOMEN

Nowakowski S[1], Dowdle CL[2], Suh S[3], Siebern AT[1], Manber R[1]
[1]Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, USA, [2]Psychology, Pacific Graduate School of Psychology - Stanford Psy. D. Consortium, Stanford, CA, USA, [3]Psychiatry, Korea University, Seoul, Republic of Korea

Introduction: Sleep disturbance was identified as a key symptom of the menopause transition in a 2005 report from the NIH State-of-the-Science Conference panel on menopause-related symptoms. During perimenopause, the period surrounding menopause including both pre-and post-menopause, approximately 26-56% of women experience chronic insomnia. No published studies have examined the efficacy of Cognitive Behavioral Therapy for Insomnia (CBTI) in perimenopausal women.
Methods: Forty-four women (age range 42-68, m=55 ± 5.9) self-described as perimenopausal were identified from a pool of 455 patients who received group CBTI in a sleep medicine clinic. Twenty-nine (66%) of those women endorsed "my sleep at night is affected by my menopause" on a baseline sleep questionnaire, which constituted the Perimenopausal insomnia group. Sixty-three women (age range 24-49, mean=35 ± 5.0) self-described as premenopausal constituted the control group. Pre and posttreatment measures include the following: Insomnia Severity Index (ISI), Beck Depression Inventory (BDI), and Dysfunctional Beliefs and Attitudes about Sleep Scale-10 item version (DBAS-10).
Results: Repeated measures ANOVA revealed a significant reduction from pre to post CBTI in ISI (from 20.2 ± 4.4 to 10.3 ± 4.2, p<.001), BDI (from 11.6 ± 7.8 to 6.6 ± 5.4, p<.001), and DBAS-10 scores (from 66.1 ± 13.7 to 41.2 ± 13.2, p<.001), with no significant main effect for group or interaction between time and group.
Conclusion: This study suggests that women who perceive their sleep to be disrupted by menopausal symptoms can benefit from group CBTI and can expect reduction in insomnia symptoms and general distress (BDI). A randomized controlled trial of CBTI for perimenopausal insomnia is warranted to test this finding.

0723

COGNITIVE-BEHAVIORAL TREATMENT FOR INSOMNIA IMPROVES SLEEP EFFICIENCY AND ISI IN INSOMNIA CO-MORBID WITH SLEEP APNEA OR PERIODIC LIMB MOVEMENTS

Garb LR[1], Bootzin R[1], Dawson S[1], Cousins JC[2], Fridel K[3], Sidani S[4], Epstein D[5], Moritz P[6]
[1]Psychology, University of Arizona, Tucson, AZ, USA, [2]Psychology, University of Pittsburgh, Pittsburgh, PA, USA, [3]The Center for Sleep Medicine, Chicago, IL, USA, [4]School of Nursing, Ryerson University, Toronto, ON, Canada, [5]Phoenix Veterans Affairs Health Care System, Phoenix, AZ, USA, [6]School of Nursing, University of Colorado Health Services Center, Denver, CO, USA

Introduction: The goal of the present study was to determine whether pre-treatment periodic limb movements (PLMS) and obstructive sleep apnea (OSA) interact with insomnia treatment outcomes. It is part of a larger 4 site project to evaluate methods involved in clinical trials of treatments for insomnia.
Methods: 38 adults (female: 22; age M = 52.4, range = 28-78) with insomnia who participated in the study at the University of Arizona were randomly assigned to two treatment conditions, group cognitive behavioral therapy for insomnia and a self-guided sleep education booklet. The group participants received four weekly treatment sessions and two weekly phone calls. Participants received a screening PSG to identify the degree of pre-treatment AHI (26.3% >5, max 24.5) and PLMI (28.9% >10, max 73.9). Primary outcome variables are sleep efficiency (SE) from baseline and post-treatment sleep diaries and baseline and post-treatment Insomnia Severity Index (ISI).
Results: The analyses of SE and ISI indicated that both the booklet and group treatment produced improvement (p < .001). The group treatment produced more improvement than the booklet (interaction, p < .05). For SE, there was a trend for those with apnea to have more improvement than those without apnea (p = .075). There was no interaction for PLMI and improvement (p > .50). For ISI, there were no significant interactions with improvement for either AHI or PLMI (p > .50).
Conclusion: These findings indicate that cognitive behavioral therapy for insomnia reduces insomnia symptoms in those who have PLMS or co-morbid mild to moderate OSA.
Support (If Any): National Institute of Nursing Research of NIH: NR05075.

0724

INSOMNIA INTERACTS WITH CPAP ADHERENCE ON DAYTIME SLEEPINESS IN VETERANS WITH OSAHS

Wohlgemuth WK[1], Wallace DM[1,2], Dayanand S[1]
[1]Psychology Service, Miami VA Medical Center, Miami, FL, USA,
[2]Neurology, University of Miami, Miami, FL, USA

Introduction: Co-morbid (obstructive sleep apnea-hypopnea syndrome) OSAHS with insomnia have received more attention during the last few years. Recent studies have shown that the prevalence of insomnia in OSAHS patients greater than the general population. Sleepiness, a common symptom in OSAHS, can be reversed by treating the OSAHS with CPAP; however, adherence to CPAP remains a challenge. The present study was undertaken to determine the effect of co-morbid insomnia/OSAHS and CPAP adherence on subjective daytime sleepiness in OSAHS patients.
Methods: Consecutive OSAHS patients over a four month period (n=442) had CPAP data downloads and completed questionnaires (demographics, sleepiness (Epworth Sleepiness Scale;ESS), and insomnia (Insomnia Severity Index;ISI)) at the Miami VA sleep center. Medical/psyciatric history and polysomnography data were obtained from medical record. CPAP adherence was defined as use ≥ 4 hours on at least 70% of nights. Insomnia was defined as severe problems with sleep onset, maintenance or early morning awakening from the ISI. Inclusion criteria were 1) (OSAHS) and CPAP prescription in the preceding 5 years, and 2) CPAP adherence data ≥ 7 days. Exclusion criteria included 1) requiring supplemental oxygen or 2) surgery for OSAHS.
Results: ANCOVA revealed (controlling for age, medical/psychiatric conditions, AHI, PAP pressure) more subjective sleepiness (total ESS) in co-morbid OSAHS/insomnia than OSAHS patients without insomnia ($p<.05$). Additionally, non-adherent OSAHS patients were more sleepy than adherent patients ($p<.001$). Finally, there was a trend for an interaction between co-morbid insomnia/ OSAHS and CPAP adherence ($p<.09$). Non-adherent, co-morbid OSAHS/insomnia patients had the highest level of sleepiness. Items 1-4 on the ESS appeared to be most sensitive to detect differences in sleepiness. When summed, items 1 to 4 detected a significant interaction between CPAP adherence and insomnia in OSAHS patients ($p=.024$).
Conclusion: Non-adherent, co-morbid OSAHS/insomnia veterans appear to have higher levels of subjective sleepiness than either non-insomnia or adherent OSAHS patients.

0725

DEVELOPING CLINICAL PROFILES AND A MULTIDISCIPLINARY APPROACH FOR PATIENTS WITH OSA AND COMORBID INSOMNIA

Ong JC, Kong A, Lederman M, Park M, Crisostomo MI, Cvengros JA, Wyatt JK
Department of Behavioral Sciences, Rush University Medical Center, Chicago, IL, USA

Introduction: Individuals with both Obstructive Sleep Apnea (OSA) and insomnia have been found to have an elevated risk of daytime impairment and psychological distress. Despite the frequency with which these disorders co-occur, there is insufficient evidence to guide assessment and treatment for this comorbid condition. The aims of this study were to characterize a sample of clinic patients with OSA and comorbid insomnia and to examine the feasibility and appropriateness of using a multidisciplinary approach.
Methods: The sample consisted of 18 patients (mean age=53.40, 50% female, 44% Black, 44% White, 11% Asian, mean BMI=35.73) who met ICSD-2 criteria for both OSA (mean AHI=15.1, SD=7.98) and insomnia disorder. All patients were evaluated at the Rush Sleep Center and offered Continuous Positive Airway Pressure and/or Cognitive-Behavior Therapy for Insomnia based on our multidisciplinary treatment model. Sleep diaries, Insomnia Severity Index (ISI), Pre-Sleep Arousal Scale (PSAS), Beliefs and Attitudes about Sleep (BAS), Epworth Sleepiness Scale (ESS), and Fatigue Severity Scale (FSS) were completed at baseline and follow-up (approximately 3 months).
Results: At baseline, patients endorsed elevated PSAS, BAS, sleep-onset latency, wake after sleep onset, and poor sleep efficiency along with moderate daytime fatigue and sleepiness. Spearman's Rho correlations revealed significant associations between AHI and ISI ($r=.71$, $p<.01$) and AHI and PSAS ($r=.78$, $p<.005$). For the 12 patients who provided follow-up data, paired-sample t-tests revealed significant changes ($p<.05$) with large effect sizes from baseline to follow-up on ISI ($d=.72$), BAS ($d=1.33$), FSS ($d=.77$), and sleep efficiency ($d=.85$).
Conclusion: These findings provide indications of an emerging comorbid phenotype for OSA and insomnia characterized by elevated pre-sleep arousal, maladaptive beliefs about sleep, respiratory disturbance, and reduced sleep efficiency along with moderate daytime fatigue and sleepiness. Data also provide initial support for the feasibility and benefits of using medical and behavioral treatments for these patients.

0726

IMPACT OF CO-MORBID OSAHS/INSOMNIA AND CPAP ADHERENCE ON SLEEP-RELATED QUALITY OF LIFE

Wohlgemuth WK[1], Wallace DM[2,3], Dayanand S[2]
[1]Psychology Service, MIami VA Medical Center, Miami, FL, USA,
[2]Neurology Service, MIami VA Medical Center, Miami, FL, USA,
[3]Neurology, Univ Miami, Miami, FL, USA

Introduction: Quality of life (QOL) is reduced in patients with obstructive sleep apnea-hypopnea syndrome (OSAHS). However, little is known about the QOL in patients with co-morbid OSAHS/insomnia. Insomnia has been reported to be more common in OSAHS patients than in the general population, so it is important to understand the contribution of combined OSAHS and insomnia on QOL. Although treatment with CPAP has been shown to improve QOL, adherence has not been optimal. This study examines the effect of co-morbid OSAHS/insomnia and CPAP adherence on sleep related QOL.
Methods: Consecutive OSAHS patients over a four month period (n=442) had CPAP data downloads and completed questionnaires (demographics, Quality of Life (Functional Outcomes of Sleep; FOSQ), and insomnia (Insomnia Severity Index;ISI)) at the Miami VA sleep center. Medical/psyciatric history and polysomnography data were obtained from medical record. CPAP adherence was defined as use ≥ 4 hours on at least 70% of nights. Inclusion criteria were 1) (OSAHS) and CPAP prescription in the preceding 5 years, and 2) CPAP adherence data ≥ 7 days. Exclusion criteria included 1) requiring supplemental oxygen or 2) surgery for OSAHS.
Results: ACOVA revealed (controlling for age, medical/psychiatric conditions, AHI, PAP pressure) that the overall FOSQ QOL in co-morbid OSAHS/insomnia was lower than OSAHS veterans without insomnia ($p.<001$). No effect was found for CPAP adherence nor did insomnia and adherence interact. Each of the FOSQ subscales (activity level, vigilance, intimacy and sexual relationships, general productivity, and social outcome) were lower in co-morbid OSAHS/insomnia veterans (all p's $<.001$). A trend for lower vigilance QOL in non-adherent OSAHS veterans was found ($p=.06$).
Conclusion: Veterans with co-morbid OSAHS/insomnia have a lower sleep-related QOL than veterans with OSAHS without insomnia. Unexpectedly, CPAP adherence was not robustly associated with sleep-related QOL. Evaluation and treatment of insomnia in OSAHS patients may help to improve sleep-related QOL.

0727

IS THERE A LINK BETWEEN SLEEP APNEA AND CHRONIC INSOMNIA?

Basta M[1], Vgontzas AN[1], Fernandez-Mendoza J[1], Singareddy R[1], Calhoun S[1], Shaffer M[2], Liao D[2], VelaBueno A[3], Bixler EO[1]
[1]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA, [3]Psychiatry, Autonomous University, Madrid, Spain

Introduction: The question whether sleep apnea is causally associated with insomnia has been examined for the last forty years. Based on cross-sectional studies in clinical samples, some investigators have suggested that sleep apnea might play a role in the etiology and/or perpetuation of chronic insomnia. In this study we present findings from a longitudinal study based on a large random general population sample.
Methods: From a random general population sample of 1741 individuals of the adult Penn State Cohort, 1395 were followed up after 7.5 years. Full medical evaluation and one-night PSG were completed at baseline and a telephone interview was conducted at follow-up. The response rate of those alive was 91%. We examined the risk factors associated with incident insomnia, persistent insomnia, and incident poor sleep. Insomnia was defined as a complaint lasting ≥ 1 year, whereas poor sleep was defined as the presence of one or more insomnia symptoms (i.e., difficulty falling or staying asleep, early morning awakening, and unrefreshing sleep).
Results: Mental health problems and poor sleep, but not sleep apnea, were significant risk factors for incident insomnia. Objective short sleep duration and mental health problems, but not sleep apnea, predicted persistent insomnia. Sleep apnea was associated with incident poor sleep; however, sleep apnea was not a risk factor for poor sleep evolving into insomnia.
Conclusion: It appears that chronic insomnia, a condition of physiological and emotional hyperarousal, is not linked to sleep apnea whereas sleep apnea through breathing pauses and intermittent hypoxia can lead to sleep disruption and, thus, to a complaint of poor sleep. Our findings suggest that routine testing for the detection of sleep apnea in insomnia is not recommended, except when clinically indicated. On the other hand, non-treated sleep apnea may lead to poor sleep quality that may affect adversely the patients' daytime functioning.
Support (If Any): R01 HL40916, R01 HL 51931.

0728

DIFFERENTIATING COMORBID OBSTRUCTIVE SLEEP APNEA(OSA) IN INSOMNIA USING AN AUTOMATED ELECTROCARDIOGRAM BASED METHOD

Lee J[1], Cho J[2], Hong I[1], Hong H[3], Hong S[4]
[1]Seoul Sleep Clinic, Seoul, Republic of Korea, [2]ISAP, Zurich, Switzerland, [3]Dept. of Molecular & Cell Biology, UC Berkeley, Berkeley, CA, USA, [4]Psychiatry, St. Vincent Hospital, Suwon, Republic of Korea

Introduction: Differentiating insomnia from insomnia with OSA is critical since OSA makes insomnia symptom difficult to be treated and vice versa. The goal of this study was to investigate the ability of ECG based Cardiopulmonary Coupling(CPC) analysis in distinguishing comorbid OSA in insomnia.
Methods: Total of 98 PSGs with chief complaints of insomnia were collected from 2009 to 2011 retrospectively. CPC was analyzed using CPC Analyzer in RemLogic(Embla, Thornton, CO) Data analysis was done using SPSS v17.0(Chicago, IL).
Results: Full PSG from 51 insomnia patients without OSA and 47 insomnia+OSA were analyzed, and 15 cases were ruled out due to age limitation(20-75). Gross sleep profiles like Total Sleep Time(282.1 vs 278.3min), Sleep Efficiency(71.1 vs 69.5%), Sleep Latency(24.6 vs 22.3min), REM latency(114.9 vs 122.3min) did not differ significantly. AHIs were different (insomnia only 1.06±1.34/hr vs OSA+insomnia group 27.89±18.05/hr) and oxygen profiles(mean O2 saturation, percentage of O2 desaturation, minimum O2 saturation) were different significantly. High frequency coupling(HFC:0.1-0.4Hz) is associated with physiological respiratory sinus arrhythmia and stable sleep and respiration. HFc duration(min) was 154.1±75.5 in insomnia only group vs 120.1±75.3 in insomnia+OSA group (p=0.043). Percentage(%) of HFc duration was also different(40.2 vs 29.9, p=0.019). Low Frequency coupling(LFC:0.0-0.1Hz) is associated with unstable sleep. LFc duration(min) in insomnia only group was 138.5±56.2 whereas in comorbid OSA group, 197.1±79.4 (p<0.001). LFc duration(%) were 35.5±14.0 in insomnia only group vs 49.9±18.1 in insomnia+OSA (p<0.001). Total elevated low frequency duration(min,%) in insomnia only group(101.0min, 14.5%) and in insomnia+OSA group(139.3min, 35.7%) differ significantly(p=0.011, p=0.010). CPC analysis showed grossly different profiles. Comorbid OSA in insomnia group has lower HFc indexes, and higher LFc indexes.
Conclusion: The evaluation of comorbid OSA in insomnia can be challenging. CPC analysis can be a useful tool in differentiating these groups.

0729

THE ASSOCIATION BETWEEN TREATMENT EFFECT AND CHANGES OF COGNITIVE AND BEHAVIORAL FACTORS FOLLOWING CBT-I TREATMENT IN PRIMARY AND COMORBID INSOMNIA

Yang C[1,2], Jan Y[1], Yang T[3]
[1]Department of Psychology, National Chengchi University, Taipei, Taiwan, Taiwan, [2]Research Center for Mind, Brain, & Learning, National Chengchi University, Taipei, Taiwan, [3]School of Medicine, Fu-Jen University, Taipei, Taiwan

Introduction: Cognitive Behavioral Therapy for Insomnia (CBT-I) consists of multiple components that are designed to change the sleep-related psychological and behavioral factors for insomnia. Previous studies have shown an association between changes in beliefs about sleep and CBT-I treatment outcome. The goals of this study is to further exam the association between treatment outcome and changes in beliefs about sleep, sleep-related practices, and pre-sleep arousal levels following CBTI treatment in both primary insomnia (PI) and insomnia comorbid with other sleep disorders and/or psychiatric conditions (CI).
Methods: Participants were 101 insomnia patients, including 21 PI received CBT-I only, 55 PI received CBT-I and hypnotic, and 25 CI received CBT-I and medication. Dsyfunctional Beliefs and Attitude about Sleep Scale (DBAS), Sleep Hygiene Practice Scale (SHPS), Presleep Arousal Scale (PSAS), and Insomnia Severity Index (ISI) were administered before and after treatment.
Results: ANOVAs showed that all outcome variables (ISI, SOL, WASO, SE) showed significant improvement after treatment except for TST that reached near-significant increase (F=3.63, p=.060). For PI received CBT-I only, Pearson correlations showed that improvement in ISI correlated with decrease of both somatic (r=6.45, p<.005) and cognitive (r=6.59, p=.001) pre-sleep arousal and reduction of arousal-related behavior (r=5.92, p=.005); for PI received CBTI and hypnotic, reduction of ISI score correlated with reduction of factor II (predictability of sleep) subtests of the DBAS (r=3.25, p<.05) and reduction of arousal-related behavior (r=.330, p<.05); for CI group, ISI improvement correlated with change of scores on the factor I (perceived consequences of insomnia, r=.438, p<.05) and factor II (r=.752, p<.001) subtests of the DBAS, both somatic (r=.530, p<.005) and cognitive (r=.772, p<.001) pre-sleep arousal, arousal-related behavior (r=.605, p<.005), and poor sleep environment (r=.450, p<.05).
Conclusion: Treatment effect of CBT-I is primarily associated reduction of arousal and changes in dysfunctional sleep beliefs. The association however differs in patients with primary insomnia and insomnia with comorbid conditions.

Support (If Any): This study is sponsored by the National Science Council of Taiwan (Grant # NSC98-2410-H-004-023-MY3).

0730

THE UNIQUE CONTRIBUTION OF INSOMNIA-BASED RUMINATION IN THOSE WITH DEPRESSION AND INSOMNIA

Harris AL, Carney CE, Zalai D
Ryerson University, Toronto, ON, Canada

Introduction: People with insomnia often ruminate on the daytime consequences of poor sleep. While previous research has found that insomnia-based rumination is not accounted for by depressed mood (Carney et al., 2006; 2010), the nature of rumination in insomnia is not well understood. This study examines whether the relation between rumination and insomnia is accounted for by: 1) depressive rumination, 2) worry, or 3) unhelpful sleep beliefs.
Methods: Participants (N=66) were enrolled in an NIH-funded (5R01MH076856-05) trial and met DSM-IV-TR criteria for depression and insomnia. They completed the Insomnia Severity Index, Dysfunctional Beliefs and Attitudes about Sleep Scale, Response Styles Questionnaire, Penn State Worry Questionnaire and the Daytime Insomnia Symptom Rumination Scale.
Results: Bootstrapping (confidence level: 95; 10,000 resamples) revealed the relationship between insomnia rumination and insomnia severity was not mediated by depressive rumination (CI = .1622 - .9884; SE = .2081), sleep beliefs (CI = .0412 - .7745; SE = .1803) or worry (CI = -.1737 - .4273; SE = .1419). Insomnia rumination mediated the relations between insomnia and depressive rumination, as well as between insomnia and sleep beliefs (CI =.0269 to .4839; SE= .11), but not the relation between insomnia and worry (CI = -.0056 to .0499; SE = .0140).
Conclusion: Even in an insomnia sample with depression, insomnia rumination is distinct from both depressive rumination and worry. Thus we might not expect strategies focused on depressive- or worry-specific cognitive content to necessarily benefit those with insomnia. Moreover, it may be more important to assess for and target rumination in insomnia than beliefs about sleep (i.e., it may be less important that one merely has a particular sleep belief, than if there is a ruminative tendency). The presence/absence of rumination may account for the finding that particular beliefs about sleep overlap significantly with the beliefs of good sleepers (Carney & Edinger, 2006).
Support (If Any): NIH 5R01MH076856-05.

0731

SLEEPLESS NIGHTS, INACTIVE DAYS? THE ROLE OF BELIEFS AND FATIGUE IN INSOMNIA AND DEPRESSION

Moss TG[1], Lachowski AM[1], Atwood ME[1], Shapiro C[2], Carney CE[1]
[1]Psychology, Ryerson University, Toronto, ON, Canada, [2]Sleep and Alertness Clinic, Toronto Western Hospital, Toronto, ON, Canada

Introduction: Poor sleepers and those with depression engage in fewer daily activities than healthy controls. Restricting activities may be a result of fatigue and anergia, and also beliefs about having to conserve energy after poor sleep. This study examined the association between objective activity, fatigue, sleep, and beliefs in those with comorbid insomnia and depression.
Methods: Participants (N =53; 68% women; M age = 41; SD = 11.7; range = 20-62) enrolled in a NIMH-funded (5R01MH076856-05) depression and insomnia treatment study completed the following measures at pre-treatment: the Insomnia Severity Index, Dysfunctional Beliefs and Attitudes about Sleep, and the Dysfunctional Attitudes Scale (DAS), and Multidimensional Fatigue Inventory. After completing the measures, participants wore an actiwatch for 7 days to measure activity and sleep.
Results: Mean actiwatch (ACT) total activity levels were associated with fatigue (-.28), maladaptive sleep beliefs (r= -.37) and perfectionistic beliefs (r = -.33). ACT variability in activity related to ACT time in bed (r = -.32); maladaptive sleep beliefs (r = -.34); and physical fatigue (r = -.34). ACT time in bed (inactivity) was associated with ACT sleep disturbance (wakefulness after sleep onset, r = .59; sleep onset latency, r = .31).
Conclusion: Those who are least active, have greater rigid beliefs about themselves and sleep, and reduce their activities to a greater degree when facing fatigue. A restriction in the variability of daily activities is associated with spending more time in bed, having more unhelpful beliefs about sleep, and greater fatigue. These findings are correlational and thus limit conclusions about causality; future research could test beliefs and activities as potential perpetuating and/or precipitating factors for sleep disturbance in this comorbid group. These findings suggest that incorporating an activity scheduling component and targeting these specific beliefs in insomnia treatment, may enhance outcomes.
Support (If Any): NIMH (5R01MH076856-05).

0732

PREVALENCE OF INSOMNIA AND ITS ASSOCIATION WITH DEPRESSION IN AN KOREAN ELDERLY POPULATION

Yoon I[1], Lee S[1], Kang S[1], Ju G[2], Kim K[1]
[1]Neuropsychiatry, Seoul National University Bundang Hospital, Seongnam, Republic of Korea, [2]Neuropsychiatry, Chungbuk National University Hospital, Cheongju, Republic of Korea

Introduction: Insomnia is characterized by difficulty initiating or maintaining sleep, or non restorative sleep, and is associated with impairments of daytime functioning. Several studies have suggested that depressive symptom is associated with insomnia. This study was carried out to investigate the prevalence of insomnia and its association with depression in an elderly population of Korea.
Methods: The subjects consisted of 881 (361 men and 520 women) representative elderly people aged 60-94 years from Osan area, Korea. At the first phase, 279 participants were selected scoring 8 or more points in Athens Insomnia Scale (AIS). At the second phase, Insomnia was diagnosed via face-to-face interview by sleep specialists with the use of Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria. Symptoms of depression were evaluated among insomnia patients by the DSM-IV major depressive episode criteria, and subsyndromal depression was defined when subject showed depressive symptoms which did not meet the criteria of major or minor depressive disorder.
Results: The prevalence of insomnia was 32.7% in all subjects with the prevalence being significantly higher in women (37.9%) than in Men (25.2%; $p<0.001$). Insomnia was classified into primary insomnia (20.5%), and insomnia related with mental disorders (6.81%), other sleep disorders (2.04%), substance use (0.15%), and general medical condition (3.17%). Subsyndromal depression was found in 54% of patients with primary insomnia. Among a total of 183 insomnia patients, 99 patients were classified as having depressive symptoms.
Conclusion: These results suggest that nearly one third of elderly population is suffering from insomnia and more than half of them showed depressive symptoms. For promotion of physical and mental well-being in the elderly, attention should be paid to insomnia and its accompanying depression.

0733

RELATIONSHIP BETWEEN CHANGES IN SELF-EFFICACY AND DEPRESSION FOLLOWING COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA

Simpson N, Nowakowski S, Siebern AT, Manber R
Psychiatry & Behavioral Sciences, Stanford University Medical Center, Stanford, CA, USA

Introduction: Cognitive behavioral therapy for insomnia (CBT-I) has been shown to improve both insomnia symptoms as well as depres-

sion outcomes. Further, sleep-related self-efficacy has been shown to increase following CBT-I; however, to our knowledge, changes in self-efficacy relative to improvement in insomnia and depression levels following CBT-I treatment has yet to be examined as a possible mechanism of change.
Methods: Two hundred and thirty six participants (57% women, mean age: 48.7+/-14.5 years) participated in a 6-session group CBT-I intervention and completed the Insomnia Severity Index (ISI), Beck Depression Inventory (BDI) and the Self-Efficacy Scale for Sleep (SES-S) pre- and post-treatment.
Results: The CBT-I intervention increased SES-S and decreased BDI and ISI scores (p values <.001). Standard regression analyses found that baseline BDI and post-treatment SES-S were significant predictors of post-treatment ISI (baseline BDI: β=0.28, p=.023; post-treatment SES-S: β=-0.53, p<.001, respectively) and that post-treatment SES-S was a full mediator of the relationship between baseline BDI and post-treatment ISI (baseline BDI: β=0.15, p=.19; post-treatment SES-S: β=-0.49, p<.001). Similarly, baseline BDI and post-treatment SES-S were also significant predictors of post-treatment BDI (baseline BDI: β=0.56, p<.001; post-treatment SES-S: β=-.42, p<.001, respectively); however, post-treatment SES-S only partially mediated the relationship between baseline and post-treatment BDI (baseline BDI: β=0.48, p<.001; post-treatment SES-S: β=-0.29, p<.001).
Conclusion: As has been previously reported, we observed that CBT-I increased sleep-related self-efficacy and decreased depression and insomnia levels pre/post treatment. A novel finding is that changes in sleep-related self-efficacy fully mediated the relationship between baseline depression and post-treatment insomnia. These findings suggest that sleep-related self-efficacy may be an important target for intervention.

0734

INSOMNIA HAS THOUGHTS OF ITS OWN: THE IMPORTANCE OF INSOMNIA-SPECIFIC BELIEFS IN THOSE WITH DEPRESSION AND INSOMNIA

Lachowski AM, Moss TG, Carney CE
Psychology, Ryerson University, Toronto, ON, Canada

Introduction: Insomnia, in the context of depression, is presumed by some to be of secondary importance relative to depression. Thus, for those with comorbid depression and insomnia, one might expect that depressotypic thinking such as global negative beliefs, self-focused rumination, or perfectionistic beliefs about the self may overshadow or even account for the relationship between sleep-specific beliefs and insomnia symptom severity.
Methods: Participants (N=66; 69% women; M age = 41.5; SD = 11.8; range = 20-62 years old) meeting DSM-IV-TR diagnostic criteria for both Major Depressive Disorder and an insomnia diagnosis were enrolled in a NIMH-funded (5R01MH076856-05) combined depression and insomnia study. At pre-treatment, participants completed diagnostic interviews with the Structured Clinical Interview for DSM Axis I Disorders, the Duke Structured Interview for Sleep Disorders, and sleep and mood measures including the Insomnia Severity Index (ISI), Dysfunctional Beliefs and Attitudes about Sleep (DBAS), Dysfunctional Attitudes Scale (DAS), and the Response Styles Questionnaire (RSQ).
Results: A bootstrapping method (Hayes, 2009) tested for mediation (using a confidence level of 95 and 10,000 resamples) of the DBAS and ISI relationship. There was no evidence of mediation for: depressive beliefs on the DAS (Bias corrected confidence interval [BCCI] = -.0515 to .2532; SE = .0723), the perfectionism subscale of the DAS (BCCI = -.1269 to .2592; SE = 0949) or self-focused depressive rumination on the RSQ (BCCI = -.0243 to .3935; SE = .1028).
Conclusion: In those with both insomnia and depression, depressotypic cognitions do not account for the relation between insomnia and sleep-specific beliefs. This is consistent with a previous study that reported that depressotypic cognitions and depression symptoms significantly improve with depression-focused cognitive therapies, but maladaptive sleep beliefs and insomnia symptoms do not (Carney, Harris, Friedman, & Segal, 2011). These findings suggest that insomnia-specific cognitions, and insomnia, require separate clinical attention in those with comorbid depression.
Support (If Any): NIMH 5R01MH076856-05.

0735

LONGITUDINAL RELATIONSHIP OF ANXIETY TO FUTURE DEVELOPMENT OF INSOMNIA

Chen IY, LeBlanc M, Ivers H, Morin CM
Department of Psychology, Universié Laval, Québec, QC, Canada

Introduction: Previous studies have suggested a bidirectional relationship between insomnia and anxiety. While the relation between insomnia and the subsequent development of anxiety has been extensively studied, research on anxiety as a predisposing factor to insomnia development has been sparse. The present study investigated the relation between anxiety and the one-year incidence of insomnia.
Methods: Participants were 2088 adults (mean age= 45.9 years; 58% women) without insomnia complaints selected from a sample enrolled in a longitudinal study of insomnia. Two definitions were used to identify anxiety cases at baseline: scores ≥ 4 on three questions of the Worry and Anxiety Questionnaire (WAQ); total score ≥ 46 on the State-Trait Anxiety Inventory (STAI). Participants were then classified in two groups, with (WAQ, n=262; STAI, n=248) or without anxiety (WAQ, n=1771; STAI, n=1821) at baseline. They were reevaluated at 6- and 12-month follow-ups (FU6 and FU12), and classified as having insomnia symptoms (SYMP), insomnia syndrome (SYND) or no insomnia.
Results: There were more individuals with anxiety at baseline who developed insomnia SYMP (21.4%) and SYND (6.4%) at FU6 compared to cases without anxiety (14.7% and 2.5%, respectively). Similar results were found at FU12, with higher incidence rates for insomnia SYMP (28.6% vs. 17.5%) and SYND (6.9% vs. 2.1%) among cases with anxiety compared to those without. Classification based on the STAI led to comparable findings. Logistic regression analyses, controlling for age, sex, and past insomnia episodes, revealed that anxiety at baseline was significantly related to the development of insomnia 6 (OR=2.78 for both definitions) and 12 months later (OR=3.83 and OR=5.30 for WAQ- and STAI-defined anxiety cases, respectively).
Conclusion: Individuals with anxiety at baseline were more likely to develop insomnia symptoms and syndrome 6 and 12 months later than non-anxious participants. This finding suggests that anxiety may be a potential risk factor for new onset insomnia.
Support (If Any): Research supported by Canadian Institutes of Health Research (#42504).

0736

IMPROVING SLEEP: MINDFULNESS BASED THERAPY FOR COMORBID INSOMNIA IN VETERANS

Campos M[1,2], Kruszewski D[3,4], Nappi CM[2,3], Straus LD[1,5], Ong JC[6], Drummond SP[3,5,7]
[1]Research Services, VA San Diego Healthcare System, San Diego, CA, USA, [2]Department of Psychology, University of California, San Diego, La Jolla, CA, USA, [3]Psychology Services, VA San Diego Healthcare System, San Diego, CA, USA, [4]Veterans Medical Research Foundation, San Diego, CA, USA, [5]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, San Diego, CA, USA, [6]Dept of Behavioral Science and Preventative Medicine, Rush University Medical Center, Chicago, IL, USA, [7]Department of Psychiatry, University of California, San Diego, La Jolla, CA, USA

Introduction: Mindfulness Based Therapy for Insomnia (MBT-I) is a novel integrative therapy, combining traditional mindfulness principles with behavioral sleep interventions, designed to reduce unwanted wakefulness at night as well as promote effective management of distress that accompanies sleep disruption. MBTI has shown positive preliminary ef-

ficacy in civilians with Primary Insomnia, with improvements in sleep as well as reductions in sleep-related arousal. Here, we examine the efficacy of MBTI in Veterans with comorbid insomnia. We expected that improvements would be noted in several measures of sleep quality as well as sleep-related behavior, with sleep latency improving the most.
Methods: 20 Veterans with comorbid insomnia (age=51 ±15.27yrs, 5F) completed the therapy, which involved 8 or 10 weekly group sessions. Comorbidities included pain and fatigue syndromes, depression and PTSD. Sleep disturbance was measured pre- and post-treatment with the Pre-Sleep Arousal Scale (PSAS), Glasgow Sleep Effort Scale (GSES), and the Insomnia Severity Index (ISI). Self reported measures on daily sleep diaries completed throughout treatment were also examined. Paired-samples t-tests examined changes associated with treatment, with $p<.05$ significance level utilized. Cohen d effect sizes are reported.
Results: Scores on all questionnaires showed significant improvement post-treatment (Cohen's d: ISI: -1.08, PSAS: -0.52, GSES: -0.75). Sleep latency (-1.08), number of awakenings (-1.02), wake after sleep onset (-0.64), and sleep efficiency (+0.78) also improved with treatment. Veterans with nightmares reported significant decreases in nightmare frequency (-0.90). Total sleep time did not show significant changes (-0.07).
Conclusion: These data suggest MBTI reduces sleep disturbances in Veterans with comorbid insomnia, with largest improvements in sleep latency and nightmare frequency. Importantly, hyperarousal and sleep effort reduced significantly post-treatment, consistent with the theoretical model underlying MBTI, and may relate to sleep latency and/or nightmare improvements. Further work will examine whether specific subtypes of insomnia benefit more from MBTI than others.

0737
WITHDRAWN

0738
WITHDRAWN

0739
HEALTHCARE UTILIZATION OF INSOMNIA PATIENTS WITH COMORBID DEPRESSION AND/OR ANXIETY

Mosti CB[1], Williams JM[1], Bramoweth AD[2,5], Berry RB[4,3], McCrae C[1]
[1]Clinical and Health Psychology, University of Florida, Gainesville, FL, USA, [2]VISN 4 Mental Illness Research, Education and Clinical Center (MIRECC), VA Pittsburgh Healthcare System, Pittsburgh, PA, USA, [3]Malcom Randall VA Medical Center, Gainesville, FL, USA, [4]Pulmonary Medicine, University of Florida, Gainesville, FL, USA, [5]Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Chronic insomnia is associated with significant financial costs and is often comorbid with psychiatric disorders, particularly anxiety and depression. Cognitive-behavioral treatment of insomnia (CBTi) is an efficacious treatment, but its impact on healthcare utilization (HCU) is largely unknown. This study compared HCU pre- and post-CBTi of insomnia patients with and without comorbid depression and/or anxiety diagnosis. We predicted greater pre-treatment HCU among patients with comorbid insomnia and psychiatric disorder. Following successful treatment, we predicted reductions in HCU for both groups, with even greater reductions for those with insomnia only.
Methods: A review of records for patients treated for insomnia (N=84; age M=54.25 years; SD=19.08) at a behavioral sleep medicine clinic in an academic medical center from 2005-2010. Participants were characterized by diagnosis (insomnia with vs. without comorbid psychiatric diagnosis) and treatment response (responder vs. non-responder). HCU was measured six months pre/post-treatment and included number of physician visits and medications, direct costs of visits, and Chronic Disease Score.
Results: Overall, there was a significant reduction in number of physician visits (M=0.35, SD=4.24; $p<.05$) following treatment. However, there were no significant reductions by group. Controlling for age and gender, there were post-treatment trends toward greater total ($p=.064$) and outpatient ($p=.072$) HCU for treatment responders with comorbid insomnia and psychiatric diagnoses compared to the other three groups.
Conclusion: One possible interpretation of these findings is that after successful treatment of insomnia, patients with comorbid conditions were motivated to address other health care concerns, resulting in greater HCU. Alternatively, following successful treatment of insomnia, patients with comorbid disorders may return to the same healthcare network for continuing care of these disorders. Finally, CBTi may have a greater long-term impact on HCU. Future studies examining HCU beyond six months post-CBTi may find greater decreases in healthcare service use and costs.

0740
INSOMNIA WITH OBJECTIVE SHORT SLEEP DURATION IS ASSOCIATED WITH INCIDENT HYPERTENSION: A LONGITUDINAL, POPULATION-BASED STUDY

Fernandez-Mendoza J[1], Vgontzas AN[1], Shaffer M[2], Liao D[2], VelaBueno A[3], Bixler EO[1]
[1]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA, [3]Psychiatry, Autonomous University, Hershey, Spain

Introduction: Cross-sectional studies have shown that insomnia with objective short sleep duration is associated with hypertension. However, no longitudinal study to date has examined the association of insomnia and objective sleep duration with incident hypertension.
Methods: From a random, general population sample of 1741 adults of the Penn State Cohort, 1102 without hypertension were followed-up after 7.5 years. All subjects underwent 8-hour polysomnography and medical and sleep history at baseline. Sleep apnea was defined as an apnea/hypopnea index ≥ 5. We used the median percent of sleep time to define short sleep duration (i.e., < 6 hours). Chronic insomnia was defined as a complaint of insomnia lasting ≥ 1 and poor sleeper as moderate-to-severe difficulties falling or staying asleep, early morning awakening, or non-restorative sleep. Medical and sleep history was reassessed at follow-up.
Results: The incidence of hypertension was 18.0% (n=196). Chronic insomnia (OR=2.3; p=.004) and objective short sleep duration (OR=1.6; p=.003) were both significantly associated with incident hypertension, whereas poor sleep was not (OR=1.1; p=.756). There were significant positive interactions between chronic insomnia (OR=4.0; p=.027) and poor sleep (OR=3.3; p=.005) with sleep duration on the incidence of hypertension. Chronic insomnia (OR=4.8; p=.001) and poor sleep (OR=2.1; p=.004) with short sleep duration were significantly associated with incident hypertension. The association between chronic insomnia with short sleep duration and incident hypertension remained significant after controlling for sex, race, age, sleep apnea, and BMI (OR=3.6; p=.002); however, poor sleep with short sleep duration was marginally associated with incident hypertension after controlling for BMI (OR=1.6; p=0.08).
Conclusion: Chronic insomnia with short sleep duration is associated with increased risk for hypertension in a degree comparable to sleep apnea. Objective measures of sleep duration in chronic insomnia may serve as useful predictors of the biological severity of the disorder.
Support (If Any): NIH R01 HL40916, R01 HL 51931.

0741

INSOMNIA AND OBJECTIVE SHORT SLEEP DURATION PREDICT THE INCIDENCE OF DIABETES: A LONGITUDINAL, POPULATION-BASED STUDY

Miksiewicz T[1], Fernandez-Mendoza J[1], Vgontzas AN[1], Shaffer M[2], Liao D[2], Bixler EO[1]

[1]Sleep Research and Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA

Introduction: The association of insomnia with mental health problems is very well established. However, there is a paucity of data linking insomnia with significant cardiometabolic morbidity. In this study we examined the role of insomnia and objective short sleep duration on the incidence of diabetes.

Methods: From a random, general population sample of 1741 adults of the Penn State Cohort, 1311 without diabetes were followed-up after 7.5 years. All subjects underwent 8-hour polysomnography and medical and sleep history at baseline. Sleep apnea was defined as an apnea/hypopnea index ≥ 5. We used the median percent of sleep time to define short sleep duration (i.e., < 6 hours). Insomnia was defined as moderate-to-severe difficulties falling or staying asleep, early morning awakening, or non-restorative sleep or as a complaint of insomnia lasting ≥ 1 year. Normal sleep was defined as the absence of insomnia. Medical and sleep history was reassessed at follow-up.

Results: The incidence of diabetes was 7.2% (n=94). Objective short sleep duration was significantly associated with incident diabetes (OR=2.4; p=.001), whereas insomnia was only marginally associated (OR=1.4; p=.18). There was a significant negative interaction between insomnia and objective sleep duration on the incidence of diabetes (OR=0.4; p=.037). Normal sleep (OR=3.4; p=.001) and insomnia (OR=3.0; p=.002) with short sleep duration were significantly associated with incident diabetes and, to a lesser degree, insomnia with normal sleep duration (OR=2.3; p=.016). These associations remained significant after controlling for sex, race, age, and SDB; however, insomnia with short or normal sleep duration were only marginally associated with incident diabetes after controlling for BMI.

Conclusion: Objective short sleep duration is an independent risk factor for incident diabetes. Within insomniacs, those with short sleep duration are more strongly associated with incident diabetes. Objective short sleep duration may serve as useful marker of the biological severity of insomnia.

Support (If Any): NIH R01 HL40916, R01 HL 51931.

0742

REM SLEEP BEHAVIOR DISORDER OR PARKINSON'S DISEASE: THE IMPORTANCE OF OCCURRING FIRST

Ferri R[1], Fulda S[2], Cosentino F[1], Pizza F[3], Plazzi G[3]
[1]Department of Neurology, Oasi Institute, Troina, Italy, [2]Sleep Center, Neurocenter (EOC) of Southern Switzerland, Lugano, Switzerland, [3]Department of Neurological Sciences, University of Bologna, Bologna, Italy

Introduction: In Parkinson's disease (PD) patients, REM sleep behavior disorder (RBD) might precede PD or develop with or after the onset of PD. To the best of our knowledge, no previous study has explored differences between these two groups. Therefore, the first aim of this study was to compare the clinical features and REM sleep patterns of patients in whom RBD heralded PD with those in whom its occurrence coincided with or followed the clinical manifestations of PD.
Methods: Twenty-seven consecutive PD patients (mean age 67.9 years) and 19 normal controls (mean age 67.5 years) were recruited. Detailed clinical, laboratory and polysomnographic studies were obtained in all participants and, in particular, the characteristics of chin electromyographic amplitude during rapid eye movements sleep was analyzed by means of an automatic quantitative approach (Atonia Index).
Results: Sixteen of the 27 patients were affected by RBD and a significantly higher stage of PD, took significantly higher doses of dopaminergic therapy, their disease duration tended to be longer and their cognitive status tended to be lower. Atonia Index showed high sensitivity and specificity for the diagnosis of RBD. Moreover, RBD did not clearly precede the onset of PD in 10 patients who showed a significantly higher disease stage, took significantly higher dopaminergic therapy and their disease duration was significantly longer.
Conclusion: This study shows that Atonia Index can be recommended as an objective measure to support and aid the diagnosis of RBD in PD. Furthermore, our findings are compatible with the hypothesis that patients in whom RBD precedes or not PD might constitute two possibly distinct clinical and physiopathological groups, based on different progressive neuropathological sequences of events.
Support (If Any): This study was partially supported by the Italian Ministry of Health ("Ricerca Corrente" and "Cinque per Mille").

0743

REM BEHAVIOR DISORDER IS ASSOCIATED WITH INCREASE OF OTHER NON-MOTOR SYMPTOMS IN PARKINSON'S DISEASE

Neikrug AB[1,2], Maglione JE[1], Natarajan L[3], Liu L[1], Avanzino JA[1], Carbungco A[1], Bradley L[1], Corey-Bloom J[5], Loredo JS[4], Ancoli-Israel S[1,2,4]
[1]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, San Diego, CA, USA, [2]Department of Psychiatry, University of California, San Diego, La Jolla, CA, USA, [3]Department of Family and Preventive Medicine, University of California, San Diego, San Diego, CA, USA, [4]Department of Medicine, University of California, San Diego, San Diego, CA, USA, [5]Department of Neurosciences, University of California, San Diego, San Diego, CA, USA

Introduction: Research has shown that non-motor symptoms (NMS), including REM-sleep behavior disorder (RBD), dominate the clinical reality of Parkinson's disease (PD) patients, contribute to the severe disability these patients experience, and significantly impair quality of life. RBD is a common NMS in PD. To our knowledge, no study has evaluated the relationship between RBD and other NMS of PD. We hypothesized that PD patients with RBD experience more of other NMS than PD patients without RBD.
Methods: 75 PD patients (Men=50; Age=67.3yrs) underwent PSG assessing RBD (REM without atonia; EMGscore=average of tonic and phasic REM activity) and completed the NMS questionnaire (NMSQ) and RBD Screening Questionnaire (RBDSQ). Patients were classified into diagnostic categories: yes-RBD (n=31; EMGscore≥10% plus RBDSQ≥5 or observed-RBD), no-RBD (n=24; EMGscore<10% plus RBDSQ<5), or probable-RBD (n=20; EMGscore≥10% or RBDSQ≥5). Mean NMSQ group differences were assessed with ANOVA with Bonferroni correction. Associations between RBD severity (i.e., RBDSQ and EMGscore) and NMSQ were tested using hierarchical linear regression adjusting for age and AHI.
Results: There were significant differences in mean NMSQ scores between RBD classifications ($F_{2,72}$=4.97; p=0.01). Post-hoc analyses suggested that yes-RBD (M=13.52, SD=5.18) group endorsed significantly (p=0.007) more other NMS compared to the no-RBD group (M=9.08, SD=4.57). A restricted regression model with NMSQ as the dependent variable and age and AHI as independent variables was not significant [R^2=0.05, $F_{2,70}$=1.95, p=0.15]. However, adding the RBDSQ and EMGscore into the model, the variance explained in NMSQ significantly increased (ΔR^2=0.17, $\Delta F_{2,68}$=7.25, p=0.001; RBDSQ (β=0.67, p=0.001; age, EMGscore and AHI not significant). This full model (AHI, age, RBDSQ and EMGscore) explained significant proportion of variance in NMSQ score (R^2=0.22, $F_{4,68}$=4.79, p=0.002).
Conclusion: Preliminary results suggest that PD patients with RBD experience and endorse significantly more other NMS than those without RBD. Furthermore, RBD symptoms are an independent predictor of other NMS in our PD population after controlling for AHI and age.
Support (If Any): Supported by NIA AG08415, UC1RR031980, the Research Service of the Veterans Affairs San Diego Healthcare System and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

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ASSOCIATION BETWEEN ABNORMAL VISUAL EVENT-RELATED POTENTIALS AND WAKING EEG IN PATIENTS WITH PARKINSON'S DISEASE AND REM SLEEP BEHAVIOR DISORDER

Gaudreault P[1,2], Gagnon J[1,3], Rodrigues Brazète J[1,2], Montplaisir J[1,4], Postuma RB[1,5], Gosselin N[1,4]
[1]Center for Advanced Research in Sleep Medicine, Hôpital du Sacré-Coeur de Montréal, Montreal, QC, Canada, [2]Psychology, University of Montreal, Montreal, QC, Canada, [3]Psychology, Université du Québec à Montréal, Montreal, QC, Canada, [4]Psychiatry, University of Montreal, Montreal, QC, Canada, [5]Neurology, Montreal General Hospital, Montreal, QC, Canada

Introduction: An abnormal increase of a visual event-related potential (ERP) wave, more specifically the occipital P2, was recently associated to the presence of REM sleep behavior disorder (RBD) in patients with Parkinson's disease (PD). The goal of this study was to verify whether the abnormal P2 was associated with changes in waking EEG spectral power in patients with PD or concomitant PD-RBD.
Methods: 15 PD patients without RBD and 14 PD-RBD patients were compared to 13 control subjects. All groups were matched for age and gender. All subjects underwent a neuropsychological evaluation and a polysomnographic recording including a 10-min waking EEG. Subjects also performed a visual attention task in which three types of stimuli were presented (i.e. standard, target and distractor) during ERP recording. The P2 wave amplitude was measured on O1 and O2 electrodes. For the waking EEG, a slow/fast frequency ratio [(Delta + Theta)/(Alpha + Beta 1 + Beta 2)] was calculated on O1 and O2. Statistical analyses were made using ANOVAs and Pearson's correlations.
Results: Significant group differences were observed for P2 amplitude on O2 where PD-RBD patients had higher amplitudes than control subjects for all three stimuli (p<0.05). Significant group differences were also found for the slow/fast frequency ratio where PD-RBD patients had a higher ratio than controls and PD patients without RBD (p<0.05), suggesting EEG slowing. Higher P2 amplitudes on O2 for all three stimuli were correlated with higher slow/fast frequency ratio (r values: 0.30 to 0.38, p<0.05).

Conclusion: Increased occipital P2 amplitude was found in PD-RBD patients and was associated with occipital waking EEG slowing. These abnormal occipital EEG activities suggest a dysfunction in the occipital regions in patients with concomitant PD and RBD.
Support (If Any): Supported by the Canadian Institutes of Health Research and Fonds de la Recherche en Santé du Québec.

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RESTING STATE FUNCTIONAL CONNECTIVITY CHANGES IN IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

Ju YS[1,2], Nolan TS[3], Duntley S[1,2], Larson-Prior L[3]
[1]Neurology, Washington University School of Medicine, St Louis, MO, USA, [2]Multidisciplinary Sleep Medicine Center, Washington University, St Louis, MO, USA, [3]Radiology, Washington University, St Louis, MO, USA

Introduction: REM sleep behavior disorder (RBD) has a strong association with neurodegenerative diseases of the α-synucleinopathy group. Individuals with the idiopathic form of RBD (iRBD) frequently develop neurodegenerative disease later, and may represent a preclinical stage of α-synucleinopathy. Prior studies of psychometrics have demonstrated subtle abnormalities of task-switching and visuospatial psychometric testing in iRBD, similar to deficits in α-synucleinopathy. In this study, we used functional connectivity MRI to assess the strength of brain networks involved in executive control in iRBD.
Methods: Nine individuals (5 male, 4 female) with polysomnogram-confirmed iRBD were compared to age- and sex-matched controls. All underwent brain MRI including two blood-oxygen level dependent (BOLD) sequences acquired resting awake with eyes closed. Following standard pre-processing and regression of noise signals, BOLD time series were extracted from pre-defined regions of interest (ROI) in several key brain networks. The correlation coefficient between BOLD time series of each pair of ROIs was Fisher-z transformed to obtain normally-distributed data, prior to constructing cross-correlation matrices. Correlation coefficients for within-network ROI-pairs were averaged to assess the connectivity strength of each network.
Results: Individuals with iRBD compared to matched controls had decreased connectivity in the dorsal attention network (iRBD 0.33 vs Control 0.37; p=0.016) and the salience network (0.31 vs 0.36, p=0.035). There was no significant difference in connectivity in the executive control network (0.33 vs 0.30; p=0.331), which is also involved in task processing. There was increased connectivity in the default mode network (0.35 vs 0.27; p=0.013), as has previously been described for non-Alzheimer dementias.
Conclusion: Resting state functional connectivity MRI analysis demonstrates decreased connection strength within the dorsal attention and salience networks, both of which play an important role in task switching and implementation. This suggests that dysfunction of these networks may underlie subtle psychometric deficits in iRBD. Further investigation incorporating task-based MRI protocols and long-term followup will be important in determing the progression of brain network dysfunction from preclinical to clinical α-synucleionopathy.
Support (If Any): American Sleep Medicine Foundation.

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AUTOMATED POLYSOMNOGRAPHIC EMG ASSESSMENT FOR REM SLEEP BEHAVIOR DISORDER (RBD) IN PARKINSON DISEASE

Burns JW[1], Kotagal V[2], Müller ML[3], Frey KA[2,3], Bohnen NI[2,3], Angell KJ[2], Albin RL[2], Chervin RD[2]
[1]Michigan Tech Research Institute, Michigan Technological University, Ann Arbor, MI, USA, [2]Department of Neurology, University of Michigan, Ann Arbor, MI, USA, [3]Department of Radiology, Division of Nuclear Medicine, University of Michigan, Ann Arbor, MI, USA

Introduction: We previously developed an automated assessment of the chin surface EMG signal during polysomnography to quantify loss of REM sleep atonia in patients with RBD [Burns et.al, SLEEP 2007;30:1771-8]. To further assess algorithm effectiveness as a screen for RBD, we applied it to recordings from patients with Parkinson disease, which is commonly comorbid with RBD. We compared algorithm results to those of human scoring and a validated questionnaire for RBD symptoms.
Methods: Subjects (n=51, mean age 60±8 (sd) years, 43 men) including 14 with positive RBD questionnaire screens [Boeve et.al, Sleep Med. 2011;12:445-53]. Each subject had a standard (AASM-2007) laboratory-based polysomnogram, scored manually for loss of phasic and tonic REM sleep atonia, as described by Lapierre and Montplaisir [L&M, Neurology 1992;42:1374-1]. For each study, the computer algorithm calculated variance of the chin EMG during all 3-second mini-epochs of REM sleep, and compared this to an upper limit for EMG variance during all non-REM mini-epochs. The percentage of REM mini-epochs with mean variance above the non-REM threshold is the supra-threshold REM EMG activity metric (STREAM) .
Results: The STREAM correlated well with the visually-derived L&M score for RBD severity (rho=.75, p<.0001). Positive (n=14) vs. negative RBD questionnaire screens were distinguished by STREAM (38±20 vs. 11±10, Wilcoxon rank sum test, p<.0001) and the L&M score (36±16 vs. 4±4, p<.0001). The L&M score in comparison to questionnaire results provided a 100% correct classification at an optimal threshold of 18. The STREAM was 90% correct at its optimal threshold of 30.
Conclusion: Results suggest that both the visually-derived L&M score and the automated STREAM effectively segregate Parkinson disease patients with and without RBD symptoms. The L&M score may be slightly more effective, but the STREAM metric takes seconds per study rather than hours to generate, and eliminates concerns for inter-scorer reliability.
Support (If Any): This work was supported by the Michael J. Fox Foundation and NIH grants P01NS015655 and UL1RR024986-02.

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CHARACTERIZATION OF REM SLEEP WITHOUT ATONIA IN PATIENTS WITH NARCOLEPSY AND IDIOPATHIC HYPERSOMNIA

DelRosso L, Hoque R, Chesson AL
Neurology, Louisiana State University, Louisiana, LA, USA

Introduction: The AASM Manual for the Scoring of Sleep and Associated Events (Manual) has provided standardized definitions for tonic and phasic REM Sleep without Atonia (RSWA). This study used Manual criteria to characterize REM in patients with two primary disorders of excessive sleepiness: narcolepsy and idiopathic hypersomnia (IH).
Methods: A retrospective review of PSG data from ICSD-2 defined patients with narcolepsy or IH and not on REM modifying medications was performed by two ACGME fellowship graduated sleep medicine physicians. Data compiled included: REM epochs; and the presence in REM of epochs scored as sustained muscle activity (tonic); and excessive transient muscle activity (phasic) as defined by Manual criteria.
Results: PSG data was analyzed in 7 narcolepsy patients (mean age: 29.7; age range: 15-55) and showed mean ± standard deviation values

for: Total REM epochs 205 ± 46.1; RSWA/phasic epochs 41.4 ± 20.4; RSWA/tonic epochs 15.4 ± 11.7; and REM onset in less than 15 minutes occurred in 4 out of 7 patients. PSG data was analyzed in 8 IH patients (mean age: 33.1; age range: 20-57) and showed mean ± standard deviation values of: Total REM epochs 163.8 ± 67.9; RSWA/phasic epochs 6.2 ± 3.5; RSWA/tonic epochs 0.2 ± 0.4; and REM onset in less than 15 minutes occurred in 0 out of 8 patients. Comparison revealed the inter-group differences in phasic REM (p-value: 0.00016), and tonic REM (p-value: 0.00144) were significant, while the inter-group differences in total REM (p-value: 0.10008) were not.
Conclusion: RSWA/phasic activity and RSWA/tonic activity is significantly different between patients meeting ICSD-2 criteria for narcolepsy versus IH. This robust difference, with further validation, could potentially be useful as electrophysiological criteria differentiating the two disorders and understanding the physiological differences.

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SLEEPWALKING: PREVALENCE, COMORBIDITY AND ASSOCIATED MEDICATIONS

Ohayon MM[1], Léger D[2]
[1]Stanford University, Palo Alto, CA, USA, [2]Centre du Sommeil et de la Vigilance, Université Paris Descartes, PARIS, France

Introduction: Sleepwalking (SW) is one of the most common parasomnias but remains mostly unstudied in the general population. Several predisposing and precipitating factors have been described for sleepwalking. However, a large part of our knowledge on SW is based on case reports. This study aims to assess the prevalence of SW and to evaluate the importance of medication consumption, sleep and mental disorders in conjunction with SW.
Methods: This cross-sectional telephone study involved 15,945 individuals representative of the American adult general population (≥ 18 years) living in 15 states. Participants were interviewed on life and sleeping habits; health; medication consumption, medical conditions (ICD-10), sleep disorders (ICSD) and mental disorders (DSM-IV-TR) using Sleep-EVAL.
Results: Lifetime prevalence of SW was 29.2% [28.5%-29.9%] and past year prevalence was 3.6% [95% CI 3.3% to 3.9%] in the sample. Several episodes of SW per month were reported by 1% of the sample and another 2.6% had between 1 to 12 episodes in the previous year. About one third of sleepwalkers had a family history of SW. Individuals with Obstructive Sleep Apnea Syndrome (OSAS) (OR:3.9), Circadian Rhythm Sleep Disorder (OR:3.4); Insomnia Disorder (OR:2.1); Alcohol Abuse/Dependence (OR:3.5); Major Depressive Disorder (MDD) (OR:3.5); Obsessive Compulsive Disorder (OCD) (OR:3.9); using over-the-counter sleeping pills (OR:2.5); or SSRI antidepressants (OR:3.0) were at higher risk of frequent SW episodes (≥2 times/month).
Conclusion: This study is the first to assess the prevalence of SW in the American general population. SSRI antidepressants and over-the-counter sleeping pills were associated with an increased risk of SW. Causality cannot be inferred. However, for the majority of these medication users, SW episodes were present before starting using these medications.
Support (If Any): NIH (R01NS044199) and Neurocrines Biosciences.

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FUNCTIONAL NEUROIMAGING OF SLEEPWALKING

Dang-Vu T[1,2], Labelle M[1,5], Petit D[1], Soucy J[3,4], Zadra A[1,5], Montplaisir J[1,6]
[1]Center for Advanced Studies in Sleep Medicine, Hopital du Sacre-Coeur de Montreal, Montreal, QC, Canada, [2]Cyclotron Research Center, University of Liege, Liege, Belgium, [3]Montreal Neurological Institute, McGill University, Montreal, QC, Canada, [4]Department of Nuclear Medicine, Centre Hospitalier de l'Universite de Montreal, Montreal, QC, Canada, [5]Department of Psychology, University of Montreal, Montreal, QC, Canada, [6]Department of Psychiatry, University of Montreal, Montreal, QC, Canada

Introduction: Sleepwalking is a frequent condition resulting in injuries and sleep fragmentation. However its underlying neural mechanisms remain poorly understood. An earlier study with Single Photon Emission Computed Tomography (SPECT) in a single patient suggests a state of functional dissociation with both arousal and sleep-like patterns during the episode. No functional neuroimaging study has been conducted during resting wakefulness in sleepwalking patients.
Methods: 8 sleepwalking patients were scanned using SPECT with 99mTc-Ethylene Cysteinate Dimer (ECD) in the morning in an awake resting state. Patients were also scanned during a second session, at least one week apart, at the same time-of-day but after a complete night of sleep deprivation. 9 healthy control subjects, matched for age and gender, followed the same procedure. SPECT data analysis was performed using Statistical Parametric Mapping (SPM8) implemented in Matlab (version 7.11), and compared regional cerebral blood flow between the two groups using a 2-sample t-test.
Results: Regional cerebral blood flow was decreased in several cortical areas in patients compared to controls during baseline wakefulness: frontopolar cortex, superior and middle frontal gyrus, superior and inferior temporal gyrus, angular gyrus ($p<.01$). A similar distribution was found after sleep deprivation, with a larger hypoperfusion in inferior temporal cortex, extending to fusiform gyrus, and additional hypoperfusion of limbic structures (hippocampus) ($p<.01$).
Conclusion: Sleepwalking patients show decreased perfusion in various association cortices during resting wakefulness, overlapping with areas of decreased perfusion previously found in one sleepwalking episode. This suggests that functional abnormalities possibly underlying the lack of awareness during the sleepwalking episodes can also be found during baseline wakefulness. In addition, decreased perfusion in limbic structures after sleep deprivation might relate to potential disturbances in emotional regulation in sleepwalking patients when submitted to a sleep-deprived state, which is known to facilitate the occurrence of sleepwalking episodes during subsequent sleep.
Support (If Any): Supported by Canadian Institutes of Health Research, Fonds National de la Recherche Scientifique (Belgium), Belgian College of Neuropsychopharmacology and Biological Psychiatry, and Fonds Léon Frédéricq (Belgium).

0750

A RANDOMIZED CONTROLLED TRIAL OF EXPOSURE, RELAXATION, AND RESCRIPTING THERAPY (ERRT) VERSUS RELAXATION TRAINING (RT) FOR CHRONIC NIGHTMARES IN TRAUMA-EXPOSED PERSONS: PRELIMINARY FINDINGS

Pruiksma KE[1], Davis J[2], Cranston C[2]
[1]STRONG STAR Multidisciplinary PTSD Research Consortium, Round Rock, TX, USA, [2]Psychology Department, The University of Tulsa, Tulsa, OK, USA

Introduction: Nightmares and difficulties with sleep onset and maintenance are frequently reported subsequent to trauma, often become chronic conditions, are significant sources of distress, and are associated with psychopathology. Moreover, nightmares and other sleep problems

may be resistant to broader treatments for PTSD. ERRT was developed to target trauma-related nightmares. Two randomized controlled trials of ERRT have demonstrated improvements in PTSD symptoms, depression, and sleep quality in addition to nightmare frequency and intensity in comparison to a waitlist control group. This is the first study to compare ERRT to an active control treatment.
Methods: Community-dwelling adults who had a history of at least one traumatic event and chronic nightmares were randomized to 3 weekly 90-minute sessions ERRT (n =16) or RT (n = 13). One-way between groups analysis of covariance (ANCOVA) was utilized to compare the effectiveness of ERRT and RT on nightmares, sleep problems, and overall PTSD symptoms. The independent variable was the intervention (ERRT vs. RT) and the dependent variables consisted of measures at 1-week posttreatment. Participants' scores at baseline on the relevant measure were used as the covariate in the analysis to control for pre-existing variance at baseline.
Results: At 1-week posttreatment, results indicated no differences between ERRT and RT after controlling for scores at baseline. Within group analyses showed both ERRT and RT improved sleep quality, insomnia severity, fear of sleep, and daytime sleepiness. However, only the ERRT group showed improvements in nights with nightmares per week, nightmares in the past week, and PTSD symptoms.
Conclusion: These limited preliminary findings suggest ERRT may be superior to RT, but a larger sample with greater power is needed. Findings also have implications regarding mechanisms of change in nightmare treatments.
Support (If Any): This study was funded by The University of Tulsa Graduate School and The University of Tulsa Research and Sponsored Programs.

0751

ACTIVATION OF THE CARDIAC AUTONOMIC NERVOUS SYSTEM IN SLEEPWALKERS DURING NOCTURNAL AND DIURNAL SLEEP: A PILOT STUDY

Scavone G[1,2], Lanfranchi PA[1,3], Baril A[1,4], Blais H[1], Pennestri M[6,1,2], Montplaisir J[1,5], Zadra A[2,1]
[1]Center for Advanced Research in Sleep Medicine, Hôpital du Sacré-Cœur de Montréal, Montreal, QC, Canada, [2]Department of Psychology, University of Montreal, Montréal, QC, Canada, [3]Department of Medicine, University of Montreal, Montreal, QC, Canada, [4]Department of Biomedical Sciences, University of Montreal, Montreal, QC, Canada, [5]Department of Psychiatry, University of Montreal, Montreal, QC, Canada, [6]Douglas Hospital Research Centre, Montreal, QC, Canada

Introduction: The occurrence of sleepwalking episodes may be facilitated in predisposed individuals with sleep deprivation followed by daytime recovery sleep. Heart rate follows a circadian rhythm with a higher activation of the autonomic nervous system (ANS) during the daytime. Our aim was to investigate ANS activation in the NREM and REM sleep of sleepwalkers (SW) and controls (CTL) and to see if ANS activation was affected by sleep deprivation.
Methods: Sleep of 9 SW (5F, 4M, 27.3±6.1 yrs) and 9 CTL (5F, 4M, 28,6±5,5 yrs) was recorded during normal sleep (N1) and during daytime recovery sleep (N2) following 25h of sleep deprivation. ANS activation was determined according to three temporal cardiac variables: mean and SD of the RR interval (mRR and sdRR) and the pNN50. These variables were extracted from multiple 3min segments of ECG recordings (minimum of 3 segments per sleep stage for each condition) from subjects' REM and NREM (stages 2 and 3) sleep.
Results: Repeated measures ANOVA revealed that when compared to the CTL group, SW had a lower sdRR during stage 2 (48.8±2.3ms vs 62.1±20.1ms; p=0.07), a lower pNN50 in stage 2 (10.2±4.7 vs 18.2±8.0 $p<0.05$) and lower sdRR in stage 3 sleep (39.3±5,4ms vs 53.3±23,7ms $p<0.05$). No other significant group effect was found including for sleep condition or group by sleep condition interaction effects. REM sleep parameters did not differentiate the two groups.
Conclusion: Since both lowered sdRR and pNN50 are known to be associated with an activation of the ANS, our results suggest higher ANS activation in sleepwalkers than in controls, specifically during their NREM sleep as opposed to REM sleep. Since somnambulism only occurs out of NREM sleep, the observed increase in ANS activation in sleepwalkers' NREM sleep may play a role in this parasomnia's pathophysiology.

0752

PSYCHOPATHOLOGICAL CORRELATES OF ADULT SOMNAMBULISM

Labelle M[1,2], Zadra A[1,2], Pilon M[1,2], Montplaisir J[1,3]
[1]Center for Advanced Research in Sleep Medicine, Hopital du Sacre-Coeur, Montreal, QC, Canada, [2]Department of Psychology, Universite de Montreal, Montréal, QC, Canada, [3]Department of Psychiatry, Universite de Montreal, Montreal, QC, Canada

Introduction: Somnambulism is a NREM sleep parasomnia affecting up to 4% of adults. Historically, the presence of somnambulism in adulthood has often been viewed as a sign of major psychopathology, but the relation between somnambulism and psychopathology has remained open to debate. The present study investigated the prevalence of depressive and anxious symptomatology in sleepwalkers and their possible relations to episode history and associated sleep phenomenon.
Methods: Participants were 92 patients (35 male and 57 female; mean age = 32.6; SD = 10.9; range: 15-67) referred to our sleep disorders clinic for suspected sleepwalking. All patients underwent overnight polysomnography, a comprehensive clinical assessment and received a final diagnosis according to ICSD-II criteria. Patients also completed several questionnaires including the Beck Depression Inventory II, the Beck Anxiety Inventory, and an instrument detailing the history and features of their somnambulism and other parasomnias.
Results: The proportion of sleepwalkers scoring above the clinical threshold on the BDI (> 13) and BAI (> 7) was 23.3% and 39.1% respectively. Examination of sleepwalkers with elevated scores on both the BDI and BAI (n = 19) revealed that when compared to the other sleepwalkers (n = 69), this subgroup was more likely to report sleep terrors (OR = 5.7, CI = 0.69-46.99), frequent nightmares (OR = 2.04, CI = 1.03-8.61) and recurrent dreams (OR = 2.35, CI = 0.70-7.86). They were also more likely to be worried by their sleepwalking (OR = 2.86; CI = 0.86-9.54), and to have had episodes involving inappropriate or hazardous behaviors (up to OR = 14.54, CI = 2.64-80.23) or having hurt themselves (OR = 1.71, CI = 0.61-4.80) or others (OR: 1.31, CI = 0.36-4.71).
Conclusion: These results indicate that a majority of adult sleepwalkers do not present with clinical scores on measures of anxiety or depression. However, the presence of elevated psychopathology appears to be associated with increased risk of experiencing potentially injurious episodes.
Support (If Any): This study was funded by research grants to Dr Zadra and Dr Montplaisir from the Canadian Institutes of Health Research (CIHR) and the FRSQ.

0753

SEXSOMNIA IN PARKINSON'S DISEASE PATIENTS

Sobreira Neto MA[2,1], Pena-Pereira M[2], Sobreira ES[2], Chagas M[2], Fernandes RM[2], Eckeli AL[2], Tumas V[2]
[1]University of São Paulo, Fortaleza, Brazil, [2]Department of Neuroscience and Behavior, University of São Paulo, Ribeirão Preto, Brazil

Introduction: Sexsomnia, sleepsex or sexual behaviour during sleep are synonymous, interchangeable terms that encompass all abnormal sexual behavior and experiences surrounding sleep: within NREM or REM sleep, and during sleep-wake transitional states. The etiologies include

parasomnias and other sleep disorders. Herein, we describe sexsomnia in a group of Parkinson disease (PD) patients.
Methods: This work consist in a case series of four PD patients with sexsomnia that we prospectively follow at a tertiary outpatient clinic in Ribeirão Preto School of Medicine, in São Paulo, Brazil. The evaluation of the patients was performed with clinical interviews by psychiatrist and neurologist, specialized in movement disorders and sleep medicine and by audio-video polysomnography (PSG) that included full-scalp EEG.
Results: The patients have reported sexual intercourse, sexual vocalization and/or masturbation during sleep. The companions described the events because none of the patients remenbered the episodes. In all cases related, we have perceived a temporal coincidence between the begin of sleep symptons and the begin or increase of pramipexole dosage. We observe, in two patients, impulsive control disorders like hypersexuality, compulsive eating and increase in financial expenses. Others sleep disorders like restless legs syndrome, obstrutive sleep apnea syndrome, REM sleep behaviour disorder and insomnia related to depressive episodes has been observed in this patients.
Conclusion: We believe that this work is the first description of PD patients with sexsomnia. This case series suggest the hypothesis of a relation between the use of pramipexol and the appearance of sexomnia symptons in PD patients. However, the methods used in this works don't permit estabilished a causal relation between this two factors. Future studies with an appropriate methodology will be necessary to answer this question. It's important draw attention to sexomnia in PD patients because this condition could be associated with adverse psychological consequences and serious medical-legal issues.

0754

NIGHT EATING SYNDROME IN PATIENTS WITH EATING DISORDERS: EATING OR SLEEPING DISORDER?

Latzer Y[1,2], Tzischinsky O[3]
[1]Faculty of Social Welfare and Health Sciences, University of Haifa, Haifa, Israel, [2]Eating Disorders Clinic, Psychiatric Division, Rambam Medical Center, Haifa, Israel, [3]Psychology, Emek Yezreel College, Emek Yezreel, Israel

Introduction: Night Eating Syndrome (NES) is a rare clinical syndrome comprising both sleeping and eating disorders. Only a few studies have examined NES among patients diagnosed with Eating Disorders (EDs), specifically those with, Bulimia Nervosa (BN), Binge Eating Disorder (BED) and Anorexia Nervosa (AN). There is a continuous debate in the literature regarding the relationship between NES and eating disorders (EDs). NES is conceptualized either as a subtype of obesity, a Sleep Related Eating Disorder (SRED), a variant of other EDs, or alternatively as a separate syndrome among EDs. Thus, the aim of this study was to compare NES with and without EDs (BED, BN and AN), EDs without NES, and a healthy control group with regard to sleeping, eating and psychopathology.
Methods: A total of 171 participants completed self-report questionnaires, a psychiatric evaluation, and an actigraph recording for one week. Subjects were divided into four groups: NES (n=59; 44 females, 15 males); NES with EDs (n=50; 32 females, 18 males); EDs without NES (n=30); and healthy controls (n=32). NES was diagnosed according to the new proposed diagnostic criteria (Allison et al., 2010). The study was approved by the Helsinki Committee of Rambam Medical Center.
Results: No significant differences were found between the groups in mean age, BMI, or gender prevalence. Significant differences were found between the groups in eating patterns (such as energy consumption), quality of sleep, and psychopathology. The NES with EDs group demonstrated a significantly higher level of sleep disorders, low sleep efficiency, higher eating disturbances, and higher levels of depression and anxiety as compared to the EDs without NES, the NES, and the healthy control groups.
Conclusion: The similarities and discrepancies between eating and sleeping patterns between the research groups raise the question as to whether NES is an eating or a sleeping disorder.

0755

STRESS REACTIVITY IN ADULTS WITH NON-REM PARASOMNIAS, INSOMNIA AND GOOD SLEEP

Espie CA, Young SE, Hooker K
Glasgow Sleep Centre, Univ Glasgow, Glasgow, United Kingdom

Introduction: To date, there is little research into either stress reactivity or the specificity of psychological characteristics in particular forms of sleep disorder. NREM parasomnias (nREMp) are a relatively un-studied group of sleep disorders. The purpose of this study was to gain greater insight into how people with nREMp respond to threat and to life situations. In particular, the aim was to investigate how their response to a psychological stressor compared to individuals with Insomnia and to good sleepers (GS) by measuring autonomic arousal, as well as subjective appraisals of stress. Baseline levels of autonomic arousal were intended to provide insight into daytime arousal levels at the trait level.
Methods: This was a three-group controlled comparative investigation of adult participants with nREMp, Insomnia and GS (total N = 38), recruited from the general population and attendance at the University of Glasgow Sleep Centre. Following an in-lab experimental protocol, autonomic arousal was measured via continuous electrocardiogram (ECG) recordings of heart rate (HR) and cardiac vagal tone (CVT) whilst participants took part in baseline, stressor (a difficult mathematical task) and recovery phases.
Results: The results indicated that the the nREMp group reacted to stress in a similar way to good sleepers, whereas the Insomnia group differed from good sleepers in exhibiting greater levels of stress reactivity. Both the nREMp and Insomnia groups exhibited a trend towards higher resting baseline HR compared to the GS group, which may be suggestive of higher underlying sympathetic arousal.
Conclusion: Findings from this type of study have potentially important implications for the development of treatment programmes for nREMp. However, further work needs to be completed before any conclusions can be drawn about the psychophysiological underpinnings on nREMp. The study was intended as an exploratory study and the preliminary findings indicate that further exploration is warranted.
Support (If Any): Dr. Mortimer and Theresa Sackler Foundation.

0756

A CONTROLLED COMPARATIVE INVESTIGATION OF RUMINATION, WORRY, AND EMOTIONAL INHIBITION IN ADULTS WITH NREM PARASOMNIAS, INSOMNIA AND GOOD SLEEPERS

Espie CA, Hooker K, Young SE
Glasgow Sleep Centre, Univ Glasgow, Glasgow, United Kingdom

Introduction: Little is known about the psychological characteristics of adults presenting with NREM parasomnias. Research indicates that a common factor associated with their onset is stress and early studies suggest that adults experiencing such phenomena may be emotionally inhibited; however no research has directly investigated this. Understanding of insomnia and its associated psychological factors is more developed with several studies finding a relationship with both worry and rumination. The role of somatic and especially cognitive arousal has also been emphasised.
Methods: The present study aimed to investigate these psychological factors in adults who experience NREM parasomnias. 148 adults were recruited with the index group of interest being the nREM parasomnia (nREMp) group (n = 48), a parallel sleep disorder group of people with Insomnia (n = 50) and a control group of good sleepers (GS) (n= 50). The three groups were compared for differences on self-report measures of emotional inhibition, worry, rumination and arousal.

Results: Compared with the GS group, significantly higher levels on all psychological variables were reported by the nREMp group and on all but rumination by the Insomnia group. The Insomnia group scored higher than the nREMp group on cognitive arousal with no other differences found between these two sleep disordered groups, suggesting that both nREMp and Insomnia may share some common psychopathological features, although the expression of sleep disturbance may differ.
Conclusion: There is preliminary evidence for the influence of psychological factors in nREM parasomnias. Further studies are required to replicate and extend these findings; however there are implications for the development and evaluation of psychological interventions which could prove a viable alternative treatment option for such clients in clinical settings.
Support (If Any): The Dr. Mortimer and Theresa Sackler Foundation.

0757

POLYSOMOGRAPHIC FINDINGS IN EXPLODING HEAD SYNDROME

Shin W[1], Chung K[1], Shon S[1], Cho Y[2]
[1]Neurology, Kyung Hee University hospital at Gangdong, Seoul, Republic of Korea, [2]Neurology, Dongsan Medical Center, Daegu, Republic of Korea

Introduction: Exploding head syndrome is a rare nocturnal disorder that the patient experiences a loud sound in their head, similar to an explosion, gunshot, crashing glass, pop, lightning strike, clash of cymbals or other indecipherable noise. The events occur usually during a period of drowsiness preceding sleep. We assessed polysomnograpic findings in 4 patient with exploding head syndrome that exploding sounds were recorded in overnight polysomnography study.
Methods: We recruited 6 patient that complained nocturnal loud sound during falling asleep, performed overnight polysomnography.
Results: All patient showed normal finding in general physical examination and neurologic examination. Also brain imaging and EEG had a normal finding. 12 events in 4 patients were recorded during polysomnography. 8 time of the events occurred during waking time prior to sleep onset and 4 time developed in N1 sleep.
Conclusion: Exploding head syndrome most often occurs during the first third of the night, about an hour or two after falling asleep. The polysomnography studies in exploding head syndrome are very rare. Some cases reported the events had recorded in rapid eye movement sleep, but in most cases the events developed in time of wake-sleep transition. In our case, the events appear to arise from early drowsiness with predominant alpha rhythm, with interspersed theta activity.

0758

CATATHRENIA: DO WE NEED TO TREAT?

Muza RT, Nakandala S, Higgins S, Kosky C, Leschziner G, Williams AJ
Sleep Disoders Centre, Sleep Disorders Centre, St Thomas' Hospital. London UK, London, United Kingdom

Introduction: Catathrenia is a disturbing rare sleep disorder whose pathogenesis and clinical consequences remains unclear. Therapeutic interventions have so far yielded unsatisfactory results. We sought to analyse the characteristics of catathrenia cases presenting to our centre over a 5 year period in order to help define more clearly the typical phenotype and looked at the response to the various treatments given. We reviewed the literature of the published case series.
Methods: We present a retrospective study of 18 patients given a diagnosis of catathrenia who presented to a tertiary sleep disorders centre. We reviewed the patients' notes, their polysomnographies and the outcomes of treatment given.
Results: There were 8 females and 10 males with an age range of 19 to 61. The duration of the symptoms ranged from years to decades. The Epworth Sleepiness Score ranged from 1 to 19. Ten patients had characteristic polysomnographic features of catathrenia exclusively confined to rapid eye movement (REM) sleep. One patient had 3 episodes of catathrenia in REM sleep and 1 episode in non REM (NREM) sleep. Only one patient had exclusively NREM catathrenia. Six patients did not exhibit any features of catathrenia. Mild obnstructive sleep apnoea was noted in 6 patients (apnoea hypopnoea index 5-10.8). Periodic limb movements of sleep were found in 4 patients (limb movement index 20.9- 61.2). One patient had narcolepsy. The patient with NREM only catathrenia and 3 patients with REM only catathrenia were unsuccessfully tried on continous positive airway pressure. Three patients were tried on zopiclone and 1 on clonazepam without improvement. The rest were re-assured as to the benign nature of the condition and were not treated.
Conclusion: It still appears that catathrenia is predominantly but not universally a REM related disorder. Treatment modalities which have been tried do not seem to confer any real benefit.

0759

ENTRAINMENT AS AN ADAPTIVE PHYSIOLOGICAL SET MECHANISM OF RHYTHMIC MOTOR PARASOMNIAS

Golbin AZ
Sleep and Behavior Medicine Institute, Vernon Hills, IL, USA

Introduction: Rhythmic motor parasomnias (RMP) might be a part of normal development (i.e. non-nutritive sucking), neutral (PLM) or abnormal (head banging, body rocking, bruxism). RMP are exceptionally difficult to control and there biological nature is still unclear. We hypothesize that RMP have an adaptive nature. To check this hypothesis different rhythmic parasomnias were studied by using polysomnography and qEEG.
Methods: Non - nutritive sucking in infants 3-6 months old was recorded by PSG during transitions from awake to sleep; 16 patients with head and body rocking (all with normal IQ), and 15 patients with significant periodic limb movements without RLS were analyzed by PSG. For two patients with leg shaking qEEG was performed.
Results: Frequency of motor rhythms and amplitude are different for each parasomnia, but as a group they fluctuates in theta and delta range. Other features of RMP's are the existence of cycles within the rhythm and the appearance of the RMP during transitional stages. It is interesting that the majority of RMP stop when brainwave frequencies synchronize with movements or a stable state of vigilance occurs; when behavior states or brainwaves destabilize RMP resume.
Conclusion: Our hypothesis states that RMP have an adaptive nature. They are developed initially by entrainment as a compensatory physiological mechanism to "offset" instabilities in the sleep -wake cycle due to immaturity or disease. Based on this concept several promising methods were designed to treat RMP.
Support (If Any): Brainwave synchronization (entrainment) occurs when rhythmic motor stimuli force a synchronization of brainwave frequencies with the stimulus in order to produce a desired outcome, i.e. sleep or stress relief. The theory behind brainwave entrainment is that dominant brainwaves of the subject can be altered to a different state by exposing the subject to a repetitive external stimulus with a specific frequency (the "driving" response).

0760

PARASOMNIA WITH AND WITHOUT DISSOCIATIVE DISORDER: SLEEP AND PSYCHIATRIC EVALUATION

Pelin Z[1], Karatas S[2], Okur H[3], Bilici M[2]
[1]Vocational School of Health Sciences, Gazikent University, Gaziantep, Turkey, [2]Sleep Disorders Center, Erenkoy Psychiatry and Neurology Education and Research Hospital, Istanbul, Turkey, [3]Chest Diseases, Sureyyapasa Chest Diseases and Thoracic Surgery Training and Research Hospital, Istanbul, Turkey

Introduction: Parasomnia characterized by abnormal behavioral events in any sleep stages may occur due to many medical, neurological, psy-

chiatric illness, and other sleep disorders. In recent years, it has been suggested that there is relationship between repetitive psychogenic trauma and abnormal behavioral events during sleep. In this study we aimed to investigate that dissociative experiences could continue during sleep, may coexist with parasomnia and dissociative experiences, trauma and depressive disorder may cause or increase the possibility parasomnia.
Methods: Patients with the history of abnormal behavioral events during sleep and polysomnographically diagnosed as non-REM parasomnia were included to the study. Among these patients, 15 patients with dissociative experiences scale (DES) scores with more than 30 were taken as dissociative disorder and parasomnia group (group 1), DES scoring with less than 30 patients were taken parasomnia without dissociative disorder group (group 2), Pittsburg sleep quality scale, Iowa sleep experience scale, dissociative experiences scale, childhood trauma scale(CTQ-28), hamilton depression rating scale, beck depression inventory, schedule of structured clinical interview for dissociative disorders (SCID-D) were carried out.
Results: Beck depression inventory mean results [t (28) = 3.92, p <0.01] and hamilton depression rating scale [t (28) = 6.97, p <0.001] were significantly higher than the score of group 2. Of patients diagnosed with dissociative disorder, 33.3% had dissociative amnesia, 13.3% had dissociative fugue, 53.4% had non-specified dissociative disorder. In polysomnographic recordings ,85.7%of patients in group 1 had mixed delta and alfa activity during abnormal behavioral events during sleep while this type of activity was seen in 46.7% of group 2 patients. There were not any statistically significant differences in sleep, respiratory and movement parameters.
Conclusion: This study suggested that there might be relationship between dissociative disorders, psychiatric disorders (PTSD, depressive disorder) and abnormal behavioral events during sleep.

0761

SIGNS AND SYMPTOMS OF SLEEP DISORDERED BREATHING (SDB) THAT PROMPTED REFERRAL FOR A PSG IN PATIENTS WITH NOCTURNAL BRUXISM (NB)

Prehn RS[1,4], Simmons JH[2,3,4]
[1]Center for Dental Sleep Medicine, The Woodlands, TX, USA, [2]Sadler Sleep Disorders Center, The Woodlands, TX, USA, [3]Comprehensive Sleep Medicine Associates, Houston, TX, USA, [4]Sleep Education Consortium, Houston, TX, USA

Introduction: The purpose of this study is to determine the prevalence of S&S in a group of NB patients (based on exam and confirmed at PSG). We have previously postulated that the possible etiology of NB is a compensatory mechanism for a collapsing airway. If this relationship exists, then it would be reflected in the prevalence of other S&S of SDB at the initial exam of our TMD patients with NB.
Methods: We reviewed 580 cases referred to Facial Pain Clinic for evaluation during 2009. We excluded all patients who did were not diagnosed with NB at the initial exam. Then only the patients who were referred for a PSG at the initial exam were included from that group for this study.
Results: There were 155 patients seen at the initial exam with NB that were referred directly for a PSG. Of these 155 patients, the following were the chief sleep related S&S that initiated the referral: Bruxism 155 100% Frequent arousals 94 60% Morning headaches 75 48% Epworth over 8 65 42% Takes or desires naps 48 31% GERD 40 26% HBP 37 24% Witnessed apnea 26 17% Blood sugar concerns 12 8% Of the 155 that were referred, 65 had the PSG completed and with the addition of the Pes, were confirmed to have SDB (NB confirmed).
Conclusion: The prevalence of S&S of SDB in NB patients clearly indicates a significant relationship between NB and SDB. This is confirmed by the PSG on the patients who completed the study. This also supports the fact that there is a high correlation between SDB and NB. It is therefore recommended that if there are S&S of NB, one should screen for SDB and treat that as well in order to treat the entire clinical range of this disorder.

0762

BRUXISM AMONG SLEEP APNEA PATIENTS - CHARACTERISTICS AND CPAP COMPLIANCE: THE ICELANDIC SLEEP APNEA COHORT

Gislason T[1,2], Benediktsdottir B[1,2], Arnardottir ES[1,2,3], Jackson NJ[3], Pack A[3], Schwab R[3]
[1]Dept of Respiratory Medicine and sleep, Reykjavik, Iceland, [2]Medical Faculty, University of Iceland, Reykjavik, Iceland, [3]Center for Sleep and Respiratory Neurobiology, University of Pennsylvania School, Philadelphia, PA, USA

Introduction: To analyze the characteristics of sleep bruxism (SB) among subjects with obstructive sleep apnea (OSA), effect of continuous positive airway pressure.
Methods: The OSA subjects (n=816) were newly diagnosed with moderate/severe OSA (658 males/156 females). SB was defined as yes to the question "Do you grind or clench your teeth during sleep". The prevalence of SB with CPAP treatment was re-assessed after 2 years (n=630).
Results: Among OSA patients 13.6% reported SB, 59% did not report SB and 27.5% did not know whether they had SB . Subjects reporting yes or no n=590) very only used for analysis, we found no gender difference. SB was more common in younger age groups (p<0.001). Subjects with SB had lower OSA severity than those without SB. SB was not related to hypertension, respiratory diseases or the metabolic syndrome. SB was not related to insomnia, nocturnal sweating, RLS or excessive daytime sleepiness. Subjects with SB had a lower mental quality of life than non-SB (p=0.002) but no difference was found for physical quality of life. MRI of upper airway in those subjects with SB had significantly smaller volumes of the retropalatal airway (p=0.04) and tongue (p=0.01) compared to non-SB. Subjects using CPAP full-time had a decreased prevalence of SB from 15.8% to 10.8% while no change in SB prevalence was found in noncompliant CPAP users. Noncompliant CPAP subjects were more likely to report SB at baseline (26.4% vs. 16.5% for fully treated and 12.3% for partially treated (p= 0.009).
Conclusion: SB is most prevalent among young OSA patients with a lower OSA severity. Subjects with SB had smaller volumes of the retropalatal airway and tongue compared to non-SB and lower mental quality of life. Subjects with bruxism are less likely to adhere to CPAP treatment.

0763

EFFECT OF PREGABALIN ON SLEEP DISTURBANCE IN PATIENTS WITH RESTLESS LEGS SYNDROME (WILLIS-EKBOM DISEASE)

Becker PM[1], Patrick J[2], Dubrava S[2], Allen RP[3], Garcia-Borreguero D[4], Lankford A[5], Chen C[2], Knapp L[2], Miceli JJ[2]
[1]University of Texas Southwestern Medical Center, Dallas, TX, USA, [2]Pfizer Global Research and Development, Groton, CT, USA, [3]Johns Hopkins Sleep Disorders Center, Baltimore, MD, USA, [4]Sleep Research Institute, Madrid, Spain, [5]Sleep Disorders Center of Georgia, Atlanta, GA, USA

Introduction: This study compared the efficacy of pregabalin vs. placebo and pregabalin vs. pramipexole for reducing restless legs syndrome (RLS)-related sleep disturbance.
Methods: This randomized, double-blind, placebo-controlled, crossover trial was conducted at 23 US sites. Study participants with moderate-severe idiopathic RLS and associated sleep disturbance (International RLS Study Group Rating Scale [IRLS]≥15; ≥2 on Item 4) were randomized across 6 treatment orders, each consisting of three 4-week periods on pregabalin 300mg/day, pramipexole 0.5mg/day, or placebo (evening dosing). Polysomnography (PSG) was conducted on two consecutive nights at the end of each period (Days 28-30).
Results: 85 participants (mean age 55.0y; 65% female) were randomized; data were obtained for 75 on pregabalin, 76 pramipexole, and 73 placebo. Pregabalin improved sleep maintenance, demonstrated by significant reductions in Wake After Sleep Onset (WASO; -27.1 and -26.9 minutes vs. placebo and pramipexole, respectively; $p<0.0001$) and Number of Awakenings After Sleep Onset (NAASO; -2.7 and -7.9 vs. placebo and pramipexole, respectively; $p<0.01$). Sleep maintenance improvement following pregabalin was also reflected in a significant increase in Subjective Total Sleep Time (sTST; 30.8 minutes vs. placebo; $p<0.0001$; 26.8 minutes vs. pramipexole; $p=0.0004$). Pregabalin significantly increased Slow Wave Sleep (SWS; 20.9 and 32.1 minutes vs. placebo and pramipexole, respectively; $p<0.0001$). Reduction in limb movements associated with electroencephalogram arousals (Periodic Limb Movement Arousal Index [PLMAI]) by pregabalin was similar to pramipexole ($p=0.1541$) and significantly less vs. placebo (-3.7 PLMA/hour; $p<0.0001$). Pregabalin also significantly improved RLS symptoms (reduction in IRLS) vs. placebo (-6.1; $p<0.0001$) and pramipexole (-3.1; $p=0.0029$). Pregabalin safety/tolerability was consistent with prior trials.
Conclusion: Pregabalin improved sleep maintenance and elements of sleep architecture compared with placebo and pramipexole, as reflected in PSG (WASO, NAASO, SWS) and the subjective measure of TST. Pregabalin relieved RLS symptoms and effects on PLMAI were comparable to pramipexole. Pregabalin was safe, effective, and well-tolerated.
Support (If Any): This study was funded by Pfizer, Inc.

0764

PROSPECTIVE STUDY OF RESTLESS LEGS SYNDROME AND RISK OF DEPRESSION IN WOMEN

Li Y[1], Mirzaei F[2], O'Reilly EJ[3], Winkelman J[4], Malhotra A[4], Okereke OI[5], Ascherio A[2,1,3], Gao X[1,2]
[1]The Channing Laboratory, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA, [2]Department of Nutrition, Harvard School of Public Health, Boston, MA, USA, [3]Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA, [4]Division of Sleep Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA, [5]Department of Psychiatry, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA

Introduction: Co-occurrence of restless legs syndrome (RLS) and depression has been reported previously. However, these studies are limited by their retrospective or cross-sectional designs and small sample sizes.
Methods: We prospectively evaluated the association between RLS and risk of developing incident depression in women who participated in the Nurses' Health Study. A total of 56,399 women (mean age 68 years) who were free of depression symptoms at the baseline (2002) were followed until 2008. RLS was self-reported as having ever been physician-diagnosed as restless legs syndrome. Incident clinical depression was defined as reporting both regular antidepressant medication use and physician-diagnosed depression through 2008. Depression symptoms were evaluated by the 10-items Center for Epidemiologic Studies Depression scale (CESD-10) in 2004 and the 15-items Geriatric Depression Scale (GDS-15) in 2008. Cox proportional hazards models were used to calculate relative risks (RRs) of developing depression with adjustment for important covariates, including major comorbidities.
Results: During the 300,155 person-years of follow-up, we identified 1268 incident cases of clinical depression. Women with physician-diagnosed RLS at baseline were more likely to develop clinical depression (relative risk (RR)=1.5; 95% confidence interval (CI): 1.1-2.1, $P=0.02$) relative to those without RLS, after adjusting for age, body mass index, several lifestyle factors, presence of major chronic conditions, sleep duration and frequent snoring. Presence of RLS at baseline was also associated with higher CESD-10 score and higher GDS-15 score thereafter. The multivariable-adjusted mean differences were 1.0 (SE 0.1) of the CESD-10 score and 0.47 (SE 0.07) of the GDS-15 score between women with RLS and those without RLS ($P<0.0001$). Meta-analysis of published studies (four clinic-based studies and fourteen community-based studies) combined with present finding indicated a pooled odds ratio of 2.25 (95% CI: 1.94-2.60; P-heterogeneity =0.02) for depression comparing individuals with RLS and those without RLS.
Conclusion: Women with physician-diagnosed RLS had an increased risk of developing clinical depression and clinically relevant depression symptoms. Further prospective studies using refined RLS and depression ascertainment approaches are warranted.
Support (If Any): The study was supported by NIH/NINDS grants of R01 NS062879-01A2, NIH grant P01 CA87969 and a grant from the National Alliance for Research on Schizophrenia and Depression (5048070-01).

0765

EFFECTS OF ROTIGOTINE TRANSDERMAL SYSTEM ON SYMPTOM SEVERITY AND SYMPTOM IMPACT IN PATIENTS WITH RESTLESS LEGS SYNDROME

Allen RP[1], Durmer JS[2], Garcia-Borreguero D[3], Rye DB[4], Dohin E[5], Grieger F[6], Moran K[7], Kohnen R[8,9]
[1]Johns Hopkins University, Baltimore, MD, USA, [2]Fusion Health and Fusion Sleep, Johns Creek, GA, USA, [3]Sleep Research Institute, Madrid, Spain, [4]Emory University, Atlanta, GA, USA, [5]UCB Pharma, Brussels, Belgium, [6]UCB Pharma, Monheim, Germany, [7]UCB Pharma, Smyrna, GA, USA, [8]ReSearch Pharmaceutical Services Inc, Fort Washington, PA, USA, [9]Psychology Department, University of Erlangen-Nuremberg, Nuremberg, Germany

Introduction: Two 6-month double-blind studies (EU: SP790 [NCT00136045]; US: SP792 [NCT00135993]) demonstrated improvements in restless legs syndrome (RLS) symptoms with rotigotine versus placebo based on International RLS Study Group Rating Scale (IRLS) total scores. A previous factor analysis of the 10-item IRLS identified separate subscales related to symptom severity (6 items) and symptom impact on daily life (3 items). IRLS Item 5 (tiredness/sleepiness during the day) contributes equally to both subscales. A post hoc analysis was carried out to investigate effects of rotigotine on RLS symptom severity and impact, as measured by the individual IRLS items related to each factor.
Methods: Patients received transdermal patches of placebo or fixed-dose rotigotine (0.5 [SP792 only], 1, 2 or 3 mg/24h) for up to 6 months. This post hoc analysis included data from all patients who received EMA-approved rotigotine doses (1-3 mg/24h [pooled for analysis, n=630]) or

placebo (n=213). Rotigotine's effects on symptom severity and impact were analyzed using mean change from baseline to end of maintenance (EoM) in individual IRLS item scores.

Results: At EoM, improvements were observed with rotigotine versus placebo in all 10 IRLS items. 6 items related to symptom severity: Severity as a whole (treatment difference, LS mean [95% CI]: -0.6 [-0.8, -0.5]); Average severity when symptoms occurred (-0.6 [-0.8, -0.4]); Severity of sleep disturbance (-0.6 [-0.8, -0.4]); Discomfort in arms and legs (-0.6 [-0.8, -0.5]); Need to move around (-0.6 [-0.8, -0.4]); Frequency of symptoms (-0.9 [-1.2, -0.7]). All p<0.0001. 3 items related to symptom impact: Impact on ability to carry out daily affairs (-0.4 [-0.6, -0.3], p<0.0001); Impact on mood (-0.4 [-0.6, -0.3], p<0.0001); Relief of RLS discomfort by movement (-0.3 [-0.4, -0.1], p=0.0009). Additional IRLS item: Tiredness/sleepiness during the day (-0.4 [-0.6, -0.3], p<0.0001).

Conclusion: Beneficial effects of rotigotine appear to be related to its broad and consistent action in improving symptom severity and impact of symptoms on daily life.

Support (If Any): This study was supported by UCB Pharma, Brussels, Belgium.

0766

SLEEP DISTURBANCE IN US CLINICAL TRIAL SUBJECTS WITH RESTLESS LEG SYNDROME (WILLIS-EKBOM DISEASE)

Garcia-Borreguero D[1], Allen RP[2], Bonzo D[3], Lassauzet M[3], AL-Sabbagh A[3]

[1]Sleep Research Institute, Madrid, Spain, [2]Johns Hopkins University, Baltimore, MD, USA, [3]XenoPort, Inc, Santa Clara, CA, USA

Introduction: Analysis of sleep-related outcomes was performed on 1310 subjects participating in US-based Phase II and Phase III clinical trials of gabapentin enacarbil to treat moderate to severe primary restless leg syndrome (RLS). The analysis aimed to characterize sleep-related integrated baseline information for the trial subjects and to facilitate comparison with non-RLS patients using a validated instrument.

Methods: Subject eligibility was based on meeting the International RLS Study Group (IRLSSG) diagnostic criteria; RLS symptoms for a minimum of 15 nights during the previous month; documented RLS symptoms for at least 4 of the 7 nights during the baseline period; and IRLS rating scale total score of ≥15 at the end of baseline period. Sleep-related complaints were not an inclusion criterion but were assessed by means of the Medical Outcomes Study (MOS) Sleep Scale and a validated 5-item Post-Sleep Questionnaire (PSQ).

Results: Baseline mean [95%CI] MOS scale scores for RLS subjects were compared with the corresponding normative mean for the general US population. RLS subjects reported more sleep disturbance (54.5[52.9,55.9] vs. 24.5); more somnolence (36.7[35.3,38.0] vs. 21.9); less sleep quantity (5.9[5.8,6.0] vs. 6.8); and less sleep adequacy (31.7[30.0,33.3] vs. 60.5). In comparing baseline mean MOS scores between subjects with previous RLS treatment and those treatment-naive, subjects with previous RLS treatment reported more sleep disturbance, less quality of sleep, and less sleep adequacy. The PSQ assessing overall quality of sleep, ability to function, number of nights with RLS symptoms, number of awakenings, and number of hours awake indicated significant sleep disturbance in this RLS population.

Conclusion: These data suggest that sleep disturbance is common among RLS patients, including those that have been previously treated with available agents.

Support (If Any): XenopoPort, Inc., Santa Clara, California.

0767

HIGH FALSE-POSITIVE RATE OF QUESTIONNAIRE-BASED RESTLESS LEG SYNDROME DIAGNOSIS IN MULTIPLE SCLEROSIS

Mery V[1], Trojan D[2], Suarez I[1], Benedetti A[3], Kaminska M[1], Robinson A[2], Lapierre Y[2], Bar-Or A[2], Kimoff R[1]

[1]Respirology-Sleep, McGill University, Montreal, QC, Canada, [2]Neurology, Montreal Neurological Hospital. McGill University, Montreal, QC, Canada, [3]Epidemiology, Biostatics and Occupational Health., McGill University, Montreal, QC, Canada

Introduction: Restless Leg Syndrome (RLS) is a clinical diagnosis based on self-reported symptoms. Conditions wich mimic RLS features and satisfy the four diagnostic ICSD-2 criteria have been reported to yield false positive diagnosis in up to 16% of the general population. Multiple Sclerosis (MS) patients have numerous disease-related sensorimotor symptoms wich could mimic RLS. Our aim was to asses in MS patients: 1) the false-positive rate for questionnaire-based diagnosis of RLS, and 2) the utility of periodic leg movements (PLM) during wakefulness on overnight polysomnography (PSG) in identifying true-positive patients.

Methods: Ambulatory MS patients were screened using the International RLS Study Group (IRLSG) diagnostic questionnaire (IRLDQ) and underwent overnight diagnostic PSG scored using current AASM criteria for sleep, PLM and arousals. Patients with a positive IRLDQ underwent a clinical evaluation to confirm the diagnosis. The severity of RLS was assessed with the IRLSG Severity Scale (IRLSS).

Results: We studied 62 MS patients (71% female) of mean age 46.8±10.4. 33 (53%) MS patients had a positive IRLDQ. The diagnosis of RLS was confirmed clinically in 17, yielding a false-positive rate of 45% for questionnaire-based RLS diagnosis. False-positive responses in the 15 subjects were predominantly attributable to paresthesiae (n=7), cramps and/or muscle spasms (n=3). IRLSS scores were not significantly different between subjects with confirmed (19.2±5.3) versus non-confirmed (16.6±9.3) RLS (p=0.3). The PLM index during wakefulness (PLMIW) was significantly higher in patients with confirmed RLS (56.8±44.1, range 5.2-113.1 vs 29.9±19.4, range 0-67.5, p=0.03). The sensitivity of a PLMWI >70/h for true RLS among positive IRLDQ respondents was 41%, and specificity was 100%.

Conclusion: There is a high rate of false-positive RLS diagnosis based on standardized questionnaire in MS patients, largely attributable to MS-related sensorimotor symptoms. While detailed clinical evaluation is essential to confirming RLS diagnosis, the PLMIW may provide useful adjunctive information.

Support (If Any): Funded by Multiple Sclerosis Society of Canada, Fonds de la Recherche en Santé du Québec & Montreal Neurological Institute & Hospital.

0768

CEREBRAL MICROVASCULAR ISCHEMIC DISEASE IN MAGNETIC RESONANCE IMAGING OF PATIENTS WITH RESTLESS LEGS SYNDROME AND CONTROLS

Ferri R[1], Moussouttas M[2], Cosentino F[1], Wang L[3], Walters A[3]

[1]Dept. of Neurology, Oasi Institute, Troina, Italy, [2]Thomas Jefferson Medical School, Philadelphia, PA, USA, [3]Dept. of Neurology, Vanderbilt University School of Medicine, Nashville, TN, USA

Introduction: There is increasing indirect (epidemiological, clinical and neurophysiological) evidence that patients with restless legs syndrome (RLS) might be at increased risk for hypertension, heart disease, and stroke. For this reason, the aim of this study was to evaluate whether RLS is an independent risk factor for cerebral microvascular ischemic disease (MVD) when other potential risk factors for stroke are controlled.

Methods: Thirty-nine patients with RLS and 37 age- and sex-matched normal control subjects were included. All patients had a normal neuro-

logical exam and no previous history of stroke; none of the patients or controls had any risk factors for stroke, including hypertension, hyperlipidemia, coronary artery disease, diabetes and excessive tobacco use. A Neurology stroke specialist (MM) blinded to the experiment scored the volume of cerebral MVD (Digital Image Analysis, Image J program, version 1.37). Patients were subdivided into two subgroups based on their RLS duration (<10 years or ≥10 years).

Results: Age, International RLS severity scale, Epworth sleepiness scale and PLMS index were not significantly different between the two patient subgroups; on the contrary, total MVD area (square cm; RLS <10 years 1.1±0.93 vs. RLS ≥10 years 5.9±11.55, p<0.0074) and volume (cubic cm; RLS <10 years 0.6±0.46 vs. RLS ≥10 years 3.0±5.77, p<0.0074) were found to be significantly higher in the RLS ≥10 years group; in addition, we plotted MVD area against age and, as one might expect, a positive correlation was found between these two measures in both controls and patients. This plot also showed that differences between these two groups might be more evident after the age of 55-60 years. This might indicate that years of repeated transient heart rate/blood pressure rises accompanying periodic leg movements during sleep and/or more general sleep architecture disruption are needed in order to develop a cerebral MVD involvement exceeding the amount expected for age.

Conclusion: The results of this exploratory study are encouraging and they seem to confirm the initial hypothesis that MVD is more frequent in patients with RLS. This study deserves to be expanded to a larger group of patients and controls for a more detailed analysis of the interactions and effects of age and disease duration.

0769

PERIODIC LEG MOVEMENTS AND CORTICAL AROUSALS CAN BE PHARMACOLOGICALLY DISSOCIATED FROM EACH OTHER

Manconi M[1], Ferri R[2], Zucconi M[3], Bassetti C[1], Fulda S[1], Aricò D[2], Ferini Strambi L[3]

[1]Neurocenter of the Southern Switzerland, Civic Hospital, Lugano, Switzerland, [2]Dept. of Neurology, Oasi Institute, Troina, Italy, [3]Sleep Disorders Center, HSR, Milano, Italy

Introduction: The purpose of this study was to characterize the nature of the relationship between periodic leg movements during sleep (PLMS) and cortical arousals in order to address the question of the clinical significance and treatment necessity of PLMS. The specific aim was to explore whether drug treatment can dissociate PLMS from cortical arousals by analyzing the differential effects of clonazepam or pramipexole on sleep, arousals, and PLMS in patients with restless legs syndrome (RLS). Addressing this question might be relevant to extract preliminary clues on their possible joint use for RLS.

Methods: A prospective, placebo-controlled, single-blind, parallel group study was carried out including 46 drug naïve patients with idiopathic RLS. Each patient underwent two consecutive full night polysomnographic studies. The first night was the baseline night. Prior to the second night, one group received a single oral dose of 0.25 mg pramipexole while a second group received a single oral dose of 0.5 mg clonazepam, and the remaining patients received placebo. Sleep stages, Cyclic Alternating Pattern (CAP), and leg movement activity were scored following standard criteria; symptoms of RLS were also assessed.

Results: Pramipexole suppressed PLMS without affecting EEG instability (CAP) and arousals (corresponding to CAP A3 and, partially, A2 subtypes), while clonazepam did the opposite, reducing the NREM sleep EEG instability without effects on PLMS. Both drugs were effective on sensitive RLS symptoms.

Conclusion: This study demonstrates that a selective pharmacological approach can disconnect PLMS from arousal events, suggesting an indirect mutual relationship between each other, and opens the doors to the possibility of a joint treatment for RLS targeting sensory and motor symptoms, as well as sleep instability.

0770

PERIODIC LIMB MOVEMENTS DURING SLEEP AND NOCTURNAL CARDIAC ARRHYTHMIA: OUTCOMES OF SLEEP DISORDERS IN OLDER MEN (MROS) STUDY

Koo BB[1], Mehra R[2], Blackwell T[3], Ancoli-Israel S[4], Stone KL[3], Redline S[5]

[1]Neurology, Case Western Reserve University School of Medicine, Cleveland, OH, USA, [2]Medicine and Pediatrics, Case Western Reserve University School of Medicine, Cleveland, OH, USA, [3]Research Institute, California Pacific Medical Center, San Francisco, CA, USA, [4]Psychiatry, University of California, San Diego, La Jolla, CA, USA, [5]Medicine, Brigham and Women's Hospital and Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

Introduction: As periodic limb movements during sleep (PLMS) are associated with repetitive sympathetic activation, we hypothesized that PLMS index (PLMI) and PLMS arousal index (PLMAI) are associated with clinically relevant adrenergic-mediated cardiac arrhythmia, atrial fibrillation (AF) and nonsustained ventricular tachycardia (NSVT), detected during a single night polysomnography (PSG) in an elderly male cohort.

Methods: 2,911 participants in the MrOS sleep study cohort (age 76.4±5.5) underwent PSG with measurement of PLMS and EKG. Logistic regression assessed the PLMI and PLMAI association with AF and NSVT. Models were unadjusted then adjusted for, age, body mass index, cardiovascular risk factors, and clinic site. Analyses were further subset to those men without pacemaker or calcium channel/β-adrenergic medication usage, or stratified by history of congestive heart failure (CHF) or myocardial infarction (MI).

Results: For NSVT, there was a significant unadjusted association with PLMI and PLMAI which only persisted in fully adjusted models subset to men without pacemaker or calcium channel/β-adrenergic medication usage (PLMI per 5 unit increase OR=1.04, 95% CI 1.01-1.08; PLMAI per 1 unit increase OR=1.05, 95% CI 1.01-1.09). For AF, there was a significant increased unadjusted odds (OR=1.57, 95% CI 1.03-2.39) of AF for men with PLMI≥30 compared to men with PLMI<5 which only persisted in fully adjusted models in a subset of men with a history of CHF or MI.

Conclusion: PLMS frequency is associated with prevalent PSG-identified arrhythmia in community dwelling elderly men, with findings most consistent with NSVT (both PLMI and PLMAI) even after consideration of potential confounders in men without pacemaker or calcium channel/β-adrenergic medication usage. Severe PLMS was associated with AF only in men with a history of CHF or MI. These findings are suggestive of a mechanism of increased sympathetic nervous activity in the genesis of nocturnal cardiac arrhythmia in the setting of PLMS.

Support (If Any): The National Heart, Lung, and Blood Institute (NHLBI) provides funding for the MrOS Sleep ancillary study "Outcomes of Sleep Disorders in Older Men" under the following grant numbers: R01 HL071194, R01 HL070848, R01 HL070847, R01 HL070842, R01 HL070841, R01 HL070837, R01 HL070838, and R01 HL070839, Association of Subspecialty Professors (ASP)-CHEST Foundation Geriatrics Development Research Award T. Franklin Williams Award.

0771

DISCONTINUATIONS DURING 3-MONTHS OF ROTIGOTINE TREATMENT: A POST HOC ANALYSIS OF DATA FROM TWO 6-MONTH DOUBLE-BLIND TRIALS

Bogan R[1], Becker PM[2], Schollmayer E[3], Grieger F[3], Moran K[4], Buchfuhrer M[5]

[1]SleepMed of South Carolina Inc, Columbia, SC, USA, [2]Sleep Medicine Associates of Texas, P.A, Dallas, TX, USA, [3]UCB Pharma, Monheim, Germany, [4]UCB Pharma, Smyrna, GA, USA, [5]Downey Regional Medical Center, Downey, CA, USA

Introduction: Two double-blind, placebo-controlled trials (EU: SP790 [NCT00136045]; US: SP792 [NCT00135993]) demonstrated that rotigotine is efficacious and generally well tolerated in patients with moderate-to-severe restless legs syndrome (RLS) for up to 6 months. In trials which investigated safety and efficacy of pramipexole and ropinirole in patients with RLS over 12-weeks, discontinuations were as follows: TREAT RLS 1 (placebo: 21%; 0.25-4 mg ropinirole: 23%), TREAT RLS 2 (placebo: 21%; 0.25-4 mg ropinirole: 22%), TREAT RLS US (placebo: 13%; 0.25-4 mg ropinirole: 12%), PIRLS (placebo: 13%; pramipexole: 0.25 mg, 11%; 0.5 mg, 24%; 0.75 mg, 26%), NCT00349531 (placebo: 28%; 0.125-0.75 mg pramipexole: 15%). In this analysis, discontinuations following 3 months of rotigotine treatment were evaluated, to allow adherence to rotigotine to be viewed in the same context as adherence to other dopamine agonists for which shorter-term data are available.
Methods: Following titration (SP790: 3 weeks, SP792: 4 weeks), patients received rotigotine (0.5 [SP792 only], 1, 2 or 3 mg/24h) or placebo for up to 6 months. Discontinuations which occurred prior to the 3-month maintenance visits were assessed.
Results: Discontinuations within the first 3 months of treatment in SP790 were as follows: placebo, 45/117 patients (38%); 1 mg/24h, 16/115 (14%); 2 mg/24h, 13/112 (12%); 3 mg/24h, 19/114 (17%). Discontinuations due to adverse events: placebo, 3/117 patients (3%); 1 mg/24 h, 5/115 (4%); 2 mg/24h, 3/112 (3%); 3 mg/24h, 10/114 (9%). The following incidences of discontinuation were observed in SP792: placebo, 17/100 patients (17%); 0.5 mg/24h, 13/99 (13%); 1 mg/24h, 32/101 (32%); 2 mg/24h, 21/99 (21%); 3 mg/24h, 35/106 (33%). Discontinuations due to adverse events: placebo, 3/100 patients (3%); 0.5 mg/24h, 5/99 (5%); 1 mg/24h, 13/101 (13%); 2 mg/24h, 10/99 (10%); 3 mg/24h, 19/106 (18%).
Conclusion: The 3-month incidence of discontinuations with rotigotine was comparable to those of previous trials of ropinirole and pramipexole.
Support (If Any): This post hoc analysis was supported by UCB Pharma, Smyrna, GA, USA.

0772

NIGHT-TO-NIGHT VARIABILITY OF THE PERIODICITY INDEX FOR PERIODIC LEG MOVEMENTS DURING SLEEP IN RESTLESS LEGS SYNDROME

Fulda S[1], Manconi M[1], Zucconi M[2], Ferini Strambi L[2], Ferri R[3]

[1]Sleep and Epilepsy Center, Neurocenter of Southern Switzerland, Civic Hospital of Lugano, Lugano, Switzerland, [2]Sleep Disorders Center, H. San Raffaele Hospital, Vita-Salute San Raffaele University, Milan, Italy, [3]Sleep Research Center, Department of Neurology I.C., Oasi Institute (IRCCS), Troina, Italy

Introduction: Several studies have shown that the number of periodic leg movements during sleep (PLMS) exhibits a high night-to-night variability in subjects with restless legs syndrome (RLS), making multiple nights of recording advisable. Our aim was to explore whether the Periodicity Index, a measure quantifying the periodicity of leg movements independent of their frequency, is a more stable measure to characterize PLMS in RLS.
Methods: Data was taken from the placebo arm of a randomized, double-blind acute treatment study of pramipexole in RLS. Eighteen subjects with idiopathic RLS (8 males, 10 females, mean age 56.4 years, range 41-83 years, IRLS 26.7 ± 4.6 SD) were randomized to receive placebo after one baseline night. Sleep and leg movements were recorded and scored according to standardized recommendations. The PLMS index and the Periodicity Index were extracted for the baseline and the placebo night. Night-to-night variability was quantified as the absolute difference between baseline and placebo night standardized to the mean of the two nights.
Results: The PLMS index ranged from 16 to 92 on the first night (mean ± standard deviation: 40.12±24.95) and from 9 to 129 on the second night (47.87±33.96). The average night-to-night variability was 54.13% ± 30.33% (10% to 114%). The Periodicity Index ranged from 0.61 to 0.96 (0.86±0.08) on the first night and 0.75 to 0.99 (0.88±0.07) on the second night. The average night-to-night variability was 8.01%±7.21% (0.1% - 22%).
Conclusion: Our data confirm the high night-to-night variability of the PLMS index in RLS. In contrast, the Periodicity Index showed considerably less variability. These results suggest that the Periodicity Index characterizes a stable feature of leg movements during sleep in RLS, more than the PLMS index.

0773

SUGGESTED IMMOBILIZATION TEST FOR DIAGNOSIS OF RESTLESS LEGS SYNDROME IN PARKINSON'S DISEASE

Cochen De Cock V[1], Bayard S[1], Yu H[3], Grini M[1], Carlander B[1], Postuma RB[2], Charif M[1], Dauvilliers Y[1]

[1]Service de neurologie, CHU de Montpellier, Montpellier, France, [2]Departement of neurology, McGill University, Montreal General Hospital, Montreal, ON, Canada, [3]Department of Neurology, Shanghai Huashan Hospital, Shangai Fudan University,, Shanghai, China

Introduction: Diagnosis of restless legs syndrome in Parkinson's disease is difficult because of clinical confounds. Suggested immobilization test is validated for diagnosis of primary restless legs syndrome. This study evaluated its usefulness for diagnosis of restless legs syndrome in Parkinson's disease.
Methods: We compared suggested immobilization test scores, as well as polysomnography measures in 50 patients with Parkinson's disease (25 with restless legs syndrome, 25 without), 25 patients with primary restless legs syndrome and 25 age/sex matched controls.
Results: Mean leg discomfort score was increased in patients with Parkinson's disease and restless legs syndrome compared to Parkinson's disease without restless legs syndrome, and also in patients with primary restless legs syndrome compared to controls. Leg discomfort was significantly higher at the end of the test in patients with restless legs syndrome compared to patients without restless legs syndrome. Intensity of leg discomfort was similar between restless legs syndrome patients with or without Parkinson's disease. Using a mean leg discomfort cut-off of 11, we showed sensitivity of 91% and specificity of 72% for restless legs syndrome diagnosis in Parkinson's disease. Periodic leg movements index during suggested immobilization test did not differ between groups. Periodic leg movements index during sleep and wakefulness was increased in primary restless legs syndrome patients compared to controls, but did not differ between Parkinson's disease patients with and without restless legs syndrome.
Conclusion: The suggested immobilization test is a simple test that may help diagnose restless legs syndrome in patients with Parkinson's disease.

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DIAGNOSTIC ACCURACY OF RESTLESS LEGS SYNDROME MEASURES

Richards KC[1], Bost J[3], Kalra G[1], DiCarlo J[1], Cuellar NG[4], Allen RP[2]
[1]Nursing, George Mason University, Fairfax, VA, USA, [2]Neurology, Johns Hopkins Bayview Medical Center, Baltimore, MD, USA, [3]Booz, Allen, Hamilton, Herndon, VA, USA, [4]Nursing, University of Alabama, Tuscaloosa, AL, USA

Introduction: The lack of sensitive and specific diagnostic measures for restless legs syndrome (RLS) in persons who lack the cognitive and verbal skills to report complex symptoms impedes their clinical treatment and the advancement of science. Therefore, the specific aim of this study was to determine the sensitivity and specificity of the Behavioral Indicators Test-Restless Legs (BIT-RL), the Periodic Activity Monitor-Restless Legs (PAM-RL), serum ferritin, and demographic and clinical variables for RLS diagnosis.
Methods: We conducted a 3-day, in-laboratory instrument validation study in 107 adults with RLS and 105 without RLS (mean age 65.9 years, SD 11.8). Persons with RLS have characteristic observable excessive motor activity, primarily of the legs. The BIT-RL measures excessive motor activity and its variability. Trained raters scored 15 BIT-RL indicators every 2 minutes for 20 minutes during 4 observation periods: evening pre- and post-exercise, bedtime, and awakening. The reference standard was the Johns Hopkins Structured Diagnostic Interview of RLS Symptoms. The interviews were conducted by one experienced clinician (Allen) who was blinded to the results of the index tests. We calculated the sensitivity, specificity, percent correctly classified and the area under the curve. The cut-off values that maximize the percent correctly classified were determined. We plotted receiver operating curves, and determined the number of days/observations needed for optimal diagnostic accuracy for the BIT-RL and the PAM-RL.
Results: The best model, with 77% correctly classified, was one 20-minute afternoon BIT-RL; history of depression, diabetes, iron deficiency, family with RLS; and report of unrefreshing sleep, difficulty falling asleep, and discomfort in legs. The PAM-RL and serum ferritin dropped out of the model.
Conclusion: A 20-minute observation of behavioral indicators of RLS, in combination with readily available clinical and history variables provided good diagnostic accuracy for RLS.
Support (If Any): NIA Grant No. R01AG02777 (Richards PI).

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NOCTURNAL LIMB MOVEMENTS ARE CORRELATED WITH CEREBRAL WHITE MATTER HYPERINTENSITIES AND FRONTO-EXECUTIVE DEFICITS

Boulos MI[1,2], Pettersen JA[3,4], Nguyen L[5], Jewell DR[2], Shammi P[5], Black S[1,2], Murray BJ[1,2]
[1]LC Campbell Cognitive Neurology Research Unit, Heart and Stroke Foundation Centre for Stroke Recovery, Brain Sciences Research Program, Division of Neurology, Department of Medicine, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada, [2]Sleep Laboratory, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada, [3]Department of Medicine, Division of Neurology, University of British Columbia, Vancouver, BC, Canada, [4]The Northern Medical Program, University of Northern British Columbia, Prince George, BC, Canada, [5]Neuropsychology Assessment Service, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada

Introduction: Nocturnal limb movements (LMs) are associated with transient but significant increases in night-time blood pressure and autonomic hyperactivity; emerging evidence suggests a link with vascular disease and cognitive impairment. While obstructive sleep apnea (OSA) is linked with white matter hyperintensities (WMH), the relationship between nocturnal LMs, WMH, and cognition remains to be clarified.
Methods: Patients evaluated in a tertiary care behavioral neurology clinic were evaluated using polysomnography for various sleep problems and underwent cognitive testing by a board-certified neuropsychologist. Polysomnography was scored according to criteria from the American Academy of Sleep Medicine. WMH were rated using the Age Related White Matter Changes Score (ARWMC) from FLAIR MRI. Polysomnographic (transformed where necessary), ARWMC data, and neuropsychological test results were compared using Pearson correlations.
Results: Forty-five participants were assessed (69% male, mean age 64 years) and vascular risk factors were as follows: hypertension (27%), hyperlipidemia (18%) and diabetes (9%). Prior cerebrovascular disease (7%), OSA (49%) and restless legs syndrome (33%) were also present. The mean ARWMC score was 3.84 (range 0-25, standard deviation 4.73). When controlling for hypertension, the total ARWMC score was positively correlated with total LMs per hour of sleep ($r=0.70$, $p<0.01$) and negatively correlated with sleep efficiency ($r=-0.72$, $p<0.01$). There were no differences in the ARWMC score between hemispheres, but more limb movements were noted on the left side (66.3 vs. 24.1, $p<0.05$). Total periodic limb movement count negatively correlated with scores on the trails making A test ($r=-0.53$, $p=0.01$).
Conclusion: LM counts strongly correlated with the presence of WMH, while sleep efficiency was negatively correlated with WMH. Our findings suggest that nocturnal LMs associated with poor quality sleep may contribute to episodes of nocturnal hypertension that contribute to the development of WMH and difficulties with fronto-executive function.
Support (If Any): Dr. Boulos is supported by a Focus on Stroke 2010 research fellowship funded by the Heart and Stroke Foundation of Canada, Canadian Institutes of Health Research (CIHR), and the Canadian Stroke Network.

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RESTLESS LEGS SYNDROME: RELATIONSHIP BETWEEN PREVALENCE AND LATITUDE

Koo BB
[1]Neurology, Case Western Reserve University, Cleveland, OH, USA, [2]Neurology, Louis Stokes Veterans Affairs Medical Center, Cleveland, OH, USA

Introduction: Restless legs syndrome (RLS) has a broad worldwide prevalence between 0.01% and 18.3%. While differences in RLS definitions and data ascertainment methods account for some variability, other factors likely contribute. The circadian nature of RLS and the fact that RLS symptoms track with endogenous melatonin levels suggest that light or ultraviolet radiation (UVR) may be related to RLS expression. As the amount of UVR decreases with latitude we considered the potential effect of geography on RLS prevalence with the thought being that RLS prevalence rises with increasing latitude.
Methods: RLS epidemiologic studies were sought via Pubmed search in the period between January 1, 1992 and November 15, 2010. Prevalence was mapped for each country or specific region studied and examined by continent. Pearson's correlational testing was carried out for RLS prevalence and latitude of the region studied.
Results: Global RLS prevalence ranges from 0.01% in Africa, 0.7% to 12.5% in Asia, 2.0% to 18.9% in the Americas, and 3.2% to 18.3% in Europe. Mapping RLS prevalence by country or region in both the Americas and in Europe suggests increasing RLS frequency with greater northern latitude. RLS prevalence is positively correlated with northern latitude in both North America and Europe with correlation coefficients of $r=0.77$ [0.15, 0.96; $p=0.02$] and $r=0.74$ [0.44, 0.89; $p=0.0002$], respectively. In Europe, lower latitudinal countries like Greece and Turkey had RLS prevalence (per 1,000 persons) of 38 and 34, respectively, middle latitudinal countries like France and England of 108 and 86, respectively, and high latitudinal countries like Norway and Iceland of 143 and 183, respectively.
Conclusion: RLS epidemiology indicates an increase in RLS frequency in northern latitudinal countries as a function of distance from the equa-

tor, an effect most evident in Europe. This suggests that factors that track with latitude like UVR may be involved in the expression of RLS.

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DEPTH AND DISTRIBUTION OF RESTLESS LEGS SYNDROME SYMPTOMS: EXCLUSIVELY SUPERFICIAL SENSATIONS ARE RARE IN IDIOPATHIC RLS

Walters AS[1], Poceta S[2], Ondo WG[3], Picchietti D[4], Davies CR[4], Allen RP[5]
[1]Neurology, Vanderbilt University School of Medicine, Nashville, TN, USA, [2]Neurology, Scripps Clinic, La Jolla, CA, USA, [3]Neurology, University of Texas Health Science Center, TX, Houston, TX, USA, [4]Neurology, University of Illinois & Carle Foundation Hospital, Urbana, IL, USA, [5]Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, USA

Introduction: Epidemiological, genetic and pharmaceutical research of Restless Legs Syndrome (RLS) has been plagued by admission of RLS patients to studies who meet all 4 criteria for RLS but who do not have RLS. The current study was undertaken to determine if the distribution and degree of depth to which patients experience their RLS symptoms might help us to identify subjects who are more likely to have idiopathic primary RLS.
Methods: Twenty seven subjects were interviewed. Twenty-four had RLS (12 F and 12 M ages 41-83 years) and 3 met all 4 criteria for RLS but had conditions mimicking true RLS such as positional discomfort and osteoarthritis and leg cramps (1F and 2 M ages 44-59). Subjects were administered the Hening Clinical Diagnostic Interview and they were then asked to shade in a human figure front and back indicating the distribution and depth of their RLS discomfort.
Results: Only 7 of the 24 RLS patients had the whole of a calf or thigh or, in one case, the knees affected without partial involvement of other body parts. An additional 2 patients had the whole of a body part affected plus a partial involvement of another body part. Thus 15 of the subjects had only partial affectation of a calf or thigh or other body part. Twelve of the RLS patients experienced their symptoms as coming exclusively from deep within the body and only one of the RLS patients experienced their symptoms as coming exclusively from the surface of the body. Eleven of the RLS patients experienced their symptoms as both deep and superficial. Four of these eleven experienced both deep and superficial sensations in the same body area and 7 also experienced deep and superficial sensations in the same body area but they also experienced either only deep or only superficial sensations in other body areas. Of the 3 patients with mimics of RLS, all 3 experienced both deep and superficial sensations.
Conclusion: Our preliminary results suggest that RLS patients who experience exclusively superficial discomfort are rare. In the one case of our 24 RLS subjects where this was true the patient had spinal stenosis and a lumbosacral radiculopathy, an established cause of secondary RLS. In research where it is desirable to only admit patients with idiopathic primary RLS for study, we recommend that subjects who only experience their discomfort as superficial be scrutinized for possible secondary causes of RLS. This study will be extended to a larger number of subjects.

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EFFECT OF HERBAL MEDICINE ON RESTLESS LEGS SYNDROME AND COMORBID ANXIETY SYMPTOMS

Shinno H[1], Ishikawa I[1], Inami Y[2], Horiguchi J[2], Nakamura Y[1]
[1]Department of Neuropsychiatry, Kagawa University School of Medicine, Kagawa, Japan, [2]Department of Psychiatry, Shimane University Faculty of Medicine, Izumo, Japan

Introduction: Dopamine agonists such as pramipexole have been accepted as the first-line medications for restless legs syndrome (RLS). As the psychological state often influences sensations of discomfort in the extremities and sleep quality, RLS patients who exhibit anxiety symptoms may continue to complain of such sensations or sleep disturbance. In order to investigate the influence of anxiety symptoms on RLS symptoms, we analyzed the relationship between anxiety symptoms and outcomes following pramipexole prescription. The effect of a herbal medicine, Yokukansan (YKS), on RLS and anxiety was also examined in this study.
Methods: Thirty-three patients with RLS were enrolled in this study. The diagnosis of RLS was made according to the essential criteria established by the International RLS Study Group. Subjects who met the diagnoses of any major psychosis were excluded. RLS symptoms, daytime somnolence, subjective sleep quality, and anxiety symptoms were evaluated using the International RLS Study Group Rating Scale (IRLS), Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index, and Hamilton Anxiety Scale (HAM-A), respectively. This study was approved by the local Institutional Research Board.
Results: The mean age of the patients was 67.1 years old. The mean basal IRLS was 24.5. After being treated with pramipexole for 4 weeks, there were 9 patients whose IRLS scores were over 10 (anxiety group). In the anxiety group, the mean HAM-A score was 9.2 after being treated with pramipexole, while the score was 2.4 in the non-anxiety group. In the anxiety group, YKS was prescribed in combination with pramipexole. Treatment with pramipexole and YKS for 4 weeks resulted in significant decreases in IRLS and HAM-A scores.
Conclusion: In patients with RLS, it is necessary to assess psychiatric symptoms such as anxiety symptoms. Pramipexole may fail to achieve sufficient remission in RLS patients with anxiety symptoms. YKS may be effective in these subjects.

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CROSS SECTIONAL SURVEY FOR RESTLESS LEG SYNDROME DURING PREGNANCY

Wei X, Lei F, Li Z, Liu H, Tang X
West China Hospital of Sichuan University, Chengdu, China

Introduction: The aim of this study was to investigate the prevalent rate of Restless Legs Syndrome (RLS) among Chinese pregnant women.
Methods: A total of 200 pregnant women (Age, 29.52 ± 5.14 years old) in hospital were interviewed before delivery (pregnant duration, 35.99 ± 4.37 weeks). RLS was diagnosed by the presence of four essential RLS diagnostic criteria recommended by the International RLS Study Group (2003). Subjective sleep was also assessed by a questionnaire concerning whether there is difficulty falling asleep and increased number of awakening.
Results: The prevalent rate of RLS was 17% (34 for RLS) among interviewed 200 pregnant women. Between the groups with RLS and with no RLS, no differences were obtained in age, pregnant weeks, and primiparous/multiparous. But, RLS group had significantly lower hemoglobin level (108.71±18.97 g/L vs. 116.64±12.16 g/L, $p<0.05$) and an increased rate in nocturnal awakening (35.3% vs. 19.3%, $p< 0.05$), compared to those with no RLS.
Conclusion: The prevalent rate of RLS in Chinese pregnant women appear to be relative lower (17%), compared to its prevalent rate in white race (20-34%). The individuals with RLS in pregnancy are possibly associated with potential iron deficiency and RLS may impact subjective sleep quality.
Support (If Any): Chinese National Science Foundation 30870891.

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DAYTIME BLOOD PRESSURES IN RESTLESS LEGS SYNDROME AND INSOMNIA

Salminen A[1], Polo O[1,2]
[1]Unesta Research Centre, Tampere, Finland, [2]Department of Pulmonary Diseases, Tampere University Hospital, Tampere, Finland

Introduction: Both restless legs syndrome (RLS) and insomnia have been associated with hypertension and cardiovascular diseases (Calhoun et al. 2010). The association with RLS, however, is under question, as some studies have failed to find a connection between the two (Walters et al. 2009). These studies rely, however, on self-reported RLS and not clinical diagnoses. Also, these two patient groups have never been compared with each other.
Methods: The RLS data set consisted of 74 patients who were screened by an experienced clinician for a clinical pharmaceutical study on RLS (Pfizer). The average score in the RLS severity rating scale (Walters et al. 2003) among the patients was 20.4. The insomnia data set consisted of 67 patients who fulfilled the DSM-IV-TR criteria for primary insomnia (Actelion study). During the screening visits, systolic and diastolic blood pressures and heart rates were measured from both groups in supine and standing positions when off from any medication for insomnia or RLS. One site baseline data were used with permission from Pfizer Inc and Actelion Pharmaceuticals Ltd.
Results: The systolic blood pressures was higher in patients with RLS than with insomnia (141 mmHg vs. 131 mmHg in supine position, 143 mmHg vs. 130 mmHg in standing position, $p<0.05$). The diastolic blood pressure in supine position tended to be higher in RLS (85 mmHg vs. 82 mmHg, $p=0.09$). The blood pressure levels did not correlate with RLS severity. The heart rates did not differ.
Conclusion: RLS patients may be at a higher risk for developing hypertension than patients with primary insomnia. This may also mean a higher risk for cardiovascular disease, which could be genetically influenced (Winkelmann et al. 2008). Larger patient populations, including a healthy control group, should be investigated to confirm our findings.

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GABAPENTIN ENACARBIL IMPROVES BOTH SENSORY AND MOTOR FEATURES OF RESTLESS LEGS SYNDROME SYMPTOMS ON THE SUGGESTED IMMOBILIZATION TEST

Winkelman J[1], Bogan RK[2], Schmidt MH[3], Ahmad F[4], DeRossett SE[4], Hill-Zabala CE[4]
[1]Brigham and Women's Hospital Sleep Health Center, Brighton, MA, USA, [2]SleepMed, Columbia, SC, USA, [3]Ohio Sleep Medicine Institute, Dublin, OH, USA, [4]GlaxoSmithKline, Research Triangle Park, NC, USA

Introduction: The suggested immobilization test (SIT) is used to quantify leg discomfort and periodic leg movements (PLMs) while awake in patients with Restless Legs Syndrome (RLS). The SIT provides a standardized protocol in which both time of day and activity level are controlled so that these markers of the sensory and motor symptoms of RLS can be assessed.
Methods: Subjects with moderate to severe primary RLS were randomized 1:1 to a sequence of gabapentin enacarbil (GEn) 1200 mg:placebo or placebo:GEn 1200 mg, receiving each treatment once daily at 5pm for 4 weeks in a multicenter, double-blind, placebo-controlled, crossover study (RXP110908). A one-hour SIT was performed at 8pm at baseline and the end of each treatment period (Weeks 4 and 10). During the SIT, subjects were asked to rate their leg discomfort on a 100mm visual analog scale (VAS) every 5 minutes. Periodic limb movements (PLMs) during wake were scored from surface electromyography (EMG) according to standard criteria.
Results: The Intent-to-treat population comprised 117 subjects who received GEn and 119 subjects who took placebo. The adjusted mean treatment difference (AMTD) in change from baseline for the number of PLMs at Week 4/10 using last observation carried forward (LOCF) data was -26.80 [95% CI: -39.93, -13.66; $p<0.0001$, unadjusted for multiplicity]. This AMTD was consistent for both the first and second 30 minute intervals, -12.17 [95% CI: -18.56, -5.77] and -14.65 [95% CI: -22.42, -6.87], respectively. Improvements in the Mean Leg Discomfort VAS Score in favor of GEn at Week 4/10 LOCF were demonstrated at each 5 minute timepoint with an AMTD between GEn and Placebo that ranged from -4.96 mm at the start of the SIT to -19.68 mm at 60 minutes.
Conclusion: Treatment with GEn reduced both the number of PLMs and the discomfort score during the entire 1 hour SIT compared to placebo.
Support (If Any): XenoPort, Inc., Santa Clara, CA and GlaxoSmithKline, Research Triangle Park, NC.

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GLOBUS PALLIDUS DEEP BRAIN STIMULATION FOR REFRACTORY IDIOPATHIC RESTLESS LEGS SYNDROME

Ondo W[1], Jankovic J[2], Jimenez-Shahed J[2]
[1]Neurology, University of Texas Health Science Center at Houston, Houston, TX, USA, [2]Neurology, Bsylor College of Medicine, Houston, TX, USA

Introduction: Restless legs syndrome (RLS) is a sensory motor disorder with an unclear pathogenesis. It usually responds to dopaminergics and other medications but in rare cases can be extremely refractory. Deep brain stimulation (DBS) of the Globus Pallidus internus (GPi) is used to treat dystonia, Parkinson's disease, and is reported to help several other hyperkinetic movement disorders. There are reports of RLS improving when GPi DBS was used to treat another concomitant condition, but it has never been attempted in idiopathic refractory RLS.
Methods: We report the case of a 54 year old Caucasian female with a 40 year history of RLS that was treated with GPi DBS for severe RLS. Symptoms became marked around age 45. She had intermittent and transient benefit from different therapies over time but now was refractory to five dopaminergics, three opioids, several benzodiazepines, gabapentin, pregabalin, and intravenous iron treatments. She now had almost entire body akathisia throughout the entire day but for many years it was isolated to the legs in the evening and meet criteria for RLS. She also had anxiety and depression. The patient underwent a bilateral GPi DBS.
Results: Single cell recordings in the GPi demonstrated a unique, fairly rhythmic 1 Hz firing pattern that was dissimilar to that seen in Parkinson's disease or dystonia. She experienced good but not complete control of her RLS symptoms over the following 18 months. Concurrent medication use waxed and waned but was reduced compared to baseline. There were no complications.
Conclusion: Recording of the GPi demonstrated a unique pattern and stimulation resulted in a better response than any other therapeutic option in this patient. It too preliminary to recommend this aggressive approach for refractory RLS but the clinical effect does suggest that this anatomy is involved with RLS pathogenesis.

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HIGH-DENSITY EEG ANALYSIS OF PERIODIC LIMB MOVEMENTS IN SLEEP

Rodriguez A[1,3], Riedner B[2,3], Smith R[2,3], Benca R[1,2]
[1]Neuroscience Training Program, University of Wisconsin-Madison, Madison, WI, USA, [2]Department of Psychiatry, University of Wisconsin-Madison, Madison, WI, USA, [3]Wisconsin Center for Sleep Medicine and Research, University of Wisconsin-Madison, Madison, WI, USA

Introduction: Periodic Limb Movements in sleep (PLMS) are present in a variety of sleep disorders and are often associated with sleep fragmentation and complaints of non-restorative sleep. Although alterations in sleep architecture have been reported, relatively few studies have used quantitative EEG to examine changes in sleep as a result of PLMS. Us-

ing high resolution EEG, we assessed the impact of PLMS on regional sleep EEG rhythms in an otherwise healthy subject population.
Methods: We evaluated sleep using standard high-density EEG (256 channels) with polysomnography in 16 subjects: 8 subjects with asymptomatic PLMS (PLMI > 30, mean 49.8) and 8 normal controls (PLMI < 1) matched for age (mean age 55 yrs) and sex (3 females). Spectral analysis [fast Fourier transform, Hanning window, 30 s epochs (averages of five 6-s epochs)] was performed for all 256 channels. Artifacts were rejected based on visual inspection and if the power exceeded a threshold based on a mean power value in the 0.67-4.5 Hz and 20-30 Hz bands. Absolute and normalized topographic power maps were calculated for standard frequency bands and were compared using statistical nonparametric mapping.
Results: No significant differences existed between groups in sleep stage duration. Topographic EEG power analysis revealed a significant decrease in absolute theta power in NREM sleep (N2 and N3) in PLMS subjects compared to controls, localized to a cluster of occipito-parietal electrodes.
Conclusion: Although the significance of decreased theta power is unclear, it may suggest that PLMS interfere with the ability to generate low frequency activity during NREM sleep. Surprisingly, there was no associated PLMS increase in higher frequency EEG activity, suggesting that this effect was not strictly related to the presence of undetected arousals.

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LEG MOVEMENT DETECTION SOFTWARE AND PERIODIC LEG MOVEMENT INDEX CALCULATOR

Moore HE[1,2], Warby S[2], Woodward SH[3], Peppard PE[4], Young T[4], Mignot E[2]
[1]Electrical Engineering, Stanford University, Stanford, CA, USA, [2]Center for Sleep Sciences and Medicine, Stanford University, Palo Alto, CA, USA, [3]National Center for PTSD, Veteran Affairs Hospital, Menlo Park, CA, USA, [4]School of Medicine and Public Health, University of Wisconsin-Madison, Madison, WI, USA

Introduction: Periodic leg movements (PLM) occur every 30 sec and disturb sleep. They are a hallmark of Restless Leg syndrome (RLS), a disorder that causes a strong urge to move your legs and which affects severely ~1% of the population. The periodic leg movement index (PLMI), calculated as a ratio of PLM activity per hour of sleep, provides an objective periodicity measurement of PLM and is useful to assist diagnosis of RLS. Our goal is to develop a user-friendly tool for the automatic detection of LM and PLM during sleep and compute the PLMI for RLS insight and clinical application.
Methods: Nocturnal polysomnographs (n=1840) from the Wisconsin Sleep Cohort was analyzed for LM using an automated detection algorithm developed to meet WASM 2007 criteria. Detected LMs were rejected from PLM classification inclusion using manually scored respiratory event and staging data. PLMI was calculated using resultant LM and PLM detections. PLMI values that surpass a set threshold will be flagged for further investigation and possible patient follow-up. The exact threshold will be determined using receiver operating characteristics to find the optimal sensitivity and specificity for clinical application.
Results: Preliminary findings on LM detection indicate % specificity and % sensitivity versus scored LMs, the low sensitivity refecting the fact LMs were ofen not scored bu technicians when associated with respiratory events. Common problems in assessment by scorers include LM duration uncertainty, low sensitivity, and disagreement with WASM 2007 criteria. Objective measurements of PLM using our automated detector may improve the reliability of PLMI calculation on a routine basis.
Conclusion: PLMI utility in clinical and laboratory practice is dependent on accurate and reliable LM and PLM detections. A highly reliable PLM detector could have applications in the detection of potentially missed RLS cases during routine polysomnography.

Support (If Any): HEM is supported through the Veteran Affair's Post 9/11 GI Bill scholarship.

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PRESCRIBING HABITS AMONG MEDICAL SPECIALTIES OF INITIAL ROPINIROLE DOSES FOR PATIENTS WITH RESTLESS LEG SYNDROME(RLS)

Irwin A, Moul DE
Cleveland Clinic, Cleveland, OH, USA

Introduction: Anecdotal evidence suggests physicians may prescribe higher initial doses of Ropinirole than recommended for RLS (0.25 mg 1-3 hrs before symptom onset). We studied initial Ropinirole dosing across several clinical specialties.
Methods: E-research data from 10/2006 to 10/2011 from the Epic EMR database was analyzed. Exclusions included previous Ropinirole use and Parkinson's disease. Initial dose was identified. Mean and mode doses were calculated for each specialty. Where doses >0.5 mg occurred, charts were reviewed manually and initial time of administration was noted.
Results: Following chart review, 988 of 1,238 plausible patients were verified. They were treated by 21 specialties. Modal starting dose across all specialties was 0.25 mg, with a mean of 0.40 mg. Mean doses for each specialty (n=9) were: Internal Medicine(IM) 0.41(n=440); Family Practice(FP) 0.45(n=194); neurology 0.36(n=195); gerontology 0.46(n=32); rheumatology 0.25(n=21); pulmonology 0.25(n=13); psychiatry 0.31(n=9). All specialties prescribed a mode of 0.25 mg. Initial doses higher than 0.5 mg by specialty were: IM 6.8% (n=30); FP 9.7%(n=19); neurology 2.6%(n=5); gerontology 6.3%(n=2). Rheumatology, pulmonology and psychiatry never used starting doses >0.5 mg. Within 120 manually reviewed charts, dosing instructions for Ropinirole "at bedtime" by specialty (n>9) were: IM 78.6%(n=57); FP 66.7%(n=39); Neurology 41.7%(n=11).
Conclusion: Most physicians prescribed initial Ropinirole doses for RLS appropriately. However, IM and FP showed a trend towards higher initial dosing. A propensity towards dosing Ropinirole at bedtime rather than 1 to 3 hours before symptom onset was noted among all specialties. Together these results suggest primary care physicians may need further education about initial dosing for RLS and the potential for medication-induced symptom augmentation when treating RLS.

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PREVALENCE OF EKBOM DISEASE (RESTLESS LEGS SYNDROME) IN AN OUTPATIENT PSYCHIATRIC CLINICAL POPULATION

Herrman KJ[1,3], Zhanhai L[2], Obermeyer W[3]
[1]Psychiatric Services SC, Madison, WI, USA, [2]Department of Biostatistics and Medical Informatics, University of Wisconsin - Madison, Madison, WI, USA, [3]University of Wisconsin - Madison, Madison, WI, USA

Introduction: Many sleep disorders are associated with psychiatric disorders; Ekbom Disease (RLS) is no exception. Anxiety is diagnosed more frequently in patients with RLS than in the general population, as is ADHD in both children and adults. Major depressive disorder and panic disorder have particularly strong associations with RLS. Despite this, there is little information about the prevalence of RLS in psychiatric patients.
Methods: Patients visiting an outpatient psychiatry clinic answered a questionnaire covering the four IRLS diagnostic criteria: an urge to move the legs with a) unpleasant sensations in the legs; b) beginning or worsening with inactivity; c) relieved by movement; d) worse in the evening or night. Patients endorsing at least three of the criteria completed an IRLS severity scale.
Results: 420 patients participated: 122 < 18 y.o., 148 were 18 to 40 y.o. and 150 > 40 y.o.; 234 females, 186 males. Twenty-three percent of

patients endorsed all four criteria with no significant difference by age. Among those over 40, prevalence was 27% (CI 20-35%), for those 18-39 y.o., 23% (17-31%) and for those under 18, 17% (10-24%). Symptom severity was significantly different by age group ($p < 0.025$); the oldest group of patients reported greater severity than those 18-39, though neither of those groups differed significantly from the under 18 group. Among patients who endorsed all four criteria there was not a significant difference in severity by age.
Conclusion: RLS is likely in psychiatric outpatients. It is far more prevalent in this population than has been reported in the general population -- approximately twice as likely in adults (23% vs. 11%) and nearly nine times as likely in those under 18 (17% vs. 2%). RLS symptoms may have a greater impact upon adults' quality of life for patients over 40 y.o. in this population.
Support (If Any): Supported by an unrestricted grant from GSK.

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PREVALENCE OF RESTLESS LEGS SYNDROME AMONG PATIENTS WITH OBSTRUCTIVE SLEEP APNEA BEFORE AND AFTER CPAP TREATMENT, COMPARED TO THE GENERAL POPULATION - THE ICELANDIC SLEEP APNEA COHORT (ISAC) STUDY

Benedikstdottir B[1,2], Arnardottir ES[1,2], Janson C[4], Pack A[3], Juliusson S[2], Gislason T[1,2]
[1]Medical Faculity, University of Iceland, Reykjavik, Iceland, [2]Department of Respiratory Medicine and Sleep, Landspitali University Hospital, Reykjavik, Iceland, [3]Center for Sleep and Respiratory Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [4]Department of Medical Sciences: Respiratory Medicine and Allergology, Uppsala University, Uppsala, Sweden

Introduction: To compare the prevalence of reported restless legs syndrome (RLS) between subjects with obstructive sleep apnea (OSA) and a randomly chosen sample from the general population as well as possible changes with CPAP treatment.
Methods: The OSA subjects (n=822) were a part of the Icelandic Sleep Apnea Cohort. They were newly diagnosed with moderate or severe OSA (665 males,157 females). The control subjects (n=742) were randomly chosen Icelanders (394 males, 348 females) who participated in another epidemiological study (www.boldcopd.org). Measurements included a standardized RLS rating scale, questions about sleep and the Epworth Sleepiness scale. The change with CPAP treatment was assessed after 2 years (n=538).
Results: Among OSA males 23.3% reported RLS but 12.9% of control males ($p<0.001$). 35.8% of OSA females reported RLS but 24.4% of control females ($p=0.03$). Both among OSA patients and controls those with RLS more commonly reported insomnia, daytime sleepiness, nocturnal sweating, snoring and gastro esophageal reflux ($p<0.05$). They were more likely to be females and to have a smoking history. No relationship was found between RLS and age, BMI, hypertension or respiratory disease in a logistic regression adjusting for the presence of OSA and the other factors mentioned. No relationship was found between RLS and sleep apnea severity. Subjects using CPAP had a decreased prevalence of RLS from 25.7% to 13.8% while no change was observed in those subjects not using CPAP ($p=0.04$ for difference between groups). Subjects that had persistent RLS were older on average and had a lower physical quality of life at baseline.
Conclusion: RLS is more prevalent among OSA patients than controls. No relationship was found with sleep apnea severity or BMI. CPAP treatment of OSA decreases RLS symptoms significantly. RLS symptoms are significantly related with insomnia and daytime sleepiness in both OSA subjects and controls.

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PROSPECTIVE STUDY OF RESTLESS LEGS SYNDROME (RLS) AND ACTIVITIES OF DAILY LIVING (ADLS)

Zhang C[1,2], Li Y[2], Malhotra A[1], Gao X[2]
[1]Sleep Medicine, Brigham & Women's Hospital, Boston, MA, USA, [2]The Channing Laboratory, Brigham & Women's Hospital, Boston, MA, USA

Introduction: We present here the first population-based prospective study on RLS and future status of Activities of Daily Living (ADLs), a marker for an individual's ability to live independently and a marker for disabilities.
Methods: The Health Professionals Follow-up Study (HPFS) with 51,529 US health professionals began in 1986. In 1996 and 2008, physical function (PF) was measured by PF-10 of the SF-36 questionnaire. In 2002, 31,729 health professionals remaining in the study completed the RLS questions. Subjects with diabetes and arthritis were excluded to minimize potential misclassification of RLS, resulting in 12,190 participants in the primary analysis. Multivariate regression models were constructed using PF as an outcome variable and RLS severity as variable of interest, adjusting for potential confounders such as: age, smoking, body mass index, physical activity and co-morbid conditions (e.g., hypertension, Parkinson's disease, and other common sleep disorders).
Results: The subjects with RLS had significantly lower ADL scores (adjusted mean difference in ADL comparing + RLS and - RLS was -2.2; $p = 0.01$) across a 6-year follow-up. Similarly, those with insomnia and daytime sleepiness also had significant lower ADL scores ($P <0.05$). Furthermore, the magnitude of ADL reduction associated with RLS was comparable to those from other high-profile diseases such as myocardial infarction and hypertension, based on a multivariate model.
Conclusion: RLS is a significant predictor for disability, with a similar magnitude to those of MI and hypertension. Hence, the disease burden of RLS on quality of life and health care related cost is high and is similar to other well-characterized diseases.
Support (If Any): 5R01NS062879-02 (PI: Xiang Gao).

0789

RESTLESS LEGS SYNDROME AND MORTALITY IN DIALYSIS PATIENTS

Cirignotta F[1,2], Mondini S[2], Pizza F[1], Baiardi S[2], Baldi Antognini A[3], Santoro A[4]
[1]Dpt of Neurological Sciences, University of Bologna, Bologna, Italy, [2]Neurology Unit, S.Orsola-Malpighi Hospital, Bologna, Italy, [3]Dpt of Statistical Sciences, University of Bologna, Bologna, Italy, [4]Nephrology Unit, S.Orsola-Malpighi Hospital, Bologna, Italy

Introduction: Among the causes of symptomatic Restless Legs Syndrome (RLS) uraemia and chronic dialysis are most commonly reported. Some studies found an increased mortality in dialysis patients with associated RLS, particularly for severe forms.
Methods: In 1996 we evaluated all patients receiving chronic haemodialysis (HD) at the outpatients dialysis unit of Nephrology Unit, S.Orsola-Malpighi Hospital. Diagnosis of RLS was made on the basis of the international criteria. RLS severity was graded as mild (symptoms < once a week, without sleep disruption); moderate (symptoms > once a week, without sleep disruption); severe (symptoms > once a week, with sleep disruption). Fifteen years later we evaluated the mortality of this population. The Kaplan Maier curves in dialysis patients with or without RLS (control group matched for age) were constructed for all-cause mortality and compared by log-rank test and Wilcoxon test.
Results: We evaluated 127 patients, 77 men (60.6%) and 50 women (39.4 %), mean age 61.4 yrs (s.d. 11.8). RLS was found in 47 patients (37%): 36 (28.3%) had RLS in the last year, 11 (8.6%) had RLS in the past but not in the last year. RLS was mild in 30 patients (63.8%), moderate in 12 (25.5%), and severe in 5 (10.6%). Patients with RLS were significantly younger than patients without RLS (56.2 vs 64.3 yrs), while

there were no differences in sex, duration of HD and metabolic variables. The survival analysis matched for age disclosed a lower mortality in the group with RLS than in controls (p=0.04). The mortality rate was not influenced by RLS severity (p=0.16 log-rank, p=0.24 Wilcoxon).
Conclusion: Despite methodological limitations (lack of follow-up in the last 15 years) our study does not confirm the association between RLS and shorten survival in dialysis patients previously reported in the literature.

0790

A RANDOMIZED, DOUBLE-BLIND, 3-ARM PARALLEL GROUP, PLACEBO-CONTROLLED TRIAL OF ROTIGOTINE IN PATIENTS WITH RESTLESS LEGS SYNDROME IN JAPAN

Inoue Y[1], Oka Y[2], Hirata K[3], Ishigooka J[4], Shimizu T[5], Uchimura N[6], Hattori N[7]
[1]Department of Somnology, Tokyo Medical University, Shinjuku-ku, Japan, [2]Department of Sleep Medicine, Ehime University Graduate School of Medicine, Tohon-city, Japan, [3]Department of Neurology, Dokkyo Medical University, Shimotsuga-gun, Japan, [4]Department of Psychiatry, Tokyo Women's Medical University, Shinjuku-ku, Japan, [5]Department of Neuropsychiatry, Akita University, Akita-city, Japan, [6]Department of Neuropsychiatry, Kurume University, Kurume-city, Japan, [7]Department of Neurology, Juntendo University School of Medicine, Bunkyo-ku, Japan

Introduction: The primary objective of this trial was to investigate that rotigotine 2 mg/24h and 3 mg/24h were efficacious in restless legs syndrome (RLS). The secondary objective was to assess tolerability and safety of rotigotine 2 and 3 mg/24h.
Methods: This trial was a randomized, double-blind, 3-arm parallel group, placebo-controlled trial of rotigotine in Japanese RLS patients. Rotigotine (or the placebo) was applied once a daily for 13 weeks. Patients received rotigotine 2 mg/24h and 3 mg/24h or placebo in the maximal 5-week dose-titration and 8-week dose-maintenance periods. The primary endpoint was the absolute change in IRLS from the baseline to the end of treatment (EOT).
Results: A total of 280 patients were randomly assigned to rotigotine 2 mg/24h (n=94), 3 mg/24h (n=94) or placebo (n=94) groups. Baseline IRLS scores were 23.3±5.3, 22.7±5.1 and 23.1±4.9 (mean±SD) in rotigotine 2 mg/24h, 3 mg/24h and placebo groups respectively. Mean absolute changes in IRLS from the baseline to EOT were -14.3±8.9, -14.7±9.0, and -11.7±8.7. The difference from placebo was -2.8 (95%CI: -5.2 to -0.2) and -3.1 (95%: -3.0 to -0.5) in 2 mg/24h group and 3 mg/24h group, respectively. Statistical significance ($p<0.05$), and superiority of both rotigotine groups to placebo were shown. In sub-group analysis, rotigotine 3 mg/24h was more efficacious than rotigotine 2 mg/24h in severe RLS patients with over 25 points of IRLS total score. Application site reaction was most common adverse event observed in rotigotine. Incidence of other dopaminergic adverse events such as nausea and vomiting was also common in rotigotine. There was no significant safety issue in rotigotine group.
Conclusion: Rotigotine were efficacious and well tolerated in Japanese RLS patients. In addition, rotigotine may be valuable for severe RLS patients.
Support (If Any): Otsuka Pharmaceutical Co., LTD.

0791

ALL THINGS THAT BUMP BEFORE SLEEP ARE NOT RESTLESS LEGS SYNDROME

Rowe VD, Hunter JA, Mecum TW, VanOwen KR, O'Shea AT
Research, MidAmerica Neuroscience Institute, Lenexa, KS, USA

Introduction: The diagnosis of Restless Legs Syndrome (RLS) is based on an affirmative response to all four questions of the International RLS Questionnaire (IRLSQ). However, several disorders lead to restless legs-like movements. We and others have reported previously on lumbar radiculopathy and its association with RLS-like movements. The IRLSQ is routinely administered to all patients presenting to our sleep disorders center. We and others have noted on polysomnography (PSG) that movements frequently occur with arousals during epochs formally scored as wake. These arousals delay sleep initiation. We wondered whether these movements would lead patients to answer affirmative to all four questions of the IRLSQ, and thus lead to an erroneous diagnosis of RLS.
Methods: We administered the IRLSQ to all patients undergoing PSG from November 1, 2010 to November 1, 2011. Patients answering affirmative to all four questions were given a diagnosis of Restless Leg Syndrome (RLS, 333.94). Others with sleep-related waking movements were given a diagnosis of Sleep Related Movement Disorder (SRMD, 327.59).
Results: The IRLSQ responses from 659 patients and their respective diagnostic PSG's were evaluated. 296 of these patients (44.9%) had SRMD only; 69 (10.5%) had RLS only; 68 (10.3%) had both SRMD and RLS; and 226 (34.3%) had neither. 70 (13.4%) had been prescribed RLS pharmacotherapies prior to evaluation at our sleep center, even though they did not meet formal RLS criteria. Additionally, 25 (18.2%) had Lumbar Radiculopathy (LR), and 120 (87.6%) had SDB only.
Conclusion: 1. Patients can confuse RLS-like movements caused by other sleep disorders with the questions asked on the IRLSQ. 2. This confusion can lead to inappropriate pharmacotherapy in patients who have other sleep disorders. 3. In this series, RLS-like movements continue to be associated with lumbar radiculopathy.

0792

RESTLESS LEGS SYNDROME IN CYSTIC FIBROSIS

Cordero C[1], Avecillas J[3], Marciel K[2], Zuckerman D[1]
[1]Sleep Medicine, University of Miami, Miami, FL, USA, [2]Psychology, University of Miami, Miami, FL, USA, [3]Pulmonary, University of Miami, Miami, FL, USA

Introduction: Most cases of restless legs syndrome (RLS) are idiopathic; however, secondary forms of the syndrome are closely associated with other medical disorders. This condition is more prevalent in certain disease states, such as iron deficiency anemia, diabetes mellitus, neuropathy and renal insufficiency. No such prevalence data exists for RLS in cystic fibrosis (CF). Because of the increased incidence of diabetes mellitus and anemia in CF, we hypothesized that these patients are at an increased risk of developing RLS.
Methods: We performed a cross-sectional, observational study to establish the prevalence and characteristics of RLS, in the CF population in our clinic. Patients filled out 2 questionnaires during a clinic visit: a diagnostic tool for RLS (the Cambridge-Hopkins questionnaire for ascertainment of RLS) and a 10-question rating scale used to assess severity (the International Restless Legs Syndrome Study Group Rating Scale for RLS). We obtained data from the medical record pertaining lung function characteristics, demographics and established risk factors for RLS.
Results: We recruited 10 patients. 1 out of the10 patients had definite RLS, as per the diagnostic tool used in our study. Her RLS was mild. This patient was female and 32 years old. Laboratory findings revealed a hemoglobin 10.3 g/dL, mean corpuscular volume of 78.5 fL, iron level of 9 μg/dL, transferrin saturation of 3%, and an FEV1 of 1.14 L (32% predicted). Kidney and liver function was normal and screening for cystic fibrosis related diabetes was unremarkable.
Conclusion: We have found an RLS prevalence of 10% in our CF population, this patient had a known risk factor for RLS (anemia). Further research is required to determine the prevalence and characteristics of RLS in the CF population overall.

0793

SYMPTOM RELATED ALTERATION OF THE RESTING-STATE BRAIN CONNECTIVITY IN RESTLESS LEGS SYNDROME

Cho Y[1], Lee Y[1], Moon H[1], Ku J[2], Chang H[3], Earley CJ[4], Allen RP[4]
[1]Neurology, Dongsan Medical Center, Keimyung University, Daegu, Republic of Korea, [2]Biomedical Engineering, Dongsan Medical Center, Keimyung University, Daegu, Republic of Korea, [3]Radiology, Dongsan Medical Center, Keimyung University, Daegu, Republic of Korea, [4]Neurology, Johns Hopkins University, Hopkins Bayview Medical Center, Baltimore, MD, USA

Introduction: There are few resting-state connectivity studies in RLS. In our previous study, we found some connectivity changes between the thalamus and the other brain areas in RLS patients during no symptoms periods. The aim of our study is to examine symptom related alteration in resting-state connectivity in RLS patients.
Methods: Resting-state fMRIs were obtained from 12 idiopathic, drug-naïve RLS patients (mean age ±sd 51.83±13.50, 8 (66.7%) female) and 12 controls (mean age ±sd 49.75±12.40, 6 (50.0%) female) in the morning when RLS symptoms were absent and, again at night, when RLS symptoms were present. The resting state connectivity was measured by a seed based method using AFNI software. The bilateral thalami (ventral posterolateral nucleus) were selected as seeds, as they have been previously shown to be differentially activated during RLS symptoms. The connectivity characteristics between the thalamus and other brain regions of RLS patients were compared to those of the controls using the 2x2 ANOVA; symptom presence (day and night) X group (RLS patients and controls) to examine patient's symptom specific characteristics without circadian effect.
Results: There were two brain regions, which showed significant interaction effects and symptom-specific reactivity. In RLS patients, the connectivity between the thalamus and the bilateral superior temporal gyrus (STG) was reduced during the symptomatic period, but was enhanced during the asymptomatic period, while the connectivity in controls was reversed relative to the RLS group over this time period. The connectivity strength between the thalamus and the right STG during the symptomatic period was negatively correlated with the subjects rating of overall severity of RLS symptoms (r=-0.608, p=0.036).
Conclusion: The STG is involved in the perception of pain-related stimuli and its processing. The thalamus-STG connectivity may be the anatomical basis for either the RLS symptom substrate or for triggering the RLS symptoms. For example, the augmented thalamus-STG connection during the asymptomatic period may represent the mechanism by which symptoms during daytime (the "protected" period) are suppressed, while reduced connectivity permits the development of RLS symptoms. The results, nonetheless, indicate a key role of the STG in developing clinical symptoms in RLS.

0794

PERIODIC LIMB MOVEMENTS IN PATIENTS WITH PULMONARY HYPERTENSION

Arunthari V, Patel NM, Burger CD
Sleep Medicine, Mayo Clinic Jacksonville, Jacksonville, FL, USA

Introduction: Periodic limb movements of sleep (PLMS) and restless legs syndrome have been associated with blood pressure elevations. Autonomic arousals accompany limb movements and may manifest as a rise in blood pressure and heart rate which may contribute to an increased risk of cardiovascular disease. The prevalence of restless legs syndrome in patients with PH was estimated to be 43.6% in one study. However, the presence and association of PLMS with patients with pulmonary hypertension (PH) has not been reported.
Methods: This is a retrospective study of patients seen in our PH clinic who also underwent polysomnography. Data collection focused on periodic limb movements and other pertinent data collected during the polysomnogram such as apnea-hypopnea index (AHI) and arousal index. Other data included baseline demographics, diagnosis, laboratory and hemodynamic values.
Results: Ninety-four patients were reviewed. Seventeen (18%) that had a high probability of having sleep apnea based on reported symptoms and abnormal overnight oximetry underwent a polysomnogram. Of these, 14 (15%) had significant sleep apnea. The mean AHI was 24.1 ± 24.7 and the arousal index was 31.7 ± 23.4. Limb movement index was 28.9 ± 56 and the arousals that were related to limb movements index was only 2.3 ± 4.6. There was no correlation between AHI, arousal index, and limb movement index with right ventricular systolic pressure p=0.91, 0.92, and p=0.19 respectively.
Conclusion: More than half of patients (59%) with PH had limb movements while asleep. However, there was no correlation between the amounts of limb movements with the severity of PH based on right ventricular systolic pressure.

0795

SEVERITY OF OBSTRUCTIVE SLEEP APNEA DOES NOT CORRELATE WITH PERIODIC LIMB MOVEMENTS OF SLEEP

Dholakia S, Lim S, Thakkar MM, Goyal MK, Sivaraman M, Sahota P
Neurology, University of Missouri-Columbia, Columbia, MO, USA

Introduction: We report the correlation of severity of obstructive sleep apnea (OSA), as measured by apnea-hypopnea index (AHI), on periodic limb movements of sleep (PLMS).
Methods: We conducted a retrospective analysis of baseline polysomnograms performed at our accredited sleep center, on patients with OSA. Patients who met the following criteria were included: 1. Apnea-hypopnea index (AHI) of more than five, and 2. Periodic limb movement index (PLMI) of more than five. Patient demographics, AHI and PLMI were obtained from the baseline polysomnograms.
Results: In our initial sampling, 63 patients met the inclusion criteria. Patients were divided into three groups based on AHI: mild OSA (AHI 5-14.9), moderate OSA (AHI 15-29.9) and severe OSA (AHI>=30). 36 patients had mild OSA, 18 had moderate OSA and 9 had severe OSA. The mean AHI for the 3 groups were 9.71 for mild, 19.93 for moderate, and 36.11 for severe OSA. The mean PLMI for the 3 groups were 7.84 for mild, 16.58 for moderate, and 17.32 for severe OSA. Our preliminary results show that there was no significant correlation between baseline AHI and PLMI.
Conclusion: The severity of OSA does not correlate with PLMI.

0796

EFFECT OF CPAP THERAPY ON PERIODIC LIMB MOVEMENTS OF SLEEP (PLMS) IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

Lim S, Dholakia S, Thakkar MM, Bollu P, Sivaraman M, Goyal MK, Sahota P
Neurology, University of Missouri Columbia, Columbia, MO, USA

Introduction: We report the effect of CPAP therapy on periodic limb movements of sleep (PLMS) in patients with mild, moderate and severe obstructive sleep apnea (OSA).
Methods: We conducted a retrospective analysis of baseline and second night polysomnograms for CPAP therapy (performed at our accredited sleep center), on patients with OSA. Patients who met the following criteria were included: 1. Respiratory disturbance index (RDI) of more than 5/hour and 2. Periodic limb movements of sleep index (PLMI) of more than 5/hour, either before and/or after CPAP therapy. Patient demographics, RDI and PLMI were obtained from the baseline and second night polysomnograms.
Results: 63 patients met the inclusion criteria. Patients were divided into three groups based on RDI: mild OSA (RDI 5-19.9), moderate OSA (RDI 20-39.9) and severe OSA (RDI >=40). In mild OSA, mean PLMI

was reduced from 24.7 to 20.8 after CPAP treatment. In moderate OSA, mean PLMI was increased from 12.35 to 20.59. The severe OSA group showed similar results of increment in mean PLMI from 11.28 to 14.5. Further analysis is pending.

Conclusion: Our results suggest that CPAP treatment resulted in reduction of PLMI only in patients with mild OSA, most likely due to reduction in respiratory effort related arousals. However, CPAP treatment increased PLMI in subjects with moderate and severe OSA. This is likely due to better sleep consolidation and unmasking of periodic limb movement disorder.

0797

RESTLESS LEG SYNDROME AND SLEEP PROBLEMS AMONG ADOLESCENTS AND YOUNG ADULTS IN THE TUCSON CHILDREN'S ASSESSMENT OF SLEEP APNEA STUDY (TUCASA)

Silva GE[1], Goodwin JL[2], Vasquez MM[2], Quan SF[3]
[1]College of Nursing and Health Innovation, , Phoenix, AZ, USA, [2]Arizona Respiratory Center, University of Arizona, Tucson, AZ, USA, [3]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Clinical reports in children implicate Restless Leg Syndrome (RLS) with sleep and behavior problems. However, population based studies on this association in adolescents and young adults are limited.

Methods: TuCASA is a prospective cohort sleep study of Caucasian and Hispanic children with baseline assessment in 1999 (T1), a second assessment in 2004 (T2) (ages 10-17 years), and a follow-up survey in 2008 (T3) (ages 12-20 years). The present analyses include RLS prevalence at T2 and cross-sectional analyses of 214 participants at T3. Presence of RLS was based on four essential criteria identified by Allen et al (2003) and if the symptoms occurred ≥ 5-15 days/ month. Sleep talking (ST) and sleep walking (SW) were present if subjects reported them ≥ 3-5 times/month. Excessive daytime sleepiness (EDS), learning problems (LP), and snore were present if subjects reported them frequently or almost always. Trouble falling asleep and difficulty initiating and maintaining sleep (DIMS) were present if reported "yes, still have the problem", and witnessed apnea (WA) if observed by a family member.

Results: Almost 50% were male, and 68% were Caucasian. The prevalence of RLS was 4.3% (n=15) at T2 and 8.4% at T3 (n=18). All RLS cases at T3 were incident cases. Of the RLS cases at T2, five met ≤4 of 5 criteria for RLS at T3, and thus were not included in the RLS count. The other RLS cases at T2 were lost to follow-up at T3. RLS at T3 was associated with trouble falling asleep (OR=3.8, p=.01), DIMS (OR=3.6, p=.04), and WA (OR=4.6, p=.04).

Conclusion: The prevalence and incidence of RLS in this community based sample of adolescents and young adults ages 12-20 years are comparable to rates reported in older cohorts. Similar to older cohorts, it may be associated with several sleep problems.

Support (If Any): HL 62373.

0798

SHORT REM LATENCY AS A SCREENING TOOL FOR NARCOLEPSY

Andlauer O[1,2,3], Moore HE[1], Han F[4], Hong S[5], Plazzi G[6], Haffen E[2,3], Roth T[7], Young T[8], Mignot E[1]

[1]Center for Sleep Sciences and Medicine, Stanford University, Palo Alto, CA, USA, [2]Department of Clinical Psychiatry, University Hospital of Besancon, Besancon, France, [3]EA 481 Laboratoire de Neurosciences, University of Franche-Comte, Besancon, France, [4]Department of Pulmonary Medicine, Beijing University People's Hospital, Beijing, China, [5]Department of Neuropsychiatry, St. Vincent's Hospital, Catholic University of Korea, Suwon, Republic of Korea, [6]Sleep Disorders Center, Department of Neurological Sciences, IRCCS Istituto delle Scienze Neurologiche, University of Bologna, Bologna, Italy, [7]Henry Ford Sleep Disorders Center, Detroit, MI, USA, [8]Department of Population Health Sciences, University of Wisconsin, Madison, WI, USA

Introduction: Current diagnostic criteria for narcolepsy are excessive daytime sleepiness associated with either cataplexy or a positive Multiple Sleep Latency Test (MSLT) following nocturnal polysomnography (NPSG). Short REM latency during NPSG has been described as a common feature, but is not used diagnostically. Narcolepsy/cataplexy is tightly associated with HLA DQB1*06:02, and caused by hypocretin deficiency. Our aim was to determine diagnostic accuracy of NPSG short REM latency, alone and combined with MSLT and HLA status, for diagnosing narcolepsy/hypocretin deficiency.

Methods: Receiver Operating Characteristic curves analyses in 1) 516 narcolepsy/hypocretin deficiency patients and 516 age- and sex-matched controls drawn from population-based samples, 2) 118 narcolepsy/hypocretin deficiency patients and 118 age- and sex-matched normal CSF hypocretin-1 narcolepsy patients, and 3) 749 successive patients with sleep disorders undergoing sleep evaluation.

Results: Short REM latency (≤15 minutes) was very specific (99.2% [98.5-100.0, 95% CI]) but not sensitive (50.6% [46.3-54.9, 95% CI]) for narcolepsy/hypocretin deficiency in all settings. Predictive positive value was 62.5%. Short REM latency as a screening tool, followed by MSLT in case of negativity, was very specific (97.8% [96.6-99.1, 95% CI]), and sensitive (94.4% [92.3-96.4, 95%CI]). HLA positivity performed before the sleep study improved specificity to 98.8% (96.4-100.0, 95%CI), without significantly lowering sensitivity (90.1% [83.6-96.6], 95% CI).

Conclusion: We propose to use short NSPG REM latency and HLA typing as a screening test prior to the MSLT. Positivity for this test mitigates the need for a full MSLT and substantially reduces costs.

Support (If Any): NIH-NS23724 to Emmanuel Mignot. Fondation Servier to Olivier Andlauer. R01HL62252 and 1UL1RR025011 to Terry Young.

0799

RAPID WEIGHT GAIN AT DISEASE ONSET IN CHILDREN WITH NARCOLEPSY: A SPECIFIC INSIGHT IN PATHOPHYSIOLOGY?

Franco P[1,2], Arnulf I[2,3], Dauvilliers Y[2,4], Lecendreux M[2,5], Reimão R[6], Lin J[1], Inocente C[1,2,6]

[1]Pediatric Sleep Unit & Integrative Physiology of Brain Arousal System, Hôpital Femme Mère Enfant & CRNL, INSERM-U1028, CNRS UMR5292, University Lyon1, Lyon, France, [2]CNR narcolepsie-hypersomnie, National Reference Centre for Orphan Diseases, Narcolepsy, Idiopathic hypersomnia and CNR narcolepsie-hypersomnie Kleine-Levin Syndrome, Montpellier, Lyon, Paris, France, [3]AP-HP Unité des Pathologies du Sommeil & Centre de Recherche de l'Institut du Cerveau et de la Moelle épinière, Groupe Hospitalier Pitié-Salpêtrière, Université Pierre et Marie Curie Paris 6 & UMR-S975, CNRS UMR7225 & Inserm, U975, Paris, France, [4]Service de Neurologie, Hôpital Gui-de-Chauliac, Inserm U888, CHU de Montpellier, Montpellier, France, [5]Centre Pédiatrique des Pathologies du Sommeil, Hôpital Robert Debré, Paris, France, [6]Sleep Medicine Advanced Research Group, Division of Clinical Neurology, Clinical Hospital, University of São Paulo School of Medicine, São Paulo, Brazil

Introduction: Some authors have reported a rapid weight gain at the onset of the disease in narcoleptic children. The purpose of our study was to compare the clinical and electrophysiological characteristics of narcoleptic children with and without rapid weight gain.

Methods: The data of 38 children (22 boys) followed in the Reference Center of Lyon were collected. All these children received the diagnosis of idiopathic narcolepsy after a complete clinical and electrophysiological evaluation. Rapid weight gain was defined by a change in weight percentile curve (+1SD) within the year of the first symptoms of the disease. Patients were separated into children with rapid weight gain (type A) from those without any weight gain (type B) or with slow weight gain started more than one year before the clinical onset of the disease (type C). These data referred to new and non-treated children. Mann Withney rank and Fisher's tests were used for statistical analysis.

Results: Type A was more frequent (52.6%) than type B (21%) or type C (26.3%). The children with type A were younger (10.1± 3.8) than those with type B (13.1± 2.1 years) (p=.028) or type C (12.5±3.6). There was no obese in the type B. Although the % of obesity was not significantly different between type A (70%) and type C (100%), children with type A had lower sleep efficiency (p=.009), higher insomnia severity index (p= .004) and apnea-hypopnea index (p=.01), more WASO (p=.022), REM sleep (p=.024) during night and SOREM during MSLT (p=.027) than type C. The adapted Epworth score, the frequency of narcolepsy with cataplexy, of HLA-DQB1*0602 positive tended also to be higher in the type A. All the cases after H1N1 vaccine (n=3) have been found in this group.

Conclusion: Narcoleptic children with weight gain at disease onset present specific characteristics that could be related to a rapid autoimmune process.

Support (If Any): CAPES (Coordination for the Improvement of Higher Level -or Education- Personnel), Brazil.

0800

IS OBESITY A SEVERITY FACTOR IN CHILDHOOD NARCOLEPSY-ONSET?

Inocente C[1,2,6], Lavault S[2,3], Dauvilliers Y[2,4], Lecendreux M[2,5], Lin J[1], Arnulf I[2,3], Franco P[1,2]

[1]1. Pediatric Sleep Unit, Hôpital Femme Mère Enfant & Integrative Physiology of Brain Arousal System, CRNL, INSERM-U1028, CNRS UMR5292, University Lyon1, Lyon, France, [2]CNR narcolepsie-hypersomnie, National Reference Centre for Orphan Diseases, Narcolepsy, Idiopathic hypersomnia and CNR narcolepsie-hypersomnie Kleine-Levin Syndrome (CNR narcolepsie-hypersomnie), Montpellier, Lyon, Paris, France, [3]AP-HP Unité des Pathologies du Sommeil & Centre de Recherche de l'Institut du Cerveau et de la Moelle épinière, Groupe Hospitalier Pitié-Salpêtrière, Université Pierre et Marie Curie Paris 6 & UMR-S975, CNRS UMR7225 & Inserm, U975, Paris, France, [4]Service de Neurologie, Hôpital Gui-de-Chauliac, Inserm U888, service de neurologie B, CHU de Montpellier, Montpellier, France, [5]Centre Pédiatrique des Pathologies du Sommeil, Hôpital Robert Debré, Paris, France, [6]Sleep Medicine Advanced Research Group, Division of Clinical Neurology, Clinical Hospital, University of São Paulo School of Medicine (USP), São Paulo, Brazil

Introduction: Different authors have emphasized the high prevalence of obesity in childhood narcolepsy-onset. The objective of this study was to evaluate if obesity could represent a severity factor for these patients.

Methods: Data from the National French multicentric research program on narcolepsy and Reference Center of Lyon were collected from 2008 to 2011. All these children received the diagnosis of idiopathic narcolepsy after a complete evaluation including a clinical examination with anthropometric measurements (body mass index (BMI)), a nocturnal polysomnography followed by a multiple sleep latency test, and HLA-DQB1*0602 testing (n= 107), a neuroimaging (n= 70), Hcrt-1 level in CSF (n= 21). To compare clinical and electrophysiological characteristics between obese (BMI growth curve P >97) and non obese children, Mann Withney rank and Fisher's tests were used for statistical analysis.

Results: The cohort was composed of 123 children (70 boys) with a mean age of 11.6 ± 3.3 years at diagnosis (39% < 10 years). The first symptom at onset was excessive daytime sleepiness (9.5 ± 4.4 years). Other symptoms were cataplexy (79.5%), hypnagogic hallucinations (39.8%), sleep paralysis (10.7%), parasomnia (73.7%) and night eating (14.7%). 92.5% were HLA positive with low Hcrt-1 levels and normal MRI. Mean BMI was 23.5 ± 11.9, 71.2% were obese, Z-score was 3.2 ± 3.9. Eight out of 31 girls (25%) had precocious puberty (75% obese). There were no significant effects of the presence of cataplexy or medications on BMI or z-score. Even when only new and non-treated children (n= 63) were considered, obese children (n= 39) had less total sleep time (p= 0.044) and less sleep efficiency (p= 0.003), more WASO (p= 0.011), more respiratory related arousals (p= 0.001) and more naps during the day (p= 0.011) than non obese children.

Conclusion: Obesity is frequent in children with narcolepsy. This factor could influence negatively the sleep quality of these children and could represent a severity factor for these patients.

Support (If Any): PHRC AOM07-138, French health Ministry; promotor: Assistance Publique - Hôpitaux de Paris, France. CAPES (Coordination for the Improvement of Higher Level -or Education- Personnel), Brazil.

0801

INSULIN SENSITIVITY IN NARCOLEPSY AND THE EFFECT OF SODIUM OXYBATE AS MEASURED BY A HYPERINSULINEMIC-EUGLYCEMIC CLAMP

Donjacour C[1], Aziz A[1], Streefland TC[2], Overeem S[3,4], Lammers G[1], Pijl H[2]

[1]Neurology, Leiden University Medical Center, Leiden, Netherlands, [2]Endocrinology, Leiden University Medical Center, Leiden, Netherlands, [3]Neurology, Radboud University Nijmegen Medical Center, Nijmegen, Netherlands, [4]Sleep medicine, Center for Sleep Medicine ''Kempenhaeghe'', Heeze, Netherlands

Introduction: Hypocretin deficiency causes narcolepsy, a condition characterized by excessive daytime sleepiness, cataplexy, and fragmented nocturnal sleep. Co-morbid obesity is present in more than half of narcolepsy patients. While a higher prevalence of the metabolic syndrome and Type 2 Diabetes Mellitus (T2DM) has been reported in narcolepsy, recent studies could not detect differences in insulin sensitivity between patients and controls. However, none of these studies applied the gold standard, i.e. the hyperinsulinemic-euglycemic clamp, to measure insulin sensitivity. Therefore, we performed a study using this gold standard to quantify insulin sensitivity in both narcolepsy patients and individually matched controls. Additionally, we investigated the effect on insulin sensitivity of three months of treatment with sodium oxybate (SXB).

Methods: Nine hypocretin deficient patients with narcolepsy-cataplexy (seven males), and nine sex, age, body mass index, and fat mass matched controls were enrolled. A hyperinsulinemic-euglycemic clamp was performed at baseline (40mU/m2/min insulin infusion for 2 hours to attain a circulating insulin level of about 40mU/L). In seven patients (five males) a second hyperinsulinemic-euglycemic clamp was performed after three months of treatment with SXB.

Results: Glucose disposal rate per unit serum insulin was significantly higher in narcolepsy patients compared to individually matched controls (2.0 ± 0.2 vs. 1.4 ± 0.4 µmol/kg lean body mass/min/mU x L ; P = 0.024) indicating higher insulin sensitivity in patients. Narcolepsy patients lost a substantial amount of weight (mean of 5.2 kg) after 3 months of treatment with SXB. Moreover, SXB treatment lowered insulin sensitivity in narcolepsy patients to levels comparable to those of control subjects.

Conclusion: Our findings suggest that narcolepsy patients are actually more insulin sensitive than body weight and fat mass matched controls. Therefore, any potential tendency to develop T2DM probably stems from their propensity to grow obese. SXB decreased weight, and normalized insulin sensitivity.

Support (If Any): This study was supported by a grant from UCB Pharma.

0802

SLEEP ATTACKS IN HUMAN NARCOLEPSY ARE HERALDED BY CHANGES IN SKIN TEMPERATURE

Fronczek R[1], Baumann CR[2], Van der Heide A[1], Werth E[2], Donjacour C[1], Van Someren EJ[3], Lammers G[1]

[1]Neurology, Leiden University Medical Centre, Leiden, Netherlands, [2]Neurology, University Hospital of Zurich, Zurich, Switzerland, [3]Netherlands Institute for Neuroscience, Amsterdam, Netherlands

Introduction: In healthy subjects, sleep propensity increases when the distal skin temperature increases relative to the proximal skin temperature. This increase results from increased blood flow in the skin of the extremities and is controlled by the hypothalamus. Narcolepsy is characterized by hypothalamic alterations. Previously, we studied skin temperature in narcoleptic patients in relation to their characteristically increased sleep propensity during the day. Awake narcoleptic patients showed higher distal and lower proximal skin temperatures than controls.

Methods: In this multicenter 24-hour ambulatory polysomnography study, we continuously measured core body, distal and proximal skin temperature in relation to daytime sleep attacks and nighttime sleep, while subjects were outside the hospital and underwent their normal activities. Subjects, included in The Netherlands and in Switzerland, were 25 medication-free narcolepsy with cataplexy patients and 10 healthy-controls.
Results: A preliminary analysis of a subset of 13 narcolepsy patients showed the following mean temperatures: core body 37.1 ± 0.1°C, proximal skin 33.9 ± 0.2°C and distal skin 33.4 ± 0.1°C. During nighttime sleep, core body temperature decreased by 0.33 ± 0.1°C, while there was an increase in distal skin (1.79 ± 0.1°C) and proximal skin (1.62 ± 0.1°C) temperature. Patients had 3.6 ± 2.8 daytime sleep attacks. Daytime sleep attacks were predicted by an increase in both distal and proximal skin temperature and an increase in their gradient in the 15 minutes before sleep onset (odds ratio / °C increase [confidence interval]: distal skin 2.04 [1.6-1.6], proximal skin 2.00 [1.4-3.0], distal-to-proximal gradient 2.43 [1.7-3.5], all p<0.001).
Conclusion: In narcolepsy with cataplexy, daytime sleep attacks were heralded by an increase in both proximal and distal skin temperature, and by an increase in their gradient, in the 15 minutes before sleep onset. Final results will be presented, including data of all narcolepsy patients and comparisons with controls.

0803

INCIDENCE OF EXCESSIVE DAYTIME SLEEPINESS IN THE GENERAL POPULATION: THE ROLE OF SLEEP APNEA, AGE, OBESITY, DIABETES, AND DEPRESSION

Fernandez-Mendoza J[1], Vgontzas AN[1], Calhoun S[1], Kritikou I[1], Basta M[1], Liao D[2], Bixler EO[1]
[1]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA

Introduction: Excessive daytime sleepiness (EDS) is highly prevalent in the general population and is associated with significant medical morbidity and occupational hazards. However, no longitudinal study to date has examined the premorbid risk factors of incident EDS.
Methods: From a random, general population sample of 1741 adults of the Penn State Cohort, 1173 subjects without EDS were followed-up after 7.5 years. All subjects underwent polysomnography at baseline and sleep apnea was defined as an apnea/hypopnea index ≥ 15. Self-reported EDS was defined as moderate-to-severe daytime drowsiness/sleepiness and/or irresistible sleep attacks.
Results: The overall incidence of EDS was 8.2% (n=138), and it was higher in males (OR=2.0), in young (≤40 years; OR=1.7) and older (≥60 years; OR=1.7) adults, and in non-Caucasians (OR=2.6). Depression (OR=2.9), sleep apnea (OR=2.2), obesity (OR=2.1), diabetes (OR=2.0), and hypertension (OR=1.5) were significantly associated with incident EDS. Multivariate regression models showed that the most significant risk factors for incident EDS were depression (ES=4.90; p=.0001), young age (ES=3.44; p=.001), male gender (ES=3.28; p=.001), obesity (ES=2.62; p=.009), non-Caucasian race (ES=2.60; p=.009), and older age (ES=1.73; p=.082). In a backward stepwise model that included hypertension and sleep apnea, obesity (ES=2.74; p=.006) and diabetes (ES=1.73; p=.083) were the strongest cardiometabolic risk factors for incident EDS. Incident EDS cases gained significantly more weight over time as compared to those who did not develop EDS (1.3 vs. 2.5 BMI units). Neither subjective nor objective short sleep duration predicted incident EDS; in fact, the longer the objective sleep duration the higher the risk of incident EDS (OR=1.3), even after controlling for confounders.
Conclusion: This study shows for the first time that depression and obesity are the strongest risk factors for incident EDS. These results suggest that obesity and emotional stress but not sleep loss are the main causes of the current "epidemic" of sleepiness and fatigue.
Support (If Any): NIH R01 HL40916, R01 HL 51931.

0804

DETERMINANTS OF OBJECTIVE VS. SUBJECTIVE SLEEPINESS IN HEALTHY CONTROLS AND APNEIC RESEARCH VOLUNTEERS: THE ROLE OF DEPRESSION, ABDOMINAL OBESITY, AND SLEEP DURATION

Kritikou I, Vgontzas AN, Fernandez-Mendoza J, Pejovic S, Basta M, Bixler EO
Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA

Introduction: Daytime sleepiness is measured both objectively and subjectively and the findings are many times inconsistent. The factors that underlie the inconsistencies between these two measures are unknown. The aim of this study was to assess the factors that influence objective vs. subjective sleepiness in a large sample of apneic and non-apneic research volunteers.
Methods: One-hundred and three research subjects (76 men; 50.51 ± 8.64 years old; 29.8 ± 5.35 BMI) underwent polysomnography for 4 consecutive nights in the sleep lab. Apnea/hypopnea index (AHI) was assessed in the first night and mean objective total sleep time (TST) was calculated as the average of TST of nights 2 and 3. Subjective sleepiness was assessed with the Epworth Sleepiness Scale (ESS) and objective sleepiness with the Multiple Sleep Latency Test (MSLT; 6 naps on the 4th day and sleep latency defined as the time elapse between lights-off until the first epoch of any stage of sleep). Depression was assessed with the Beck Depression Inventory-II (BDI-II).
Results: In univariate analyses, AHI, waist circumference, BDI-II scores, BMI, and fasting blood glucose (FBG) levels, but not TST, were significantly correlated with ESS scores. In a backward stepwise regression model that included BMI, waist circumference, AHI, and FBG, with gender, age, and BDI-II always in the model, waist circumference (β=0.23, p=0.02) and depression (β=0.23, p=0.02) were the most significant independent predictors of ESS scores. Furthermore, an identical analytical approach showed that TST (β=-0.36, p=0.001) was the best single predictor of MSLT latencies.
Conclusion: Our findings suggest that different factors influence objective vs. subjective sleepiness. It appears that depression and obesity are the best predictors of subjective sleepiness, whereas objective sleepiness appears to be affected by an individual "trait" in sleep propensity, most likely genetically determined.

0805

PERSISTENCE OF EXCESSIVE DAYTIME SLEEPINESS IN THE GENERAL POPULATION: THE ROLE OF WEIGHT GAIN

Shea S[1], Fernandez-Mendoza J[1], Vgontzas AN[1], Calhoun S[1], Kritikou I[1], Liao D[2], Bixler EO[1]
[1]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA

Introduction: Excessive daytime sleepiness (EDS) is highly prevalent in the general population and is associated with significant medical morbidity and occupational hazards. However, no longitudinal study to date has examined the risk factors associated with the persistence and remission of EDS in the general population.
Methods: From a random, general population sample of 1741 adults of the Penn State Cohort, 1173 subjects without EDS and 222 with EDS were followed-up after 7.5 years. All subjects underwent polysomnography at baseline and sleep apnea was defined as an apnea/hypopnea index ≥ 15. Self-reported EDS was defined as moderate-to-severe daytime drowsiness/sleepiness and/or irresistible sleep attacks.
Results: Persistence and remission rates of EDS were 38% and 62%, respectively. Persistent EDS was significantly associated with sleep complaints (OR=2.7) and higher BMI (30 vs. 32) at baseline and marginally associated with female gender (OR=2.1), depression (OR=2.1),

hypertension (OR=2.1), and higher AHI (4.7 vs. 1.5) when compared to remitted EDS. Age, diabetes, subjective or objective sleep duration were not significantly associated with persistent EDS. A multivariate regression model showed that weight gain (OR=1.2 for each 1-unit increase in BMI; p=.008) was the main risk factor for persistent EDS, whereas hypertension was only marginally associated (OR=2.4; p=.063) and sleep complaints became non-significant (OR=2.2; p=.105) after controlling for depression (OR=1.8; p=.155). Persistent EDS cases gained significantly more weight as compared to those who remitted (2.5 vs. 0.4 BMI-units). In fact, 21.2% of remitted EDS cases and only 9.5% of persistent EDS cases lost weight over time (i.e., ≤-1 BMI-unit).
Conclusion: This study shows that weight gain is the strongest predictor of the persistence of EDS and that weight loss is associated with remission of EDS. These results suggest that the "epidemic" of sleepiness parallels the "epidemic" of obesity and that weight loss should be our priority in terms of early intervention.
Support (If Any): NIH R01 HL40916, R01 HL 51931.

0806

CLINICAL AND POLYSOMNOGRAPHIC CHARACTERISTICS OF PATIENTS WITH DAYTIME SLEEPINESS

Kim D, Yoon S, Joo E, Hong S
Department of Neurology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea

Introduction: To understand characteristics of patients with excessive daytime sleepiness (EDS), we assessed clinical and polysomnographic characteristics of patients with EDS who underwent nocturnal polysomnography (PSG) and multiple sleep latency test (MSLT).
Methods: Consecutive 107 patients with EDS were enrolled. First, patients were divided into 3 groups according to the number of sleep onset REM periods (SOREMPs) on MSLT (group A, 0; B, 1; and C, ≥2) and secondly, they were classified. into 5 groups according to the MSLT findings [group 1, mean sleep latency (MSL) ≤8 min and ≥2 SOREMPs; 2, MSL ≤8 min and ≤1 SOREMP; 3, ≥1 SOREMPs with MSL of >8 min; 4, no SOREMP and MSL of 8-10 min; and 5, no SOREMP and MSL of >10 min].
Results: Mean age was 40.9 ± 18.1 years and 47.7% of them were women. Their mean Epworth sleepiness scale (ESS) was 14.1 ± 3.7 and mean MSL was 6.4 ± 4.8 min. Sixty (56.1%) showed ≥1 SOREMPs. Their ESS was not correlated with MSL or numbers of SOREMPs. MSL and numbers of SOREMPs showed trend of negative correlation. Their common clinical diagnoses were as follows: narcolepsy (27.1%), obstructive sleep apnea syndrome (21.5%), restless leg syndrome (17.8%), and idiopathic hypersomnia (10.3%). When PSG parameters were compared among groups A, B, and C, REM sleep latency was the shortest and proportion of N3 sleepwas the highest in group C while proportion of N2 and REM sleep were the smallest in group A ($p < 0.05$). 88.2% of patients in group 1 and 36.6% in group 2 were diagnosed as primary hypersomnia. Primary hypersomnia was diagnosed in only 7.1% in group 3 and no one in groups 4 and 5.
Conclusion: Our findings showed that patients with various sleep disorders had EDS and substantial number of them showed MSLT findings mimicking primary hypersomnia.

0807

WHAT CHARACTERIZES THOSE WITH EXCESSIVE DAYTIME SLEEPINESS? AN EPIDEMIOLOGICAL STUDY ON GENERAL POPULATION IN ICELAND AND SWEDEN

Benedikstdottir B[1,3], Janson C[2], Lindberg E[2], Arnardottir ES[1,3], Gislason T[1,3]
[1]Medical Faculty, University of Iceland, Reykjavík, Iceland, [2]Respiratory Medicine and Allergology, Uppsala University, Uppsala, Sweden, [3]Department of Respiratory Medicine and Sleep, Landspitali University Hospital, Reykjavík, Iceland

Introduction: This study investigates the prevalence of excessive daytime sleepiness (EDS) and the association of EDS with large variety of health variables in two well characterized random samples from the general population.
Methods: Using the national registries of inhabitants, a random sample Of adults aged >40 and living in Reykjavík, Iceland (n=939) and Uppsala, Sweden (n=998), were invited to participate in a study on the prevalence of COPD (www.boldstudy.org) response rate 81, 1% and 62, 2%. In addition, the participants were asked to answer the following questionnaires: The Epworth Sleepiness Scale (ESS), Short Form-12 and standardised questions about sleep and health, gastro-eosophageal reflux, diabetes and hypertension,.
Results: In Reykjavik mean (+/- SD) ESS was 6.0 +/- 3.9, compared to 6.1+/- 3.9 in Uppsala.The prevalence of EDS, defined as ESS scores >10, were 18.5% in Uppsala and 18.4% in Reykjavík. EDS was more common among men than women and was more prevalent in age groups <60years ($p<0.0001$) but not related to body max index (BMI) or smoking status. Those reporting habitual snoring and apneas scored higher on ESS ($p<0.0001$) and so did also those with respiratory symptoms; wheeze and breathlessness ($p<0.05$), cough at least three months per year ($p<0.0001$), asthma ($P<0.01$) and nasal allergy ($p<0.02$), There were no difference in EDS by depending on insomnia, diabetes or hypertension. Mental health scores on SF-12 were significantly lower among those with EDS ($p<0.05$), but there was no difference regarding physical health scores.
Conclusion: Excessive daytime sleepiness is a common complaint in the general population both in Iceland and Sweden and is related to decrease in mental quality of live. It's more common among men than women, in those who snore and have apneas and is related to respiratory symptoms and allergy, but not to BMI, diabetes or hypertension.

0808

SLEEP REGULATION, DAYTIME SLEEPINESS COMPONENTS AND HEALTH RELATED QUALITY OF LIFE, IN COLOMBIAN UNIVERSITY STUDENT SAMPLE

Marín Agudelo HH, Jimenez U
Psicologia, Universidad Cooperativa de Colombia, Medellín, Colombia

Introduction: Excessive daytime sleepiness in different studies has been described as a problem with a high prevalence in older adolescents and young adults (characteristic of Colombian university population), characterized by risk factors, such as sleep-incompatible behavior, the variation sleep patterns and circadian change in the trend. In the literature, we found no studies that directly addressed this relationship in this population, despite the relevance given the high prevalence in the same. The aim of this study is analyze the differences in the dimensions of health related quality of life in a sample of university students, affected and unaffected of excessive daytime sleepiness.
Methods: A Cross-sectional comparison group, 414 university students selected cluster randomness. Was applied Epworth Sleepiness Scale, State Trait Sleepiness Inventory, SF-36 Scale, Morning and Evening Questionnaire, Pittsburgh Sleep Quality Index.
Results: Significant differences ($p < 0.05$), compared to the dimensions of quality of life (SF36), in the groups with excessive daytime sleepiness (EDS) and without EDS. Subsequently we performed a multiple

regression analysis considering the dimensions of quality of life with Sleepiness, finding that the vitality explains 29.5% of the total variance of EDS(Measure for ESS, daytime dysfunction(DD), sleep latency (SL) and age , Sleepiness trait ST and sleepiness state (SS). Mental health (SF36) 20.6% of the total variance of EDS (Measured, DD, LS, ESS, ST and SS), Social Function (SF36) 17.5% of the total variance of EDS (Measure DD, SL ,ESS, ST and SS) and emotional role (SF36) 16% of the total variance of EDS (Measure DD, SL , ESS, ST and SS).

Conclusion: Excessive daytime sleepiness in University students have a high impact on quality of life, specifically in the dimensions of vitality and social function, considering these two functions in the developmental age of the older teen and young adult, it could be concluded as a health problem for this population group.

0809

NARCOLEPSY IN LOUISIANA

Shamsnia M[1], Sharon D[2], Beaucoudry T[2], Shamsnia S[3]
[1]Neurology, Tulane University, Metairie, LA, USA, [2]Advanced Sleep Center, ANC, Metairie, LA, USA, [3]Neurosurgery, University of Nebraska, Omaha, NE, USA

Introduction: Narcolepsy a Greek word for "siezed by somnolence" described in 1880. This disorder occurs in all racial and ethnic groups. Its prevalence is estimated to be 0.1% in USA. Narcolepsy has four main symtoms of , excessive daytime sleepiness(EDS), sleep paralysis, hallucination and cataplexsy.

Methods: We studied patients betwwen 2010 and 2011 referred to Advanced Sleep Center(ASC) with main symptom of EDS and for ruling out the narcolepsy. Overnight polysomongraphy (PSG) followed with next day multiple sleep latency test(MSLT) were completed. The standard protocols established for PSG and MSLT was followed for this studies.

Results: In the tested group of 39 patients, we had 39 patients with EDS, 14 patients had sleep paralysis , 16 patients had hallucinations and 12 patients had cataplexsy, 32 patients met the criteria for narcolepsy out of 39 patients(82%) after completion of PSG/MSLT tests. Youngest age in the group was 5 years old and the oldest patient was 57 years old with average age of 32, average BMI index was 26 and average ESS score was 15. MSLT study in narcolepsy group showed mean sleep latency of 5.6 minutes and REM sleep latency(SOREM) was 4.0 minutes.

Conclusion: Our research in our sleep center between 2010/2011 points to the fact that narcolepsy is more common than has been estimated. The age diversity also indicates that patients with this disorder is under diagnosed. We recommend that health care providers take a good history in patients with EDS and refer patients to accredidated sleep centers for establishing the diagnosis for this treatable disorder that can improve patients quality of life.

0810

SLEEPINESS AS A PREDICTOR OF PLAYER LONGEVITY WITHIN MAJOR LEAGUE BASEBALL

Potenziano BJ[3], Rogers SL[4], Pfeifer PE[2], Winter WC[4,1]
[1]Sleep Medicine Center, Martha Jefferson Hospital, Charlottesville, VA, USA, [2]Business Administration, Darden School of Business, Charlottesville, VA, USA, [3]Athletic Training Department, Pittsburgh Pirates Baseball Club, Pittsburgh, PA, USA, [4]Sleep Medicine, Charlottesville Neurology and Sleep Medicine, Charlottesville, VA, USA

Introduction: Excessive daytime sleepiness has been shown to diminish performance in a variety of physical and cognitive tasks. This study evaluated Epworth Sleepiness Scale (ESS) data collected from Major League Baseball (MLB) players and determines if their scores were related to the players' continued play within the league three seasons later.

Methods: ESS data from 40 MLB players representing three teams was collected prior to the 2009 season as part of a larger sleep survey. This data was collected from a completely random assortment of players. Informed consent was obtained and participation was completely voluntary. Player status within the league was determined to be the player's current status as of December 1, 2011. A player who was continuing to play with his original team or in a similar capacity with another team was considered 'active'. A player who was demoted to a minor league, unsigned, or no longer playing was deemed 'inactive'.

Results: Of the 40 players surveyed randomly in 2009, 15 were inactive as of December 1, 2011. This represented a baseline attrition rate of 37.5%. This is consistent with estimates of MLB player attrition typically cited as 30-35%. For players scoring 8 or higher on an ESS, attrition was 57%. For players scoring 9 or higher, the rate was 70%, and 86% for players scoring 10 or higher. A linear regression model of our data suggests statistical significance (tstat: 2.08, p-value: 0.044).

Conclusion: This data indicates a possible relationship between the sleepiness of a MLB player and his longevity in the league. Based upon this study, levels of sleepiness may provide important insight as to which players may be at risk for future declines in productivity.

0811

EVENT RELATED POTENTIALS IN NARCOLEPSY-CATAPLEXY AND CONTROLS TO HUMOROUS REWARDING PICTURES

Khatami R[1,2], Poryazova R[2], Zollinger N[2], Bislimi F[2], Huegli G[1], Badel L[1], Baumann CR[2], Mensen A[1]
[1]Sleep center, Clinic Barmelweid, Barmelweid, Switzerland, [2]Neurology, University Hospital Zurich, Zurich, Switzerland

Introduction: A defining feature of narcolepsy with cataplexy (NC) is loss of muscle tone induced by emotional events, especially humorous ones. Humour engages the mesolimbic reward network which is compromised in NC during reward anticipation and appreciation. Here we examined whether NC-patients and healthy controls show a different neurophysiological response to humour as a task reward.

Methods: Participants completed a simple time estimation task while observing a non-humorous picture. If the estimation was within a certain timeframe (online adjusted), subjects received positive feedback in that the observed picture altered slightly to become humorous, otherwise, the picture was horizontally flipped. EEG was measured in 8 NC-patients and 8 healthy matched controls from 125 scalp sites in a geodesic array. Event-related potentials were created 200ms prior to picture change until 800ms post-event. Statistical differences, for all channels and time points, in the ERPs were analysed using a threshold-free cluster-enhancement (TFCE), followed by a non-parametric permutation test for main effects of group and feedback as well as their interaction.

Results: Group differences peaked around 170ms, but did not reach significance (peak F-value = 25.83). Reward feedback showed multiple significant peaks at posterior sites around 150ms, 280ms and 380ms (peak F-value = 40.61). Peak interaction of both variables occurred around 350ms, but did also not reach significance (peak F-value = 30.52), in this conservative test.

Conclusion: Preliminary data show overall differences in both groups ERP between rewarding humorous pictures and their neutral counterpoint and possible group differences between NC-patients and controls in their feedback responses.

Support (If Any): The study is sponsored by a Swiss National Foundation (SNF).

0812

TIME PERCEPTION IN PATIENTS WITH NARCOLEPSY, PARKINSON'S DISEASE AND HEALTHY CONTROLS

Poryazova R[1], Mensen A[2], Zollinger N[1], Bislimi F[1], Eberle T[2], Huegli G[2], Badel L[2], Baumann CR[1], Khatami R[2]
[1]Department of Neurology, University Hospital Zurich, Zurich, Switzerland, [2]Sleep Center, Klinik Barmelweid, Barmelweid, Switzerland

Introduction: The striatum and the prefrontal cortex play an important role in cognitive time processing, and time perception depends on sustained attention. Narcolepsy-cataplexy (NC) patients are unable to maintain sustained attention, probably due to deficient hypocretin signaling. Impaired time perception has been found in Parkinson's disease (PD) and attributed to dysfunctional dopaminergic striatal pacemaker. We aimed to assess time perception in patients with NC and PD and compare the outcome to that of healthy control subjects.
Methods: Thirteen HLA positive, hypocretin-deficient (9/9 tested) unmedicated (8/13) NC patients (mean age 40 years), seven PD (mean age 64 years) on dopaminergic medication, and 16 healthy controls (mean age 33 years) performed a short time estimation task, where they had to estimate an interval of one, two or five seconds. Accuracy of interval timing and its variability were analyzed using repeated measures ANOVA with group (NC, PD, controls) as a between subject factor and length of time to be estimated (1s, 2s, 5s) as within factor.
Results: Accuracy of time estimation for different time intervals was similar in patients and controls (main effect for length, $F=0.41$, $p=0.62$; main effect for group $F=1.37$, $p=0.27$), but variability of responses differed significantly between NC, PD and controls (main effect for group, $F=6.33$, $p=0.005$). Post hoc tests revealed that responses were significantly more variable in NC in comparison to PD and controls. In all groups response variability was higher for longer time intervals (main effect for length, $F=10.8$, $p=0.001$). There was no interaction between group and variability.
Conclusion: Short time perception is more variable in narcolepsy patients as compared to healthy controls and PD patients. These preliminary data may point to a dysfunctional network that is critically involved in distinct stages of temporal processing including the prefrontal cortex and the basal ganglia.
Support (If Any): The study is sponsored by a Swiss National Foundation (SNF) Grant.

0813

EVENT-RELATED POTENTIALS AND REACTION TIME RESULTS IN A REWARD-BASED TASK IN PATIENTS WITH NARCOLEPSY, PARKINSON'S DISEASE, AND HEALTHY CONTROLS

Poryazova R[1], Mensen A[2], Zollinger N[1], Bislimi F[1], Eberle T[2], Huegli G[2], Badel L[2], Baumann CR[1], Khatami R[2]
[1]Department of Neurology, University Hospital Zurich, Zurich, Switzerland, [2]Sleep Center, Klinik Barmelweid, Barmelweid, Switzerland

Introduction: Hypocretin (orexin) and dopamine deficiency/dysfunction in narcolepsy-cataplexy (NC) and Parkinson's disease (PD) patients have been linked to disturbed reward processing. We aimed to assess reaction time (RT) and event-related potentials (ERPs), in these patients in a reward-based reaction time task, and to compare outcomes to healthy controls.
Methods: Thirteen NC patients (HLA positive, hypocretin-deficient), six PD patients (Hoehn & Yahr stage I-III), and 16 healthy controls performed a reward-based task using different value (high and low) and valence cues (positive and negative). The participants had to press a button as fast as possible while a picture of a landscape was presented on the screen in order to gain or not lose money. Analysis of RT was performed using repeated measures ANOVA (with group as a between subject factor, valence - positive versus negative, and value - high versus low cues, as within subject factors and participants' age as a covariant). EEG was measured using a 125 channel geodesic array. ERPs were segmented 200ms prior to reward cue onset until 800ms post event. ERPs were analyzed using a threshold-free cluster enhancement, followed by non-parametric permutation statistics on potential reward size and group.
Results: Behaviourally, NC, PD patients and controls did not show any significant differences. For ERPs, a trend towards a reduced response to higher reward cues in NC patients compared to controls was observed. Interaction effects peaked around 80ms and again at 200ms.
Conclusion: NC and PD patients are able to achieve normal behavioral outcome in reward based tasks, while only NC patients may differ from controls in their EEG response to reward anticipation.
Support (If Any): The study is supported by a Swiss National Foundation (SNF) Grant.

0814

IRON METABOLITES ARE DYSREGULATED IN THE BRAIN AMONG THE PATIENTS WITH HYPOCRETIN/OREXIN DEFICIENT NARCOLEPSY

Kikuchi Y[1], Kanbayashi T[1], Narita E[1], Takehima M[1], Ito W[3], Sato M[2], Takahashi Y[1], Shimizu KM[1], Nishino S[2], Shimizu T[1]
[1]Neuropsychiatry, Akita University School of Medicine, Akita, Japan, [2]The Sleep and Circadian Neurobiology Laboratory, Stanford School of Medicine, Palo Alto, CA, USA, [3]Health Science, University of South Carolina, Columbia, SC, USA

Introduction: Periodic leg movements during sleep (PLMS) are often associated with restless legs syndrome (RLS). Reduced ferritin and elevated transferrin levels (with normal or low iron levels) in CSF (as indicators of low brain iron) are reported in PLMS/RLS subjects. A much higher incidence (25-50% vs. -5% in general population) of PLMS is reported in narcoleptic patients. Since altered dopaminergic neurotransmissions are suggested in both diseases and since iron is a co-factor for dopamine synthesis (thyrosine hydoroxylase), we evaluated CSF ferritin, transferrin and iron in patients with orexin deficient narcolepsy in the study.
Methods: We enrolled 17 patients with orexin deficient narcolepsy and age, gender-matched 20 control subjects. Differences between patients with orexin deficient narcolepsy and control subjects were tested using the standard two-tailed t-test.
Results: Patients with orexin deficient narcolepsy had higher CSF transferrin and iron levels when compared to control subjects. There was no difference in CSF ferritin levels between the two groups.
Conclusion: As seen in RLS subjects, an increase in transferrin was observed in narcoleptic subjects. However, normal ferritin and increased iron levels in these subjects may possibly suggest a higher utilization of iron or a dysregulation of iron metabolites in narcolepsy. It is not known if these findings are direct or indirect (such as a compensatory increase in dopaminergic synthesis) to orexin deficiency, and whether or not this contributes to the high incidence of PLMS in narcolepsy. As a result of these findings, further studies are warranted.

0815

NO DIFFERENCE OF ANTI-STREPTOCOCCAL ANTIBODIES BETWEEN PATIENTS OF NARCOLEPSY WITH CATAPLEXY AND WITHOUT CATAPLEXY

Kang D[1], Hong S[1], Mignot E[2], Suh S[1,2], Lim H[1]
[1]Psychiatry, St. Vincent Hospital, Suwon, Republic of Korea, [2]Stanford University, Psychiatry, Stanford, CA, USA

Introduction: Recent studies have revealed that Streptococcal infections were probably a significant environmental trigger for narcolepsy patients with cataplexy. However the relationship between the streptococcal infection and narcolepsy without cataplexy (NA s cat) is not clear.

The aim of this study is to explore the relationship between the ASO titer and Narcolepsy without cataplexy.

Methods: One hundred twenty eight narcolepsy with(N=48) and without cataplexy(N=24) and age-matched healthy controls (N=56) were recruited at Sleep Center of St.Vincent hospital. The multiple sleep latency test data from the time of their diagnosis were compared between groups. Disease duration was defined as time between first symptom and time of blood draw. The immunologic evaluation(Helicobacter Pylori Ab,IgG), HLA typing were performed. Participants were tested for markers of immune response to β hemolytic streptococcus (anti-streptolysin O [ASO]) A general inflammatory marker, C-reactive protein (CRP), were evaluated.

Results: One-way ANOVA analyses results indicated that titers of antistreptococcal antibodies were significantly higher in patients with narcolepsy without cataplexy versus healthy controls for ASO [F(2, 127)=5.35, p=.006]. After controlling for age, there were no significant differences in the ASO titer beween Narcolepsy with cataplexy and Narcolepsy without cataplexy [F(2, 127) =.401.p=ns].

Conclusion: To the best of our best knowledge, this is the first study exploring relationships between ASO titer and narcolepsy without cataplexy. From these results, further investigation is needed to compare the pathway of onset in Narcolepsy without and with cataplexy .

0816

EXAMINING QUALITY OF LIFE IN A SAMPLE OF NARCOLEPTIC PATIENTS

Kahlon H[1], Stevens S[2], Dwyer M[1], Uppalapati S[1], Korotinsky A[1], Singh A[3]

[1]Psychiatry, University of Kansas Medical Center, Kansas City, KS, USA, [2]Neurology, University of Kansas Medical Center, Kansas City, KS, USA, [3]Family Care Medical Center, Calgary, AB, Canada

Introduction: Narcolepsy is a sleep disorder characterized by excessive daytime sleepiness, cataplexy, sleep paralysis and hypnagogic hallucinations. Disturbed sleep at night, depression and anxiety has also been implicated in Narcolepsy. Narcolepsy impacts quality of life. The aim of the current study is to determine the impact of daytime sleepiness, disturbed nighttime sleep, cataplexy, and depression and anxiety symptoms on mental and physical aspects of narcoleptic patients' quality of life.

Methods: Study sample consisted of 27 subjects who are treated in the sleep medicine clinic at the KUMC. All subjects met the diagnostic criteria for narcolepsy, based on ICSD-R classification. Subjects filled out the questionnaire packet consisting of: BDI, BAI, ESS, PSQI, SF-36 and general demographic questions related to the diagnosis of Narcolepsy. For Biostatistics SPSS version 20 was used.

Results: Participants endorsed an average Global PSQI score of 11.12 (SD = 4.61), a mean ESS score of 16.70 (SD = 5.66), average BDI score of 17.78 (SD = 12.42), and an average BAI score of 17.11 (SD = 12.10). 30% reported experiencing cataplexy. Linear regression was used to examine the impact of key variables on patients' mental and physical quality of life using SF-36 scores. The first model showed that ESS, PSQI, BAI, and BDI scores, along with the patients' experience of cataplexy, significantly impacted their overall mental health quality of life (MQOL)($F = 7.23$, $p > .001$). However, only the BDI score was shown to be a unique significant predictor. This model accounted for 56.5% of the variance in MQOL. The second model showed that the same variables were significantly impacting patients overall physical health quality of life (PQOL)($F = 6.59$, $p > .001$). The second model accounted for 53.8% of variance in PQOL. In this model, only the PSQI global score was a unique significant predictor.

Conclusion: In the current sample of Narcoleptic patients, many reported significant symptoms of anxiety and depression which appear to be common in this clinical population. The current findings imply that along with the typical sleep disturbances associated with Narcolepsy, depression and anxiety symptoms also play key roles in patients' QOL. Clinically this may suggest that providers assess for and treat these potentially comorbid conditions to improve patient QOL. The current study is somewhat limited, notably by the small sample size and the potentiality of reporting bias.

0817

SCHEDULED NAPS AND SYSTEMATIC DESENSITIZATION IN THE EMOTIONAL PROCESSING IN PATIENTS WITH NARCOLEPSY: A COMPARATIVE STUDY OF AUTONOMIC AND COGNITIVE EVOKED POTENTIALS

Marín Agudelo HH[1], Jimenez U[2]

[1]Psicologia, Universidad Cooperativa de Colombia, Medellín, Colombia, [2]Clinica de trastornos del Dormir, UNAM, México DF, Mexico

Introduction: Cataplexy is an important symptom of narcolepsy definition, characterized by loss of muscle tone stimuli in the presence of both good and bad, the literature has reported few studies that discriminate and compare both cognitive reactivity as measured autonomic processing psychophysiologically after scheduling naps and the application of systematic desensitization in the response cataplexy. The aim of this study was to establish the association between cognitive evoked potentials P300 waves, and Skin response potentials in a cataplexic patients, after scheduled naps and training in systematic desensitization.

Methods: Fifteen patients diagnosed with narcolepsy cataplexy, which became part of the sample, was used as the emotional induction technique International Affective Picture System (IAPS) previously validated in Colombia, of which 45 images were selected randomness, in the registration procedure was events related potential (ERP) and the response of the skin conductance (SCR), with records before, during and after the training scheduled naps and when exposed to images of higher valence using systematic desensitization.

Results: The analysis focused on comparing the P300 wave action and SCR after the scheduled naps and systematic desensitization, as well as amplitude and latency of the wave, which reaches to a decrease in the amplitude of the P300 wave frontal areas and increased the amplitude of the wave action on SCR, after naps agenda and systematic desensitization, compared to past records to them ($p < 0.01$). The evaluation of the correlation of these two measures was negative and statistically significant ($p < 0.01$). As the wave latencies, showed a decrease in P300 wave latency in comparison to not having the intervention, and increased the latency of the SCR.

Conclusion: The different measures reflect a decrease in emotional reaction, and increased cognitive function, emotional response becomes less intense after sleep deprivation, suggesting a choice of emotion break after systematic desensitization and training in naps, and highlights the role of recovery sleep homeostasis in the role emotional, within the response cataplexy.

0818

CLINICAL EFFICACY OF L-CARNITINE SUPPLEMENTATION FOR NARCOLEPSY SYMPTOMS

Honda M[1,5], Miyagawa T[2], Shigematsu Y[3], Ozaki A[4], Inoue Y[5], Tokunaga K[2]

[1]Dept Psychiatry and Behavioral Sciences, Tokyo Metropolitan Institute of Medical Science, Tokyo, Japan, [2]Dept Human Genetics, Tokyo University School of Medicine, Tokyo, Japan, [3]Dept Health Science and Pediatrics, Fukui University School of Medicine, Fukui, Japan, [4]Dept Nursing, Toho University School of Medicine, Tokyo, Japan, [5]Japan Somnology Center, Neuropsychiatric Research Institute, Tokyo, Japan

Introduction: Narcolepsy patients have obese tendency and a higher risk of type2 diabetes mellitus, suggesting the abnormal energy homeostasis. A genome-wide association study revealed that *CPT1B* gene, which is a rate-controlling enzyme of long chain fatty acid beta-oxidation, was associated with narcolepsy. *CPT1B* mRNA level was higher in

narcolepsy after adjusting genotype. And acylcarnitine level, products of CPT1, was abnormally low in a subgroup of narcolepsy patients. We hypothesized that promoting fatty acid oxidation by L-carnitine supplementation could alleviate narcolepsy symptoms.
Methods: Thirty narcolepsy-cataplexy patients were enrolled in the clinical trial to evaluate the efficacy of oral L-carnitine using placebo-controlled cross-over design, and 28 patients (15 males, 41.2±15.9 year of age, BMI 26.1±5.9, all with HLA-DQB1*06:02) completed the study. Participants recorded sleep diary throughout the study period. Measurement of changes in subjective symptoms and objective blood analysis were performed at the end of 8 weeks placebo and carnitine periods. This study was approved by IRB and written informed consent was obtained from all the participants.
Results: L-carnitine efficiently increased serum acylcarnitine fraction ($p<0.001$), and reduced serum triglyceride concentration. Although Epworth Sleepiness Scale score (Japanese version) did not show significant changes, total time for dozing off during daytime calculated from sleep diary reduced in carnitine period (from 0.96hr to 0.82hr, $p=0.049$). Based on the overall subjective evaluation, 14 of 28 patients were classified as carnitine effective group. Besides sleepiness change, they also showed improvement of vitality and mood scores of SF36 subscales.
Conclusion: L-carnitine was effective for narcolepsy patients in the reduction of daytime dozing off time. Half of the patients reported alleviation of overall subjective symptoms together with the improvement of vitality and mood. Carnitine supplementation can be utilized as a novel treatment for narcolepsy. Underlying mechanism of this clinical efficacy remains to be clarified.

0819

NOCTURNAL TEMAZEPAM IN THE TREATMENT OF NARCOLEPSY

Kansagra S, Walter RJ, Vaughn B
Neurology, UNC-Chapel Hill, Chapel Hill, NC, USA

Introduction: Narcolepsy with cataplexy is characterized by fragmented nighttime sleep and excessive daytime sleepiness. One treatment approach for this disorder is through the nocturnal use of CNS depressants in hopes of consolidating nighttime sleep and thus improving daytime symptoms. The purpose of this case review was to share our experience of nocturnal temazepam on daytime sleepiness in patients with narcolepsy with cataplexy as measured by the Epworth Sleepiness Scale.
Methods: In this retrospective case series, the records of patients diagnosed with narcolepsy with cataplexy and treated with temazepam were examined. Doses of temazepam ranged from15mg to 30mg and were administered once nightly prior to bedtime for a minimum of one week. Each patient had a quantified measure of daytime sleepiness through the Epworth Sleepiness Scale both prior to initiation of temazepam and at each tolerated dose. Four patients were included in this study.
Results: The age for patients in this study ranged from 18 to 71 years, with a mean age of 41 years. They were diagnosed with narcolepsy for a mean of 19 years (range 4 to 49 years). All other medications and doses were unchanged during the temazepam titration. All patients reported a decrease in daytime sleepiness, with a mean decrease in Epworth Sleepiness Scale score of 6 points (range 5 to 7). The mean Epworth Sleepiness Scale score was 16.25 prior to initiation of temazepam and was 10.25 on the highest tolerated dose. Although not quantified, two patients who had frequent cataplexy at the time of initiation of temazepam reported a subjective improvement in frequency of cataplexy.
Conclusion: Nocturnal temazepam may be an option to improve excessive daytime sleepiness in patients with narcolepsy. Future prospective, placebo-controlled trials are needed to establish the effectiveness of this therapy.

0820

SERUM CYTOKINE LEVELS DURING KLEINE-LEVIN SYNDROME EPISODES

Kornum BR[1,2], Rico TJ[1], Lin L[1], Mignot E[1]
[1]Department of Psychiatry and Behavior, Stanford University, Palo Alto, CA, USA, [2]Danish Center for Sleep Medicine, Copenhagen University Hospital Glostrup, Copenhagen, Denmark

Introduction: Kleine-Levin Syndrome (KLS) is a rare sleep disorder characterized by recurrent episodes of hypersomnia, behavioral/cognitive disturbances and megaphagia. These episodes alternate with periods without any symptoms. The cause of KLS is still unknown, although nearly half of all patients report symptoms reminiscent of a viral infection a few days before the onset of the first episode. Speculations about pathogenesis include: abnormal response to infection, chronic cycles of reactivation of a rare pathogen, autoimmunity, and brain developmental defects. We report on an in-depth analysis of serum cytokine levels, and cytokine production in lymphocytes from KLS patients in and out of episode.
Methods: Blood samples were collected in and out of episode (n=12). Serum cytokine levels were analyzed using a 51-plex Luminex platform. The fraction of IL2, TNF, IFNgamma, and GM-CSF cytokine-producing T lymphocytes was determined by single-cell mass cytometry following 3h of stimulation with PMA/Ionomycin. Thirty-four different markers of cell phenotypes or specific cytokines where measured simultaneously in a CyTOF instrument.
Results: Our data shows a significant decrease in serum CCL7, IL4, IL15, and G-CSF levels during a KLS episode. No cytokines were significantly increased. An independent replication of this finding is pending. The frequency of T lymphocytes producing cytokines in response to activation was consistently higher across cell subtypes in samples taken in episode compared to out of episode.
Conclusion: This is the first study comparing immune factors measured in and out of KLS episodes within the same patient. We found several changes in cytokine levels and lymphocyte reactivity during episodes. These results suggests that immune dysregulation could be triggering episodes, although the changes observed could also be caused by in-episode changes in sleep, activity or feeding. Further studies of immune function up to and during an episode are needed to answer these questions.
Support (If Any): We thank patients and families for contributing samples. Funded by MH080957-03 and the Danish Medical Council 09-066348/FSS.

0821

CLARITHROMYCIN REDUCES SLEEPINESS AND IMPROVES VIGILANCE IN PATIENTS WITH CENTRAL NERVOUS SYSTEM HYPERSOMNIAS

Trotti L[1], Stout AK[1], Saini P[3], Freeman A[1], Jenkins A[2], Garcia PS[2,4], Rye DB[1]
[1]Neurology, Emory University School of Medicine, Atlanta, GA, USA, [2]Anesthesiology, Emory University School of Medicine, Atlanta, GA, USA, [3]Emory School of Public Health, Atlanta, GA, USA, [4]VA Medical Center, Atlanta, GA, USA

Introduction: An endogenous positive allosteric modulator of the GABA-A receptor has been documented in patients with central hypersomnias. The macrolide antibiotic clarithromycin attenuates the response of cloned GABA-A receptors to exogenous GABA in vitro and potentially represents a novel therapy for hypersomnia.
Methods: We performed a chart review of all non-cataplectic hypersomnia patients with positive allosteric modulation of the GABA-A receptor who had tried clarithromycin for EDS. We collected subjective (sleepiness, adverse effects) and objective (psychomotor vigilance task, PVT, performance) data.

Results: Thirty-six patients had taken at least one dose of clarithromycin (typically prescribed as a 1-2 week trial). Diagnoses included idiopathic hypersomnia with long sleep time (n = 6), idiopathic hypersomnia without long sleep time (n = 5), narcolepsy without cataplexy (n = 11), Kleine-Levin (n = 2), and physiologic hypersomnia unspecified (n = 12). Twenty-five (69%) were women. Mean age was 36 years (+/- 13.8). Five patients did not have repeat evaluation on clarithromycin. Of the remaining 31 patients, 19 (61.2%) reported improvement in daytime sleepiness while taking clarithromycin. Six patients (19.4%) could not tolerate due to side effects, six patients noticed no improvement, and one patient (who also reported side effects) felt clarithromycin made her sleepiness worse. PVT data with and without clarithromycin use were available for 13 patients (57.9% of subjective responders and 66.7% of subjective non-responders). Median reaction time was significantly improved with clarithromycin (251.7 +/- 38.6 msec vs 276.4 +/- 44.0 msec, p = 0.017), as was the reciprocal reaction time of the slowest 10% of responses (2.78 +/- 0.63 vs 2.40 +/- 0.56, p = 0.02). Number of lapses of > 500 msec was not different (1.46 +/- 2.02 vs 2.69 +/- 4.68, p = 0.23).
Conclusion: Clarithromycin may decrease sleepiness and improve vigilance in patients with central hypersomnias. Controlled trials are needed.
Support (If Any): Woodruff Health Sciences research funds; American Sleep Medicine Foundation.

0822

UNAPPRECIATED BEHAVIOURALLY INDUCED INSUFFICIENT SLEEP SYNDROME

Werth E[1], Michael N[1], Bassetti C[1,2], Baumann CR[1]
[1]Department of Neurology, University Hospital Zürich, Zürich, Switzerland, [2]Neurocenter of Southern Switzerland, Ospedale Civico, Lugano, Switzerland

Introduction: Behaviourally induced insufficient sleep syndrome (BIISS) occurs when an individual chronically fails to obtain the amount of sleep required to maintain normal levels of alertness and wakefulness. Its significance is mostly unappreciated by the patient. Furthermore, some patients may develop secondary symptoms which may even become the main focused complains and often serve to obscure the primary cause of the difficulties.
Methods: This retrospective study presents the results of the evaluation of 47 consecutive patients who received the diagnosis of BIISS in our Center of Sleep Disorders.
Results: Mean age of the BIISS patient was 40±12 years (mean±SD). Age of BIISS onset was bimodal distributed with a first peak occurring at age 20-25 years a second peak present at age 40-45 years. Only 30% were females. Patients mostly complain symptoms of excessive daytime sleepiness; however, many individuals reported other symptoms as sleep attacks without general daytime sleepiness, fatigue, sleep drunkenness, concentration and attention deficits or cognitive impairment. Mean ESS was 14.1±3.6. Time in bed (TIB) estimation (from questionnaire) revealed TIB of 7:10h±1:03h during weekdays and 8:29h±1:16h on weekend. However, TIB estimation based on actigraphy recordings revealed significantly shorter TIB on weekdays and on weekends (weekday: 6:25h±0:57h, weekend: 7:56h±1:13h). PSG recordings showed short sleep latency 8.4±7.9 minutes and high sleep efficiency (91.5±16.7%). Mean sleep latency of MSLT was 5.5±3.3 minutes. Sleep onset REM (SOREM) episodes with 2 and more SOREM were present in 17% of the patients. Mean sleep latency of MWT was very variable. A clear reduced ability to maintain wakefulness (sleep latency < 12 min) was present in 34% of patients.
Conclusion: To conclude, the results of this case series indicate (1) that there are a noticeable large number of patients who were not aware that their sleep duration was insufficient and (2) that some chronically sleep-deprived subjects may be falsely diagnosed with narcolepsy without cataplexy or idiopathic hypersomnia.

0823

A COMPARISON OF TRAIT AND STATE SUBJECTIVE SLEEPINESS: HOW SUBJECTIVE SLEEPINESS INFLUENCES DRIVING PERFORMANCE

May J[3,1,2], Porter B[3], Ware J[2,1]
[1]Sleep Center, Sentara, Norfolk, VA, USA, [2]Sleep Medicine, Eastern Virginia Medical School, Norfolk, VA, USA, [3]Psychology, Old Dominion University, Norfolk, VA, USA

Introduction: Subjective sleepiness measures capture two different types of subjective sleepiness. One measure of subjective sleepiness is a general sleepiness, or trait sleepiness. Another measure of subjective sleepiness is a time-specific measure of how sleepy a person is at that moment, or state sleepiness. The goal of this study was to compare state and trait measures of sleepiness to determine how they impact driving performance and decrements in performance over time.
Methods: After consent, participants completed a brief questionnaire collecting demographics, sleep and driving history. Participants completed a 10-minute practice drive and an hour long drive in an Systems Technology STISIM driving simulator. Participants were grouped by their scores on their Epworth Sleepiness Scale (ESS) and Visual Analog Scale of Sleepiness (VAS) scores, which were completed before the test drive. The ESS represented a measure of trait sleepiness, whereas the VAS score was a measure of state sleepiness. There were three groups for sleepiness: NORM (ESS <= 10, VAS < 30), TRAIT (ESS > 10, VAS < 30) and STATE (ESS <= 10, VAS > = 30). Lane position variability (LPV) was the measure of driving performance. LPV across time was represented by 6 10-minute epochs.
Results: A 6 (time blocks) by 3 (groups) repeated measures ANOVA was performed. LPV was reciprocally transformed to meet assumptions of normal distribution. There were 21 NORM, 10 TRAIT, and 15 STATE participants. There was a significant effect of time, F (3.82, 172.02) = 19.75, p < .05. LPV increased across the hour long drive. There was a main effect for group, F (2, 45) = 10.81, p < .05. Post-Hoc tests indicated that the TRAIT group (M = 1.73 ft, SD = 0.32) had significantly greater LPV than both the NORM (M = 1.18ft, SD = 0.17) and STATE (M = 1.25 ft, SD = 0.25) groups. The NORM and STATE group were not significantly different from each other. There was no significant time by group interaction.
Conclusion: Results indicate that LPV increased over the hour long drive. Participants exhibiting high levels of trait sleepiness performed worse than those participants feeling sleepy at the start of the drive and normal participants. These results indicate that ESS is a strong predictor on driving performance and there may be implications in using this scale in commercial driving environments to screen drivers. Future research should compare the ESS with changes in VAS scores to examine drivers who report increasing sleepiness during the drive.

0824

USING FATIGUE, ANXIETY AND DEPRESSION TO PREDICT OBJECTIVE SLEEPINESS

Spohr S[2], Townsend D[1]
[1]St. Paul Lung Clinic, St. Paul, MN, USA, [2]Psychology Department, Minnesota State University, Mankato, Mankato, MN, USA

Introduction: Differentiating fatigue from sleepiness is a difficult and essential component of the sleep evaluation. Sleepiness is generally associated with primary sleep disorders and sleep deprivation. However, fatigue is frequently considered multidimensional and can be associated with physical and mental exertion, chronic illness or disease, temporary conditions like pregnancy, medications, primary sleep disorders and psychological conditions. The Multiple Sleep Latency Test (MSLT) is used to quantify daytime sleepiness but negative findings do not provide information related to the patient's perception of poor daytime functioning. Assessing anxiety, depression and fatigue may help predict whether the patient is describing a primary sleep disorder or other processes at

work. We investigated whether fatigue, anxiety and depression would predict a longer mean sleep onset latency and that depression and anxiety would predict fatigue.
Methods: Archival data from 67 individuals presenting with a complaint of daytime sleepiness who completed a polysomnogram and MSLT was examined. Each patient had completed a Pittsburgh Sleep Quality Index, Beck Depression Inventory, State-Trait Anxiety Inventory, Epworth Sleepiness Scale and Fatigue Assessment Scale following a nocturnal polysomnogram and prior to an MSLT. Linear and logistic regressions were used to examine the relationship between questionnaire data and mean sleep onset latency. Correlations were performed as part of the regression analysis.
Results: Subjective questionnaire data was unable to predict objective mean sleep latency determine by the MSLT. Anxiety was the only significant predictor of fatigue (R square 0.351). Depression, anxiety and fatigue were all significantly correlated ($p<0.05$).
Conclusion: Neither depression, anxiety, nor fatigue predicted sleepiness although they were highly related to one another. Assessing anxiety, depression and fatigue in clinic is likely to help explain negative MSLT results and help clarify the nature of fatigue for patients.

0825

NOCTURNAL SLEEP-ONSET REM PERIODS (SOREMP) IN ADULT PATIENTS EVALUATED AT A SLEEP CLINICAL SETTING

Oksenberg A, Goizman V, Eitan E, Gadoth N
Sleep Disorders Unit, Loewenstein Hospital, Raanana, Israel

Introduction: Study Objectives: To describe the clinical and polysomnographic characteristics of 60 patients without narcolepsy in whom nocturnal sleep-onset Rapid Eye Movements REM periods (SOREMPs) were recorded (the "study group") and to compare these data with that of 60 patients without SOREMPs ("the control group") matched for Age, Gender and Apnea Hypopnea Index (AHI).
Methods: Design: Retrospective analysis. Patients: The clinical characteristics and polysomnographic (PSG) data of 2250 seeking treatment patients, who were studied at our Sleep Disorders Unit between January 2007 and August 2009, were screened for the presence of SOREMPs.
Results: Out of 2250 seeking treatment patients who underwent a complete PSG evaluation, 60 (2.7%) had SOREMPs. Compared to the control group, the patients with SOREMPs, woke - up earlier, had shorter sleep duration and lower sleep efficiency due mainly to a higher percentage of stage 1. They also showed more REM sleep periods and a higher percentage of REM sleep but a lower percentage of Slow Wave Sleep. The severity of sleep apnea and of periodic leg movements were not related to SOREMP. In 22 (36.6 %) of the 60 patients with SOREMPs (defined as REM sleep latency < 30 min), the REM latency was < 15 min. The clinical and polysomnographic characteristics of this group did not differed from the rest of the study group. Although these are not narcoleptic patients, the nocturnal sleep patterns of patients with SOREMPs partially resemble the nocturnal sleep patterns of narcoleptics.
Conclusion: In our large group of seeking treatment patients, in a country where Narcolepsy is very rare, 2.7% had SOREMPs. The presence of SOREMPs in our non-narcoleptic patients was associated with poor sleep quality regardless of the severity of obstructive sleep apnea and periodic leg movements during sleep. However, patients with SOREMPs did not differ significantly from patients without SOREMPs in a large number of clinical, epidemiological and polysomnographic characteristics.

0826

THE TEMPORAL DISTRIBUTION OF SLOW WAVE ACTIVITY DURING SLEEP IS AN OBJECTIVE MARKER OF SUBJECTIVE DAYTIME SLEEPINESS

McGee-Koch LL[1], Malkani R[1], Reid KJ[1], Chapotot F[2], Whitmore H[2], Zee P[1]
[1]Neurology, Northwestern University, Chicago, IL, USA, [2]Department of Medicine, University of Chicago, Chicago, IL, USA

Introduction: Early in the sleep period, non-rapid eye movement (NREM) slow wave activity (SWA) is characteristically high in intensity and dissipates throughout the night. This homeostatic regulation of SWA has been postulated to be important for the restoration of physiological, affective and cognitive functions. However, little is known about the relationship between the temporal dynamics of SWA across the sleep period and daytime sleepiness. In this study, we sought to determine if subjective daytime sleepiness is associated with the temporal distribution of SWA.
Methods: Thirty-four older adults (mean 64.2y/o SD 6.8, 5 males) were recruited. Each participant underwent 3 nights of standard nocturnal polysomnography (PSG). Participants were given the Epworth Sleepiness Scale (ESS) at the beginning of their visit. Using fast Fourier transform, SWA (defined as NREM absolute power in the 0.75 to 4.5-Hz frequency band) was calculated across the entire sleep period. To measure the dissipation of SWA, the delta sleep ratio (DSR, quotient of SWA from hours 1-3 of sleep divided by the hours 4-6 of sleep), exponential time decay function and the latency to peak SWA (minutes from sleep onset to peak of SWA) were determined. The ESS was compared with DSR, exponential time decay, and with latency to SWA peak using a Pearson's partial correlation controlling for age, gender, and total sleep time from the 2nd night of PSG monitoring.
Results: Mean ESS score was 7.8 (SD=4.3). Mean DSR was 1.7 (SD=0.4). Mean exponential time decay was -0.0015 (SD=0.0007). Mean latency to SWA peak was 62.4min (SD= 50.8). There was a significant negative correlation between ESS and DSR ($r=-.408$; $p=.005$) and a positive correlation for exponential time decay ($r=0.374$; $p=0.04$) and latency to SWA ($r= 0.353$; $p=0.04$).
Conclusion: There is an association between less dissipation of the homeostatic load (DSR, exponential time decay, latency to SWA peak) and greater subjective daytime sleepiness. These measures of SWA dissipation may represent important physiological markers of daytime sleepiness. Further studies are needed to determine the utility of these measures in assessing interventions aimed at improving daytime sleepiness.
Support (If Any): R01 HL090873; NIH/NHLBI T32, Training Grant in Sleep Research NIH/NHLBI HL090873.

0827

THE CARDIOPULMONARY STUDY AS AN EARLY SLEEP APNEA SCREENING TOOL IN ACUTE ISCHEMIC STROKE

Chernyshev OY[1,2], Moul DE[1,3], Liendo C[1], McCarty DE[1], Caldito GC[1], Besliu S[1], Munjampalli SK[1], Kelley R[1], Chesson AL[1]

[1]Neurology, LSU Health Science Center, Sleep Disorders Center, Shreveport, LA, USA, [2]Neurology, University of Texas Medical School at Houston, Houston, TX, USA, [3]Sleep Disorders Center, Cleveland Clinic, Cleveland, OH, USA

Introduction: Prompt diagnosis of obstructive sleep apnea (OSA) after acute ischemic stroke is critical for optimal clinical outcomes, but full bedside polysomnograms are not routinely practical. To validate a potentially practical diagnostic portable cardiopulmonary (CP) screening modality after such strokes, we compared it to conventional polysomnography (PSG).

Methods: Simultaneous bedside Level 3 (Embletta X100) CP and PSG studies were performed in patients <72 hours from stroke onset. The accuracy of CP was compared to PSG using: Chi-square tests, Receiver-Operatory Characteristic curves, Bland-Altman plot, paired Student t-test /Wilcoxon signed rank test and calculation of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV).

Results: Twenty one out of 23 acute ischemic stroke patients (age 61± 9.4; 52% male; 58% African-American), successfully completed both of the simultaneous screenings (9% technical failure). Nearly all (95%) had Mallampati IV posterior oropharynx; the mean neck circumference was 16.8± 1.6 inches; the mean BMI was 30 ±7 kg/m2. The Apnea Hypopnea Index (AHI) provided by CP was similar to that provided by PSG (19.8± 15.8 vs. 22 + 21.1, respectively; p=.049). In identifying patients with AHI ≥ 5 on PSG, CP screening had the following parameters: sensitivity 100%; specificity 85.7%; PPV 93%; NPV 100%. For AHI ≥ 15 on PSG, CP screening parameters were as follows: Sensitivity 100%; Specificity 83.3%; PPV 81.8%; NPV 100%. Bland-Altman plotting showed overall diagnostic agreement between CP and PSG modalities for an AHI cutoff of > 5, despite finer-grained differences in estimated AHIs.

Conclusion: Compared with PSG, CP provides similar diagnostic information when run simultaneously in acute ischemic stroke patients. CP potentially can serve as a reliable screening tool for early diagnosis of sleep apnea in acute ischemic stroke patients.

Support (If Any): American Sleep Medicine Foundation/American Academy of Sleep Medicine's 2010 Physician Scientist Training Award in the Best Science category.

0828

MECHANISMS OF ISCHEMIC STROKE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: RETROSPECTIVE CASE CONTROL STUDY

Lipford MC[1], Calvin A[2], Mandrekar J[3], Somers VK[2], Brown RD[4], Flemming K[4], Caples SM[1,5]

[1]Center for Sleep Medicine, Mayo Clinic, Rochester, MN, USA, [2]Division of Cardiovascular Diseases, Mayo Clinic, Rochester, MN, USA, [3]Biomedical Statistics and Informatics, Mayo Clinic, Rochester, MN, USA, [4]Department of Neurology, Mayo Clinic, Rochester, MN, USA, [5]Division of Pulmonary and Critical Care Medicine, Mayo Clinic, Rochester, MN, USA

Introduction: Obstructive sleep apnea (OSA) is an independent risk factor for ischemic stroke, but the causative mechanisms of infarction remain unknown. Understanding these mechanisms may tailor diagnostic evaluations and provide clinical guidance for recurrent stroke prevention. Our study compares stroke etiology in OSA patients to controls without significant sleep disordered breathing.

Methods: Consecutive patients were identified who underwent polysomnography (PSG) at Mayo Clinic between 1/2000 - 9/2011 and suffered an ischemic stroke within one year after PSG. Patients with an apnea-hypopnea index (AHI) ≤ 10 were classified as controls; AHI > 10 classified as OSA cases. Mechanism of stroke was determined using (1) the Causative Classification System for Ischemic Stroke (CCS) and (2) the phenotype definitions used in the Trial of Org 10172 in Acute Stroke Treatment (TOAST). Information on cardiovascular risk factors, neuroimaging, and echocardiography data were collected on each patient.

Results: In 53 total subjects, mean age of cases was 67.6 (n=32, SD +/-9.4); 3:1 M:F ratio. Within controls, mean age was 62.0 (n=21, SD +/-14.2); M:F ratio of 1:1. Using CCS subtype, cardioembolic (CE) strokes were more common among OSA cases than controls (72% vs 33%, p=0.01). Large artery atherosclerosis and small vessel occlusion were more common in controls. Atrial fibrillation (AF) was more frequent in OSA patients versus controls (47% vs 24%, p=0.1). Frequency of CE stroke increased with OSA severity. The association between OSA and CE stroke remained significant after controlling for AF (p=0.03, OR 4.5).

Conclusion: Cardioembolic strokes are more common in patients with OSA than controls. Although those with OSA had a higher frequency of AF, a third of CE strokes occurred in OSA patients without documented AF. Further study is needed to determine whether the higher rate of CE strokes in those with OSA is a result of occult AF or related to other factors specific to OSA. OSA patients also suffer from other stroke etiologies, necessitating multifaceted risk factor reduction strategies.

Support (If Any): Mayo Clinic Department of Neurology funding for statistical support.

0829

SHORT SLEEP PREDICTS STROKE SYMPTOMS IN PERSONS OF NORMAL WEIGHT

Ruiter M[1], Howard VJ[1], Letter AJ[1], Kleindorfer D[2]

[1]The University of Alabama at Birmingham, Birmingham, AL, USA, [2]The University of Cincinatti College of Medicine, Cincinatti, OH, USA

Introduction: Self-reported sleep duration is related to incident stroke, but it is unknown whether it remains a risk factor after ruling out the presence of sleep-disordered breathing. The aim of the present study was to determine, amongst persons with low risk for sleep-disordered breathing, if sleep duration is predictive of self-reported stroke symptoms.

Methods: In the REasons for Geographic And Racial Differences in Stroke (REGARDS) study (30,239 US blacks and whites, aged 45+ years), the cohort self-reported their average sleep duration. Self-reported stroke symptoms were collected at six-month intervals thereafter. In the 5,666 participants without history of stroke, transient ischemic attack, stroke symptoms, or high risk for sleep-disordered breathing (Berlin Sleep Questionnaire) as of 2008, interval-censored, parametric survival models with exponential distributions were conducted to estimate the hazard ratios predicting time from measurement of sleep duration (<6, 6-6.9, 7-7.9 (reference), 8-8.9, ≥9 hours) to first stroke symptom. Adjusted models included demographic information, Framingham stroke risk factors, depressive symptoms, anxiety, and various health behaviors.

Results: In the unadjusted model, short sleep (<6hrs) and long sleep (≥9hrs) significantly predicted stroke symptoms, but the effect was attenuated in adjusted models. However, there was a significant interaction between sleep duration and body mass index (BMI; p=.047). Stratifying by BMI suggested a significant association between short sleep duration and stroke symptoms only for persons with normal BMI (n=1,651; HR=2.93, 95% CI 1.38-6.22, p=.005). There was no association among overweight and obese participants. In the fully adjusted model for participants with normal BMI, a sleep duration of less than six hours was strongly associated with a greater incidence of stroke symptoms (n=1,189; HR: 4.54, 95% CI: 1.75-11.83, p=.002).

Conclusion: Habitually sleeping <6 hours per night significantly increases the rate of stroke symptoms, beyond other risk factors, among middle-aged to older individuals of normal weight and low risk of sleep-disordered breathing.

0830

ARMODAFINIL FOR THE TREATMENT OF EXCESSIVE SLEEPINESS ASSOCIATED WITH MILD OR MODERATE CLOSED TRAUMATIC BRAIN INJURY: A 12-WEEK, RANDOMIZED, DOUBLE-BLIND STUDY FOLLOWED BY A 12-MONTH OPEN-LABEL EXTENSION

Menn SJ[1], Earl CQ[2], Yang R[2], Lankford A[3]
[1]Pacific Sleep Medicine Services, Redland, CA, USA, [2]Cephalon, Inc, Frazer, PA, USA, [3]Sleep Disorders Center of Georgia, Atlanta, GA, USA

Introduction: Patients with closed traumatic brain injury (TBI) have a high prevalence of excessive daytime sleepiness. This study examined whether the wakefulness-promoting agent armodafinil improved wakefulness in patients with excessive sleepiness associated with mild or moderate closed TBI.
Methods: Patients 18-65 years old with closed TBI were included if they had: Glasgow Coma Scale score 13-15 (mild) or 9-12 (moderate), injury 1-10 years ago, Epworth Sleepiness Scale (ESS) ≥10, sleep latency <8 minutes on Multiple Sleep Latency Test (MSLT), and Clinical Global Impression-Severity of Illness (CGI-S) score ≥4 related to excessive sleepiness. Randomized patients received armodafinil (50, 150, or 250 mg) or placebo for 12 weeks. Efficacy assessments included MSLT, ESS, Clinical Global Impression-Change (CGI-C), and TBI-Work Instability Scale (TBI-WIS). Patients completing the randomized study were permitted to enter a 12-month open-label extension where all patients received 250 mg armodafinil. Tolerability was also assessed.
Results: A total of 484 patients were screened and 117 were randomized before the study sponsor terminated the study early due to poor enrollment. Patients receiving 250 mg armodafinil showed significantly greater improvement in sleep latency from baseline to final visit versus placebo (+7.2 minutes vs. +2.4 minutes; p=0.0010). CGI-C ratings were much/very-much improved in approximately 50% of patients in the 150 and 250 mg armodafinil groups compared to 38% in the placebo group. ESS and TBI-WIS scores were not significantly different between armodafinil and placebo groups. In the open-label extension (N=49), patients demonstrated gradual improvement in ESS, TBI-WIS, and CGI-S scores. Armodafinil was generally well-tolerated and headache was the most common adverse event.
Conclusion: Armodafinil 250 mg significantly improved MSLT sleep latency in patients with excessive sleepiness associated with mild or moderate TBI. Other efficacy measures were not significantly different for armodafinil versus placebo. Efficacy and tolerability of armodafinil were maintained throughout the open-label extension.
Support (If Any): This study was sponsored by Cephalon, Inc., Frazer, PA.

0831

INSOMNIA SYMPTOMS IN POST-TRAUMATIC STRESS DISORDER PATIENTS WITH A HISTORY OF TRAUMATIC BRAIN INJURY

Beltran J
University of California, San Diego, Chula Vista, CA, USA

Introduction: Military personnel are at great risk of physical injury and psychological trauma due to their line of work. Traumatic brain injury (TBI) is one of the most common types of injury among members of the military. Some of the emotional and behavioral changes following a TBI also overlap with Post-Traumatic Stress Disorder (PTSD) symptoms. Furthermore, patients that have been diagnosed with both TBI and PTSD seem to have worse overall symptoms compared to PTSD patients that have never had a TBI. In brief, treating insomnia symptoms in PTSD patients can be more challenging when patients have a history of TBI.
Methods: A group of 40 subjects enrolled in Prolonged Exposure (PE) treatment. Baseline and post-treatment PTSD and insomnia symptoms were compared in two groups: TBI and non-TBI.
Results: The TBI group had a higher drop-out rate from PE treatment and worse post-treatment questionnaire scores than the non-TBI group.
Conclusion: Patients with a history of TBI have less success in PE treatment and might benefit from multiple treatment modalities in order to address their wide range of behavioral and psychological symptoms.

0832

FURTHER EVIDENCE OF A NARCOLEPTIC PHENOTYPE IN PARKINSON'S DISEASE (PD)

Bliwise DL, Trotti L, Juncos J, Factor SA, Wilson A, Greer S, Rye DB
Neurology, Emory University School of Medicine, Atlanta, GA, USA

Introduction: Evidence of phenotypic similarity between daytime sleepiness in narcolepsy and PD remains controversial. Conflicting data exist regarding a role for hypocretin deficiency in PD, and only 4 of 13 studies using MSLT have noted SOREMs.
Methods: PD pts (n = 63) (X age = 63.1 [SD = 9.7]; 41 M, 22F) underwent a 48 hr sleep lab protocol of 2 PSG nts followed by 2 days of 4-nap MWT. MWT duration was held constant at 40 mins; we scored SOREMs if they occurred any time during the 40 mins. 14 patients were unmedicated with any dopaminergic drugs; 8 received only dopamine receptor agonists; 14 received only the dopamine precursor L-dopa; 27 received both.
Results: REM was seen during MWTs in 22 patients (35%) and occurred in 1 to 8 naps; 11 had > 1 REM episode. Presence/absence of REM on MWT was unrelated to nocturnal TST, SE, or REM%, PLM Index, AHI, age, UPDRS, MMSE, ESS, disease duration, Hoehn-Yahr score, levo-dopa dose equivalence, or gender. REM on MWT was unrelated to dopaminergic medication status per se (38.8% [medicated] vs 21.4% [unmedicated], Fisher's exact p = .68); however, patients receiving only agonists were more likely to have REM than unmedicated patients (62.5% vs 21.4%, Fisher's exact p = .08). L-dopa alone did not show this effect (p = .42). Patients demonstrating REM periods on MWT also had shorter mean daytime sleep latencies (10.4 [8.5] vs 23.2 [12.4] mins, t = 4.30, p < .0001).
Conclusion: These data continue to draw parallels between the sleep phenotypes of treated and untreated PD and narcolepsy. An additional potentially permissive role for dopamine agonists in REM generation may be compatible with rodent models showing REM-related dopamine release in the ventral tegmentum in conjunction with transition to predominantly burst-firing in REMS.
Support (If Any): R01 NS-050595; KL RR-025009 (ACTSI).

0833

INCREASED NREM SLEEP ALPHA AND SIGMA ACTIVITY IN NEWLY DIAGNOSED PARKINSON DISEASE

Margis R[1], Schonwald S[1], Carvalho DZ[1], Rieder C[2,3], Gerhardt G[4]
[1]Sleep Laboratory, Hospital de Clinicas de Porto Alegre - HCPA, Porto Alegre, Brazil, [2]Neurology Department, Universidade Federal de Ciências da Saúde - UFCSPA, Porto Alegre, Brazil, [3]Movement Disorders Unit, Neurology Section, Hospital de Clínicas de Porto Alegre - HCPA, Porto Alegre, Brazil, [4]Physics and Chemistry Department, Universidade de Caxias do Sul - UCS, Caxias do Sul, Brazil

Introduction: Little is known about sleep microstructure in early stages of untreated Parkinson's disease (PD). This study evaluated NREM sleep EEG spectral distribution in newly diagnosed, levodopa-naive PD patients. Special attention was given to avoidance of signal contamination from arousals, respiratory events or movement-related activity.
Methods: Eight PD patients (50%female; 64.9±6.3y; disease duration=3±2.8y; Hoehn-Yahr stages I-II) and nine controls (44% female; 64.8±6.5y) contributed with 15min N2 sleep selected from initial,

middle and final night sections. Whole-night sleep studies were performed according to AASM 2007 guidelines. EEG activity during respiratory events, movements (including periodic limb movements) and arousals was not included in the analysis. Exclusion criteria were benzodiazepine use, Mini-Mental score <24, presence of other known neurological disease or psychiatric disorder, and PSG Apnea-Hypopnea Index >15. Sleep macrostructure and Epworth Sleepiness scores did not differ statistically between groups; patients had worse subjective sleep quality than controls (Pittsburgh Sleep Quality Index scores 9±3.9 vs. 4.7±3.5; Students t test, p=0.03). Average normalized spectral power was computed in 4s windows for every 0.25Hz bin in the 0.25Hz-19.75Hz range, for left and right frontal, central, parietal and occipital EEG channels.
Results: Compared to controls, PD patients showed significant increase in alpha activity (7.5Hz-10Hz) in frontal, parietal and occipital areas, and significant increase in sigma activity (11Hz-15Hz) in all areas analyzed, especially central and parietal channels (all Bonferroni-corrected p-values < 0.05, Mann-Whitney test). No significant group differences were found around 10.5Hz-10.75Hz.
Conclusion: These results indicate the presence of two (alpha and sigma) EEG spectral patterns closely co-existing for PD patients during unequivocal NREM sleep stage 2. Although the significance of alpha activity during sleep is not entirely understood, these two firing patterns have theoretically different, potentially competing functions. These results may thus indicate disruption of NREM sleep intrinsic organization and/or increased NREM sleep instability in PD.
Support (If Any): CNPq / FIPE.

0834

HEART RATE VARIABILITY DURING SLEEP IN PARKINSON'S DISEASE

Covassin N[1], Neikrug AB[2], Liu L[2], Maglione JE[2], Corey-Bloom J[3], Loredo JS[4], Ancoli-Israel S[2]
[1]Department of General Psychology, University of Padua, Padua, Italy, [2]Department of Psychiatry, University of California San Diego, San Diego, CA, USA, [3]Department of Neurosciences, University of California San Diego, San Diego, CA, USA, [4]Department of Medicine, University of California San Diego, San Diego, CA, USA

Introduction: In addition to motor signs, Parkinson's disease (PD) patients often suffer from a variety of non-motor disorders including autonomic nervous system (ANS) dysfunctions and sleep difficulties. The nature of the relationship between ANS activity during sleep and the PD clinical features is unclear. The purpose of the present study was to explore the association between PD clinical parameters and cardiac autonomic activity during sleep by means of heart rate variability (HRV) analysis.
Methods: Eighteen PD patients underwent a night of polysomnographic recording. Interbeat intervals were derived from the ECG recording and the following frequency domain measures of HRV were computed for NREM and REM sleep stages: high frequency (HF) power, low frequency (LF) power, ratio of LF to HF (LF/HF) power. PD severity was rated by using the Hoehn and Yahr (HY) staging and the Unified Parkinson's Disease Rating Scale (UPDRS). Correlations were run between HRV indices and demographic and clinical data.
Results: Correlation analyses revealed strong negative relationships between HF power during REM and HY score (r=-.682, p<.01), UPDRS total score (r=-746, p<0.001) and UPDRS motor subscale score (r=-517, p<0.05). LF/HF ratio in REM was positively related with HY staging (r=.690, p<.01), UPDRS total score (r=.569, p<0.05) and UPDRS motor subscale score (r=.478, p<0.05). No significant relationships were detected between the HRV parameters and age and PD duration.
Conclusion: Our findings displayed a progressive decrease in vagal tone and an increase in sympathetic drive during sleep with the worsening of the PD. Interestingly, these associations were observed only with regard to the REM sleep. As REM sleep is characterized by marked neurovegetative instability, even in PD patients without clinically relevant dysautonomies, the ANS complications may be subclinical and emerge only during conditions requiring an active modulation of cardiac functions such as during REM sleep.

0835

NOCTURNAL HYPOKINESIA AND SLEEP QUALITY IN PARKINSON'S DISEASE

Louter M[1,2], Munneke M[3], Bloem B[1], Overeem S[1,2]
[1]Neurology, Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands, [2]Sleep Medicine Centre Kempenhaeghe, Heeze, Netherlands, [3]Neurology, Nijmegen Centre for Evidence Based Practice, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

Introduction: More than half of patients with Parkinson's disease (PD) have difficulties turning around in bed. This nocturnal hypokinesia is considered one of the factors responsible for the high prevalence of sleep disorders in PD. To date, little is known about the possible association between sleep disruption and problems turning around in bed. We therefore studied a large cohort of patients with PD, looking specifically at the relation between sleep quality on the one hand, and the presence and frequency of nocturnal hypokinesia on the other.
Methods: We included 240 consecutive PD patients visiting the Parkinson Centre Nijmegen, a tertiary university referral centre. Clinical and demographic data were obtained. Nocturnal hypokinesia was assessed using question 35 of the Parkinson's Disease Quality of Life Questionnaire. The presence was rated on a 5-point Likert scale, ranging from 1='all of the time' to 5='never'. Patients scoring 1-3 on the item were considered to have clinically relevant nocturnal hypokinesia. The Pittsburgh Sleep Quality Index (PSQI) was used to quantify sleep quality, higher scores indicating poorer sleep quality.
Results: Out of 240 patients, 135 had difficulties turning around in bed. PSQI scores were significantly higher in patients with nocturnal hypokinesia (PSQI 7.7±4.1) compared to those without (PSQI 6.1±3.4, p=0.001). A regression model correcting for age, disease duration and Hoehn & Yahr stage showed a significant influence of nocturnal hypokinesia on sleep quality (standardized-beta = 0.163, p=0.026). Finally, there was a linear relationship between frequency of nocturnal hypokinesia and sleep quality.
Conclusion: This is the first study to show that nocturnal hypokinesia negatively affects sleep quality in PD. Nocturnal hypokinesia therefore merits therapeutic attention, including optimal night-time dopaminergic treatment and education about turning strategies in bed.

0836

OBSTRUCTIVE SLEEP APNEA AND SUBJECTIVE DAYTIME SLEEPINESS IN PARKINSON'S DISEASE

Daley J[1], Chahine L[2], Cantor CR[1,2], Dahodwala N[2]
[1]Division of Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Department of Neurology, University Of Pennsylvania, Philadelphia, PA, USA

Introduction: Excessive daytime sleepiness (EDS) is common in Parkinson's disease (PD). Potentially, the use of dopaminergic medications or underlying neuropathology may contribute to somnolence. Obstructive sleep apnea (OSA), commonly associated with EDS, may also play a role. We sought to investigate this link by correlating apnea-hypopnea index (AHI) and subjective measures of night time and daytime sleep using a PD-specific questionnaire, the Scales for Outcomes in Parkinson's disease (SCOPA)-SLEEP.
Methods: Patients with PD were recruited from the Movement Disorders Clinic at the University of Pennsylvania. Patients answered the SCOPA-SLEEP questionnaire prior to nocturnal polysomnography. Scores for the overall assessment of sleep quality (SCOPA-C), nocturnal

sleep (SCOPA-NS), and daytime sleepiness (SCOPA-DS) were considered separately for this analysis.
Results: Of the 24 Parkinson's disease patients (16 males, 8 females) included, all were Hoehn and Yahr stage II, except for 3 who were stage I and 1 who was stage III. Mean disease duration was 5.2 years from time of diagnosis, and 6.5 years from time of symptom onset. 10 of these subjects had AHI>10; 7 of those had AHI>20. There was no significant correlation between SCOPA-DS score and AHI (Spearman's correlation = 0.11, p=0.60), nor did the presence of EDS (SCOPA-DS ≥ 5) correlate with the presence of OSA (AHI ≥ 10) (Fisher's exact test, p=0.50). Likewise, there was no correlation between SCOPA-C and AHI (Spearman's correlation = -0.31, p=0.15), or SCOPA-NS and AHI (Spearman's correlation=-0.28, p=0.19).
Conclusion: Within the limits of this small preliminary sample, this study demonstrates that AHI does not correlate to subjective ratings of nocturnal sleep or EDS in PD. Although previous studies have shown that EDS (as measured by the Epworth Sleepiness Scale), snoring and nocturia do not correlate with the presence of OSA in PD, this study confirms those findings with a PD-specific scale, the SCOPA-SLEEP.

0837

QUALITY OF SLEEP AND QUALITY OF LIFE IN PARKINSON'S DISEASE: PRELIMINARY ANALYSIS

Eckeli AL[1], Pena-Pereira M[1], Sobreira-Neto M[1], Sobreira ES[1], Chagas M[2], Rodrigues GR[1], Tumas V[1], Fernandes RM[1]
[1]Neurology, USP, Ribeirão Preto, Brazil, [2]Psychiatry, USP, Ribeirão Preto, Brazil

Introduction: Parkinson's disease is a progressive neurodegenerative disease, which substantially reduces the quality of life of affected individuals. This damage is due to motor symptoms such as tremor, rigidity, bradykinesia and postural instability, and non-motor symptoms, as autonomic dysfunction, pain, cognitive impairment, depression and sleep disorders. Changes in sleep affects up to 80% of patientes causing underestimated damage. The main objective is to evaluate the quality of sleep and quality of life in Parkinson's disease patients in a tertiary center for Movement Disorders in Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto - USP, São Paulo, Brazil.
Methods: Until now 31 patients with Parkinson's disease were randomly evaluated. The quality of sleep and quality of life were assessed by applying the Pittsburgh Sleep Quality Index - Portuguese version (PSQI-BR) - and the 39-item Parkinson's disease Questionnaire (PDQ-39), respectively. We calculated Pearson and Spearman correlation coefficients for non-parametric and parametric variables.
Results: The sleep quality index (PSQI-BR) was positively correlated with the quality of life index (PDQ-39) (r= 0.61, p ≤ 0.05), the component of the PSQI-BR corresponding to daytime dysfunction caused by sleep disorders had the highest association with total score of the PDQ-39 (r= 0.56, p ≤ 0.05). Among the sub-items of the PDQ-39, the one related to mobility had the greatest association with PSQI BR index (r= 0.52, p ≤ 0.05).
Conclusion: The poor quality of sleep measured by PSQI-BR was positively correlated with the quality of life measured by PDQ-39 questionnaire.

0838

EFFECTS OF HALLUCINATIONS ON DAYTIME SLEEPINESS AND SLEEP DISTURBANCES IN PARKINSON'S DISEASE

Bradley L[1], Neikrug AB[1,2], Avanzino JA[1], Carbungco A[1], Lichter L[1], Maglione JE[1], Liu L[1], Natarajan L[3], Ancoli-Israel S[1,2]
[1]Department of Psychiatry, University of California San Diego, La Jolla, CA, USA, [2]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, , San Diego, CA, USA, [3]Preventive and Family Medicine, UCSD, La JOlla, CA, USA

Introduction: Approximately one third of patients with Parkinson's disease (PD) also experience visual and/or auditory hallucinations. As PD progresses, hallucinations can occur more frequently. Researchers have suggested that visual and/or auditory hallucinations can be linked to REM Behavior Disorder (RBD). We hypothesized that PD patients who experience visual and/or auditory hallucinations are sleepier during the day and have more disrupted sleep patterns while controlling for RBD status.
Methods: As part of a larger study assessing the effect of OSA treatment in PD, eighty-one PD patients (mean age=68; SD=8.9) were assessed for hallucinations with a single question: "Have you seen or heard things that you know or are told are not there?" Patients were classified as either a hallucinator (n=13) or non-hallucinator (n=68) based on their responses. Patients were also assessed for RBD using the REM behavior disorder screening questionnaire (RBDSQ) (RBDSQ < 5, no-RBD; RBDSQ >= 5, yes-RBD). Finally, all patients were assessed for subjective sleepiness using the Parkinson's Disease Sleep Scale (PDSS). Multiple regression correlation was used to assess the relationship between hallucinations, RBD, and PDSS scores.
Results: Regression analysis showed a significant model (R2=0.142, F2,77=6.395, p=0.003) with only hallucination status being a significant predictor of PDSS scores while controlling for RBD status. Post-hoc analysis revealed a significant difference in the scores of those who experienced hallucinations (mean PDSS=80.73, SD=20.13) vs. those not experiencing hallucination (mean PDSS= 107.71, SD=19.45; p=.001).
Conclusion: While preliminary, these results suggest that PD patients with hallucinations are sleepier during the day than those with no hallucinations, independent of RBD.
Support (If Any): NIA AG08415, UC1RR031980, the Research Service of the Veterans Affairs San Diego Healthcare System and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

0839

EVALUATION OF CSF HISTAMINE IN THE PATIENTS WITH VARIOUS ATYPICAL PARKINSONIAN DISORDERS

Kanbayashi T[1], Yasui K[2], Kodama T[3], Nomura T[2], Inomata Y[1], Yagisawa K[1], Yaegashi K[1], Kosaka M[1], Nakashima K[2], Shimizu T[1]
[1]Akita University, Akita, Japan, [2]Neurology, Tottori University, Tottori, Japan, [3]Metropolitan Institute of Medical Science, Tokyo, Japan

Introduction: It has been recently reported that histamine decreases in the primary CNS hypersomnia, such as narcolepsy and idiopathic hypersomnia (Nishino 2009, Kanbayashi 2009). Histaminergic neurons are located exclusively in the tuberomammillary nucleus (TMN) of the posterior hypothalamus and project their axons to various brain regions. Histamine is released in the brain not only from TMN histamine neurons, but also from brain mast cell enriched in the choroid plexus, and peripheral blood transferred to CNS. Histamine release by these cells may contribute to CSF histamine levels. In association with the mast cells, increased CSF histamine levels have been reported in meningitis and encephalitis (Ito 2010). However, the histamine levels in other diseases are still unknown. We have estimated the histamine in CSF of several neurological diseases.

Methods: The histamine was measured by using HPLC. The hypocretin/orexin levels were measured by RIA. The measurements were duplicated and the mean values were used. The disease groups are patients with various atypical parkinsonian disorders (APD), such as, cerebellar variant of multiple system atrophy (MSA-C, n=54), parkinson variant of MSA (MSA-P, n=5), progressive supranuclear palsy (PSP, n=4) and corticobasal degeneration (CBD, n=3). For statistical analysis, a nonparametric Kruskal-Wallis test was used to analyze. Statistical significance was set at $p< 0.05$.
Results: The CSF histamine levels in PSP (mean: 351 pg/ml) and CBD (306 pg/ml) were lower compared to MSA-C and MSA-P (2588 pg/ml, 2651 pg/ml, respectively). However the significant difference was only seen between PSP and MSA-C (p=0.026), due to the few sample numbers. The levels of hypocretin/orexin were within normal range (199-345 pg/ml) and no siginificant difference was identified between the disease groups.
Conclusion: The hypocretin/orexin levels were not shown any differences, the histamine levels of PSP and CBD were lower than those of MSA-C and MSA-P. Since the hypothalamus became atrophic due to the pathogenesis of PSP and CBD, the histamine levels of PSP and CBD were reduced compered to those of MSA-C and MSA-P. Although the differential diagnosis of parkinsonian syndromes is considered one of the most challenging in clinical neurology, the histamine levels could be used for the diagnosis. Further studies are needed for the patients with Parkinson's diseases and more cases with MSA-P, PSP and CBD.

0840

COGNITIVE IMPAIRMENT PREDICTS WAKE AFTER SLEEP ONSET IN PARKINSON'S PATIENTS

Avanzino JA[1], Neikrug AB[1,2], Maglione JE[1], Palmer B[1], Liu L[1], Carbungco A[1], Bradley L[1], Faierman M[1], Corey-Bloom J[3], Ancoli-Israel S[1,2,4]
[1]Psychiatry, University of California, San Diego, La Jolla, CA, USA, [2]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, , San Diego, CA, USA, [3]Neurosciences, UCSD, La Jolla, CA, USA, [4]Medicine, UCSD, La Jolla, CA, USA

Introduction: Sleep disorders are prevalent in Parkinson's disease (PD), and research indicates that cognitive impairment (CI) in PD is related to multiple factors including sleep disturbances. Obstructive sleep apnea (OSA) may be a contributing factor in sleep disruption of PD patients. Few studies have evaluated the relationship between OSA, CI, and sleep disruption in PD. We hypothesized that OSA and mild CI are significant predictors of greater wake after sleep onset (WASO) in PD.
Methods: As part of a larger study evaluating the effect of OSA treatment in PD, 78 patients (mean age=67.6y; 52 men) underwent an overnight PSG screen for OSA (AHI≥10). WASO was calculated. All patients were evaluated with the Montreal Cognitive Assessment (MoCA) for mild CI (defined as MoCA<26). The relationship between patients with OSA and CI (OSA+CI), with OSA and without CI (OSA-CI), without OSA and with CI (nOSA+CI), and without OSA and without CI (nOSA-CI) was assessed with a multiple regression correlation, controlling for age.
Results: Of the 78 patients, 44 had OSA and 46 were classified as having mild CI. There were 27 patients with OSA+CI (mean WASO=118.3, SD=71.8), 17 patients with OSA-CI (mean WASO=83.3, SD=40.3), 19 patients with nOSA+CI (mean WASO=138.7, SD=72.1) and 15 patients with nOSA-CI (mean WASO=86.6, SD=38.2) (differences between groups were significant; p=0.022). A regression analysis revealed a significant model ($F_{3,77}$=4.72, p=0.005, R^2=0.16) with only cognitive groups being a significant predictor of WASO (β=33.98, p=0.021).
Conclusion: These results showed that mild cognitive impairment was associated with and was a predictor of more wake time during the night while OSA was not. These results suggest that wakefulness after sleep onset is correlated with factors other than OSA in PD patients.

Support (If Any): Supported by NIA AG08415, UL1RR031980 (CTRI), the UCSD Stein Institute for Research on Aging and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

0841

SLEEP MOTOR ACTIVITY IN PARKINSONISM AT DISEASE ONSET: A POSSIBLE MARKER FOR DIFFERENTIAL DIAGNOSIS

Alessandria M, Calandra-Buonaura G, Sambati L, Terlizzi R, Guaraldi P, Provini F, Cortelli P
IRCCS Istituto delle Scienze Neurologiche, University of Bologna, Bologna, Italy

Introduction: Differential diagnosis of parkinsonisms at disease onset may be difficult as clinical and instrumental markers for a specific syndrome are still lacking. Aim of this study is to describe the possible diagnostic value of videopolysomnographic (VPSG) motor findings in patients with recent onset parkinsonism.
Methods: We studied 23 consecutive patients (11 women; mean age 59±11 years) evaluated at the Movement Disorders Center of our Institute for a neurodegenerative disease presenting with parkinsonian features and disease duration up to 3 years (mean disease duration 21±12 months). Patients were diagnosed as Parkinson disease (PD, 17 patients), PD plus (PD with cognitive impairment or dysautonomia, 2 patients) and as parkinsonian syndromes (PS, 4 patients). All patients underwent a full night VPSG, scored by a neurologist blinded to the clinical diagnosis.
Results: All patients showed a reduced sleep efficiency (66±15%; normal value >85%); total sleep time (TST) was 260 ± 65 minutes. All sleep stages were represented; REM sleep percentage was 16±8% of TST. Analysis of sleep motor activity showed a sustained muscle EMG activity or an excessive phasic muscle activity during REM sleep in 12 patients (7/17 PD; 2/2 PD plus; 3/4 PS). REM behavior disorder was recorded in 1/17 PD, 2/2 PD plus and 2/4 PS. 4 patients (1/2 PD plus; 3/4 PS) presented more than one hypnic jerks during VPSG; 2 patients showed excessive fragmentary myoclonus (1/2 PD plus;1/4 PS); in 8 patients the periodic limb movements index was >15 (4/17 PD; 4/4 PS).
Conclusion: Our preliminary data suggest that sleep motor control is more impaired at disease onset in patients with PS and PD plus compared to PD patients. More data are needed to establish if these features may have a diagnostic value in the differential diagnosis of parkinsonism.

0842

SLEEP BENEFIT IN PARKINSON'S DISEASE; THE BENEFIT OF AFTERNOON NAPS

van Gilst MM[1], Louter M[2], Bloem B[1], Baumann CR[3], Overeem S[1,2]
[1]Neurology, Donders Institute for Brain Cognition and Behavior, Radboud University Nijmegen Medical Center, Nijmegen, Netherlands, [2]Sleep Medicine Centre Kempenhaege, Heeze, Netherlands, [3]Neurology, University Hospital Zurich, Zurich, Switzerland

Introduction: Some patients with Parkinson's disease (PD) report a beneficial effect of sleep, with an improved motor functioning upon awaking in the morning, contrary to what would be expected after a night without medication. This so-called sleep benefit (SB) is an intriguing phenomenon, but research is still limited. We further examined SB, with additional attention to possible SB after daytime naps.
Methods: We assessed clinical screening questionnaires completed by consecutive PD patients visiting the Parkinson Centre Nijmegen, a tertiary referral centre for extrapyramidal disorders. Questionnaires were analyzed on the subjective presence of SB, general patient characteristics, sleep quality and sleeping habits.
Results: We included 240 patients, 113 of whom (47,1%) indicated to experience SB. There was a difference in presence of SB between pa-

tients who did take daytime naps (n=98; 40.8%) versus those who did not ($\chi^2 = 22.641$ $p < 0.000$). Of the patients who regularly took an afternoon nap, 13.3% experienced SB after a nap and 20.4% after both night and daytime sleep. Whereas 20.4% only had SB after night sleep and 45.9% was not familiar with SB. Of the non-nappers 42.3% experienced SB.

Conclusion: These data confirm that sleep benefit is a significant phenomenon in PD. We found a substantial part of the patients profiting from SB, also after daytime sleep. As such, an afternoon nap could be a valuable addition to regular medical therapy. Patients and medical practitioners should be made aware of these beneficial effects of sleep in PD. Furthermore, research should be conducted to study the underlying mechanisms and enhance the clinical applicability of SB.

0843

SLEEP BENEFIT IN PARKINSON'S DISEASE; THE BENEFIT OF NOCTURNAL SLEEP

Valko P[1], Sherif E[1], Overeem S[2], Baumann CR[1]
[1]Neurology, University Hospital of Zurich, Zurich, Switzerland,
[2]Neurology, Donders Institute for Brain Cognition and Behavior, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

Introduction: Sleep benefit (SB) in Parkinson's disease (PD) has been defined as restoration of mobility on awakening from sleep prior to drug intake. Previous studies suggested that SB is a common phenomenon in PD patients, with a frequency above 40%, and is associated with longer disease duration and more severe motor symptoms. There is, however, no information on whether type (predominant bradykinesia versus predominant tremor) and laterality of motor symptoms or psychiatric comorbidities in PD are associated with the presence of SB.

Methods: In 131 consecutive PD patients, we performed clinical examinations of motor symptoms in the OFF state including the Unified Parkinson's disease rating scale part III (UPDRS III), and also assessed clinical screening questionnaires for SB, anxiety, depression and sleep-wake characteristics.

Results: Thirty-nine PD patients (30%) reported improvement after nocturnal sleep. PD patients with and without SB did not differ in age, sex distribution, disease duration and presence of motor fluctuations. We found an increased UPDRS III score in patients with SB (30±15 vs. 23±10, p=0.05). Measures of sleep quality, sleepiness, fatigue, depression, or anxiety were not linked to SB, and side and type of motor symptoms had no influence on the expression of SB. Also, we could not detect any association between dopaminergic treatment including long acting dopamine agonists and the presence of SB.

Conclusion: Although our data yielded a lower prevalence of SB in PD than most previous reports, this study confirms that this phenomenon is common in PD patients. Apart from severity of motor symptoms, as assessed with the UPDRS III, no other characteristics including demographic variables, type of motor symptoms, laterality, psychiatric comorbidities, measures of sleep and wakefulness or medication are linked to SB, which suggests that this phenomenon can be neither predicted nor induced by medication.

0844

THE ASSOCIATION BETWEEN PROCESSING SPEED AND PSG-MEASURED SLEEP IN TRAUMATIC BRAIN INJURY

Beaulieu-Bonneau S, Fortier-Brochu E, Morin CM
Ecole de psychologie, Universite Laval, Quebec, QC, Canada

Introduction: Traumatic brain injury (TBI) is often characterized by long-lasting cognitive deficits. Previous studies have suggested a link between impaired attention and poorer sleep quality in healthy individuals. The aims of this study were to compare TBI and healthy control participants on processing speed measures and explore the relationship between processing speed deficits and sleep continuity and architecture in the TBI group.

Methods: Participants were 22 adults with moderate/severe TBI (mean age=37.5±13.3 years, 22.7% women, mean time since injury=53 months) and 22 matched healthy controls (37.0±14.1 years, 22.7% women). They underwent one night of polysomnography (PSG) and completed the Trail Making Test (TMT) and the Continuous Performance Test (CPT-II) on the following day. Using age-corrected Z scores for selected variables from the TMT and the CPT-II, participants were classified as either having at least one mild processing speed deficit ($z \leq -1$; n=12) or no deficit ($z > -1$; n=10). T-tests were computed to compare TBI and CTL participants on processing speed measures and to compare TBI participants with or without processing speed deficits on standard PSG variables of sleep continuity (SOL, WASO, TWT, SE, nWAK) and architecture (%s1, %s2, %s3, %s4, %REM).

Results: TBI participants were slower on all measures of processing speed ($.02 \leq ps \leq .08$) relative to healthy controls. In the TBI group, participants with mild speed deficits tended to display more sleep continuity problems and lighter sleep compared to those without deficit ($.08 \leq ps \leq .37$). Although none of these differences reached statistical significance, their magnitude was in the moderate to large range ($.55 \leq ds \leq .78$), except for WASO (d=.40), %REM (d=.47) and %s3 (d=.06).

Conclusion: These exploratory analyses suggest that the presence of a mild deficit in processing speed is associated with worse PSG-measured sleep quality in individuals with moderate-to-severe TBI. Thus, it seems that poor sleep could exacerbate attentional deficits in vulnerable individuals.

Support (If Any): Supported by the Canadian Institutes of Health Research.

0845

PROSPECTIVE LONG-TERM EVALUATION OF SLEEP-WAKE DISTURBANCES AFTER TRAUMATIC BRAIN INJURY

Imbach LL, Valko P, Li T, Werth E, Baumann CR
Departement of Neurology, University Hospital Zurich, Zurich, Switzerland

Introduction: Sleep-wake disturbances (SWD) are frequently encountered in patients after traumatic brain injury (TBI). After acute brain lesions, sleep electroencephalogram changes including enhanced non-rapid eye movement sleep and increased delta power occur, but controlled prospective studies are not available so far. Therefore, we examined SWD shortly after TBI and in a long-term follow-up to gain better insight into sleep-related recovery processes after TBI.

Methods: For the presented prospective study, we included patients within the first week after TBI and assessed polysomnography and multiple sleep latency test (MSLT) 5 and 18 months after TBI. Here, we present preliminary data of patients at 5 months (15 patients, age 41±17 years) and at 18 months (5 patients, age 31.4±12.2 years) after TBI.

Results: 5 months after TBI we observed short sleep latencies (< 10min) on MSLT in 47%, and excessive daytime sleepiness (Epworth Sleepiness Scale > 10) in 20% of all TBI patients. After 18 months, mean sleep latencies showed a slight increase (9.5±1.1 min vs. 11.4±1.0 min). In nocturnal polysomnography, we found high amounts of deep sleep 5 and 18 months after TBI (16.6±5 % and 25.8±5 %). Furthermore, we observed a significant increase in REM sleep after 18 months (15±2 % (5m) vs. 23±1 % (18m) p=0.02), representing an improved sleep efficiency 18 months after TBI.

Conclusion: In line with previous studies we found a high prevalence of SWD 5 months after TBI with a tendency for improvement after 18 months. The observed increase of deep sleep in polysomnography could represent a long-standing recovery process after TBI. This observation is in line with the notion that deep sleep might be related to neuronal plasticity processes. The increase in REM sleep after 18 months on the other hand could be related to increased need of procedural learning during the rehabilitation process after TBI.

Support (If Any): This study is supported by the Swiss National Science Foundation (SNF).

0846

THE ASSOCIATION OF SLEEP AND FUNCTIONAL OUTCOMES AT ONE YEAR AFTER TRAUMATIC BRAIN INJURY

Fogelberg D[1], Hoffman JM[1], Dikmen S[1,2,3], Vitiello MV[3], Bell KR[1]
[1]Rehabilitation Medicine, University of Washington, Seattle, WA, USA, [2]Neurological Surgery, University of Washington, Seattle, WA, USA, [3]Psychiatry and Behavioral Medicine, University of Washington, Seattle, WA, USA

Introduction: Sleep disturbances are common sequelae of traumatic brain injury (TBI), with prevalence rates exceeding those of the general population. Individuals with TBI who report poor sleep have significantly higher levels of depression, anxiety, and pain, all factors potentially affecting function. While the impact of sleep disturbance on function in the general population is becoming better understood, this has not been well documented in the context of TBI.
Methods: 174 individuals with moderate to severe TBI were recruited from consecutive admissions to an inpatient rehabilitation unit and enrolled into the TBI Model System Study. Data for this study were collected at one year after TBI. Sleep was assessed using the Pittsburgh Sleep Quality Index (PSQI). Functional outcomes were assessed using the FIM™ (a measure of caregiver burden), the Disability Rating Scale (DRS; a measure of general function), and the Satisfaction With Life Scale (SWLS; a measure of subjective well-being).
Results: The overall sample mean for the PSQI was 5.54, indicating a clinically significant sleep disorder. Subjects classified as having poor sleep scored significantly worse on all outcome measures studied ($p<0.001$). The sleep dimensions most strongly correlated with both the FIM and DRS were sleep disturbances (r=-0.46 and 0.38 respectively) and daytime dysfunction (-0.39 and .41 respectively). The strongest correlates for the SWLS were sleep quality (-0.46), latency (-0.44), and disturbances (-0.42).
Conclusion: The results of this study highlight the importance of screening individuals with TBI for sleep disturbances. While conclusions about causality cannot presently be made, the strong association of sleep and poor functional outcomes in this population indicates the importance of further research on how treatment of sleep difficulties may impact functioning.
Support (If Any): University of Washington Traumatic Brain Injury Model System H133A070032 funded by the National Institute on Disability and Rehabilitation Research.

0847

IS NREM SLEEP MICROSTRUCTURE ALTERED SEVERAL YEARS AFTER TRAUMATIC BRAIN INJURY?

Beaulieu-Bonneau S[1], Gosselin N[2,3], Blais H[2], Morin CM[1]
[1]Ecole de psychologie, Universite Laval, Quebec, QC, Canada, [2]Centre d'etudes avancees en medecine du sommeil, Hopital du Sacre-Coeur de Montreal, Montreal, QC, Canada, [3]Departement de psychiatrie, Universite de Montreal, Montreal, QC, Canada

Introduction: Sleep disturbances are common following traumatic brain injury (TBI). While several studies have examined the sleep macrostructure in TBI, data on the sleep microstructure are scarce, especially in the long-term in patients with moderate-to-severe injuries. The objective of this study was to compare TBI and healthy control participants on quantitative EEG measures during NREM sleep.
Methods: Participants were 22 adults with moderate/severe TBI (mean age=37.5±13.3 years, 22.7% women, mean time since injury=53 months) and 22 matched healthy controls (37.0±14.1 years, 22.7% women). They underwent one night of polysomnography (PSG). Power spectral analysis was performed on NREM (stages 2, 3 and 4) sleep for the entire night on three electrode sites (frontal: F3; central: C3; occipital: O1). Delta (0.5-4 Hz), theta (4-8 Hz), alpha (8-13 Hz), beta-1 (13-22 Hz) and beta-2 (22-32 Hz) frequency bands were examined. Mixed-model factorial repeated-measure analyses of variance (between-subject factor: group, within-subject factor: site) were computed for relative spectral power for each frequency band. Group effect and group*site interaction were examined. Analyses were conducted for the total sample and in an unmedicated subsample (N=9/group).
Results: Group*site interaction was significant for relative delta (p=.01) and theta (p=.003) power in the total sample, and remained significant in unmedicated participants for the theta band only (p=.04). Simple effects' tests revealed a trend towards greater relative theta power at the occipital site in TBI compared to control participants, both in the total sample (p=.07) and in the unmedicated subsample (p=.06). There were no other significant interactions or group effects.
Conclusion: These preliminary results suggest that NREM sleep microstructure is well preserved several years after moderate-to-severe TBI. Further analyses will be conducted on REM sleep and on the course of spectral power across time during the night.
Support (If Any): Supported by the Canadian Institutes of Health Research.

0848

IDENTIFYING SLEEP DISORDERED BREATHING IN CHRONIC SPINAL CORD INJURY

Bascom AT[1,2], Sankri-Tarbichi A[1,2], Badr M[1,2]
[1]John D. Dingell VA Medical Center, Detroit, MI, USA, [2]Wayne State University, Detroit, MI, USA

Introduction: Sleep disordered breathing (SDB) is more prevalent in those with spinal cord injury (SCI) compared with healthy non-injured individuals. The phenotype of this SDB is not well described in the literature and the underlying mechanisms are not known.
Methods: Thirteen consecutive subjects with chronic SCI (4 female, 9 male, age 41±15 years, BMI 25±4.9 kg/m^2, neck circumference 39±5 cm) were recruited. Eight cervical and 5 thoracic SCI subjects (C4-T6 spinal levels) were studied using overnight polysomnography in our laboratory. Sleep staging and respiratory events were scored according to the American Academy of Sleep Medicine (AASM) alternate criteria. Additionally, 9 of the 13 studies were scored using the AASM standard criteria. Each subject completed sleep questionnaires including the Pittsburg Sleep Quality Index (PSQI), the Fatigue Severity Scale (FSS) and the Epworth Sleepiness Scale (ESS).
Results: AHI was significantly higher using the alternate criteria versus the standard criteria (29.8±30.2 vs. 18.9±23.3, p=0.02). Scoring with alternate criteria revealed that 11 of 13 (84.5%) subjects had an AHI>5/hour while this was the case in only 6 of 9 (66%) subjects when scored using standard criteria. All 8 cervical SCI subjects (100%) had SDB, while 3 of 5 (60%) thoracic subjects had an AHI >5/hour. The sleep efficiency was 60.0±23.8 and the arousal index was 29.0±21.5/hour (predominantly respiratory related). The mean PSQI was 10.8±3.6, the FSS was 4.5±1.5 and the ESS was 10.6±3.9. The ESS correlated with AHI in cervical (R2 =0.48) but not thoracic subjects. No association was found between AHI either the PSQI or FSS.
Conclusion: Sleep disordered breathing is more common and more severe in chronic SCI when alternate scoring criteria is used. SDB is more predominant in cervical vs. thoracic SCI. The majority of SCI patients have poor sleep, fatigue and mild daytime sleepiness that correlates with the severity of SDB in cervical SCI only.
Support (If Any): VA Merit Review Award.

0849

SEASONAL DIFFERENCE OF CIRCADIAN VARIATION IN THE TIMING OF CEREBRAL INFARCTION ONSET: A HOSPITAL-BASED STUDY

Yang K[1], Choi Y[1], Jeong D[1], Oh H[1], Park H[1], Jung K[2], Hwangbo Y[3]
[1]Neurology, Soonchunhyang University Cheonan Hospital, Cheonan, Republic of Korea, [2]Neurology, Korea Medical Center, Korea University, Seoul, Republic of Korea, [3]Preventive Medicine, Soonchunhyang University, Cheonan, Republic of Korea

Introduction: Stroke occurrence shows a chronobiological variation, which is considered to related with waking in the morning. We hypothesized its seasonal difference would be also existed because individual life activity including sleep-wake pattern can be influenced by different seasonal environment. The objective of this study was to investigate seasonal difference of circadian variation in the timing of onset in the Korean patients with acute cerebral infarction.
Methods: We studied 1,104 patients were admitted to the neurology department of Soonchunhyang Cheonan hospital of Korea due to acute ischemic stroke from March 2008 to February 2011. Stroke onset time was defined as the earliest time the patient or a witness noted definite neurological symptoms or signs. The patients were divided into three categories as onset time; clear, unclear, and undetermined. Frequency of onset was analyzed for twelve 2-hour and four 6-hour intervals from 0 to 24 hour in a day. We compared circadian variation of clear onset patients in all type of stroke between four seasons.
Results: The clear onset time was known in 737 patients (66.8%). Mean age of the patients was 68±0.5 years and 445 patients (60.4%) were male. Stroke occurred in spring (n=197, 26.7%), summer (n=196, 26.6%), fall (n=185, 25.1%), and winter (n=159, 21.6%). In all onset situations, the ischemic stroke showed a significant circadian variation in time of onset, both divided into 2 and 6 time interval by chi-square test ($p<0.001$). High peak period was between 6:01 to 12:00 (n=273, 37%) and same pattern in the each season.
Conclusion: We did not find significance of seasonal difference although circadian variation existed in time of onset in acute ischemic stroke. Sleep-wake pattern may not be influenced by seasonal environment in this regional population.

0850

SUBJECTIVE SLEEP CHARACTERISTICS IN STROKE PATIENTS

Coelho FM[1,2,3], Parekh N[2], Narayansingh M[2], Daniels C[3], McIlroy W[3], Black S[2,3], Murray BJ[2,3]
[1]Neurology, Hospital Albert Einstein, São Paulo, Brazil, [2]Neurology, University of Toronto, Toronto, ON, Canada, [3]Heart and Stroke Foundation Centre for Stroke Recovery, University of Toronto, Toronto, ON, Canada

Introduction: The natural history of sleep disorders following stroke is unknown. In the stroke population, subjective sleepiness does not reflect the higher prevalence of sleep disorders in the stroke population. Recent studies have shown that daytime napping has a positive impact on learning and memory.
Methods: 54 stroke patients were followed for a minimum of three assessments immediately following discharge from outpatient rehabilitation and at 3-months, 6-months, 1- and 2-years following stroke. Identical 10 question surveys on sleep including the Epworth Sleepiness Scale, sleep routines, as well as symptoms of sleep disorders such as restless sleep, restless leg sensations, snoring, and gasping were used in each assessment.
Results: Neither sleep routines nor symptoms of sleep disorders significantly changed throughout the follow up. This cohort was not subjectively sleepy. Higher FIM scores and a trend towards greater improvement in FIM scores were seen in individuals who nap.
Conclusion: A lower threshold for assessing sleep is warranted given the absence of subjective sleepiness. This study also suggests that daytime napping could enhance rehabilitation in the stroke population. Future prospective studies could evaluate the impact of planned napping during stroke rehabilitation once underlying sleep disorders are identified and appropriately treated.

0851

POLYSOMNOGRAPHIC FINDINGS IN PATIENTS WITH CREUTZFELDT-JAKOB DISEASE (SCJD) AT BARNES-JEWISH HOSPITAL FROM 2005-2010

de Bruin G[1], Patrick E[1], Bucelli RC[1], Wang LH[1], Alvarez EA[1], Lim MM[1,2], Ances BM[1], Ward BA[1]
[1]Neurology, Washington University School of Medicine, St Louis, MO, USA, [2]Sleep Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA, USA

Introduction: Sporadic Creutzfeldt-Jakob Disease (sCJD) is a rapidly progressive dementia (RPD) that is difficult to diagnose. Definitive diagnosis requires tissue confirmation via biopsy or autopsy. Sleep complaints have been identified as a common, early manifestation of sCJD. However, studies aimed at characterizing the polysomnographic features of sCJD are limited. In this study, we evaluated the sleep complaints of 20 patients with sCJD and reviewed polysomnography (PSG) data on 10 patients. We compared the PSG findings to those of 5 patients with RPD of non-prion etiologies.
Methods: We reviewed clinical data on 20 patients with sCJD (19 definitive, 1 probable) that presented to our institution between 2005 and 2010. Charts were reviewed for the presence and quality of sleep symptoms. In 10 cases, PSG was available for review. We analyzed the PSG for sleep architecture and sleep-related pathology. We compared the PSG findings to those of 5 patients that presented between 2009 and 2010 with rapidly progressive dementia of other etiologies.
Results: Sleep symptoms were present in 18 of 20 sCJD patients. The most common symptoms, in order of frequency, were excessive daytime sleepiness, dream-enactment behavior, fragmented nocturnal sleep and insomnia. PSG showed loss of normal sleep architecture in over 50% of the sCJD cohort. REM sleep and SWS were decreased compared to stages N1 and N2. Sleep architecture was more disrupted in patients with more advanced disease. Sleep apnea and periodic limb movement disorder (PLMD) were common. Similar findings were present in the non-prion RPD cohort, with regards to both sleep architecture and the presence of sleep apnea and/or PLMD.
Conclusion: Our results suggest that sleep symptoms are common to all RPDs, including sCJD and that normal sleep architecture is lost in both with disease progression. Sleep-disordered breathing and PLMD were common in both groups.

0852

SLEEP SPINDLES IN AUTISM: DEVELOPMENTAL PERSPECTIVE OF AN EEG MARKER OF POOR SLEEP

Chicoine M[1], Duplan SM[1], Lambert A[1], Tessier S[1], Rochette A[1], Chevrier [1], Mottron L[2,3,4], Godbout R[1,3,4]
[1]Sleep Laboratory and Clinic, Rivière-des-Prairies Hospital, Montréal, QC, Canada, [2]Autism Clinic, Rivière-des-Prairies Hospital, Montréal, QC, Canada, [3]Centre de recherche Fernand-Séguin, Rivière-des-Prairies Hospital, Montréal, QC, Canada, [4]Department of Psychiatry, Université de Montréal, Montréal, QC, Canada

Introduction: Autism is characterized by poor sleep maintenance. EEG sleep spindles represent a sleep protective mechanism based on thalamocortical loop inhibition. Adults with autism display less sleep spindles than typically developed (TD) individuals but the data in children is less documented. We compared sleep spindle activity in children and adults, with and without autism to answer the following: 1) Are sleep spindles also less in autistic children compared to TD children? 2) Does spindle

density vary according to age similarly in children and adults with and without autism?.
Methods: 34 adults (16 with autism: 15M, 1F, 22.1 +/- 1.3 yrs; 18 controls: 17M, 1F, 21.1 +/- 1.0 yrs) and 26 children (13 with autism: 13M, 0F, 10.7 +/- 1.9 yrs: 13 controls: 13M, 0F, 10.2 +/- 2.0 yrs) were recorded for two consecutive nights in a sleep laboratory. Stage 2 sleep spindles were visually identified for Fp1, Fp2, C3 and C4 electrodes. Sleep structure and spindle density were compared using t-tests.
Results: Children and adults with autism showed signs of poor sleep when relative to their respective comparison group of TD individuals. Sleep spindle density was similar in children with and without autism. Adults with autism had significantly less spindles than controls at C3 and C4, not Fp1/Fp2 and significantly less spindles than children with autism at the four recording sites. TD children had significantly more spindles than TD adults at Fp1 and Fp2, not C3/C4. Both groups showed a similar decrease in sleep spindle density from childhood to adulthood at the frontal electrodes but the age-related decrease at central electrodes was steeper in the autism group.
Conclusion: Contrary to adults with autism, poor sleep in children with autism is not reflected in EEG sleep spindle activity. The pattern of sleep spindle topography according to age suggests an atypical antero-posterior maturational course in autism.
Support (If Any): Supported by the Canadian Institutes of Health Research.

0853

SLEEP AND SLEEP DISORDERS IN PRIMARY AUTONOMIC DYSFUNCTION SEEN IN A TERTIARY REFERRAL SLEEP CENTER

Nair A[1], Guggali S[2], Barboi A[3], Franco RA[1]
[1]Division of Sleep Medicine, Dept. of Otolaryngology, Medical College of Wisconsin, Milwaukee, WI, USA, [2]Dept of Psychiatry, Medical College of Wisconsin, Milwaukee, WI, USA, [3]Dept. of Neurology, Medical College of Wisconsin, Milwaukee, WI, USA

Introduction: Fatigue and sleep difficulties are common complaints in primary autonomic dysfunction and may lead to significant decrease in quality of life. However the cause of the complaints is not well characterized. We aim to better characterize sleep disorders and sleep architecture in patients with primary autonomic dysfunction.
Methods: Nocturnal Polysomnograms and sleep complaints recorded from the intake questionnaire for patients with primary dysautonomia referred to our sleep center from 2003 through 2009 were retrospectively reviewed.
Results: Sixty two subjects (age: 45±13 years, range: 16-79 years, female/male = 46/16) with complete data were selected. The sleep symptoms reported most often were unrefreshing sleep (96.8%), excessive daytime sleepiness (75.8%), snoring (58.1%), RLS symptoms (54.8%), and waking up gasping (53.2.%). Polysomnogram analysis showed sleep efficiency 80.2±17%, sleep onset latency 27.6±43.9 minutes, REM latency 142.6±76.7 minutes, sleep arousal index 16.2±14.8, sleep stage distribution: stage I (13.5%), stage II (57.4%), stage III (14.9%) and REM (14.2%). Periodic Limb Movement (PLM) Index was >15/hour in 19% of patients (32.2±21.8). The Apnea-Hypopnea Index (AHI) was >5 in 37% of the subjects (16.9±10.9).
Conclusion: Although unrefreshing sleep and excessive daytime sleepiness were frequent complaints in patients with primary autonomic dysfunction, the role of sleep study in this population appears limited. Only 37% studied had obstructive sleep apnea, often mild in nature. The PLM index was elevated only in 19% while 55% reported RLS symptoms. With rare exception, sleep macro and micro architecture of subjects were not in general revealing. Prospectively designed studies including comprehensive sleep evaluations and quality of life measurement in this population are needed.

0854

HOME BASED UNATTENDED SLEEP STUDY ACCELERATES NON-INVASIVE VENTILATION (NIV) DEPLOYMENT FOR AMYOTROPHIC LATERAL SCLEROSIS (ALS) PATIENTS: AUDIT RESULTS AT CAROLINAS NEUROMUSCULAR /ALS-MDA CENTER

Desai U, Langford VL, Bravver E, Sanjak M, Williams NM, Russo PC, Lindblom SS, Brooks BR
Sleep Disorders Clinic; Carolinas Neuromuscular/ ALS-MDA Center, Department of Neurology, Carolinas Medical Center; University of North Carolina School of Medicine, Charlotte Campus, Charlotte, NC, USA

Introduction: Respiratory insufficiency(RI) occurs earlier during sleep than standard diurnal measures indicate in ALS patients. Increased survival observed in ALS related to earlier deployment of NIV and number of ventilator use hours warrants early RI detection.
Methods: ALS patients have difficulty tolerating multichannel polysomnography because of weakness, reduced mobility, secretions and dysarthria hampering communication. Peripheral arterial tonometry(WatchPAT100, Itamar Medical) measures changes in blood flow to the finger, an area nearly exclusively regulated by adrenergic innervation. Periodicity, duration, heart rate and desaturation algorithms indirectly estimate AHI(Apnea Hypopnea Index)by identifying surges of sympathetic activation(autonomic arousals) occurring at termination of respiratory events. Advantages include home based setting, simplicity of equipment, reduced cost and inbuilt actigraphy. Audit of 26 consecutive patients at ALS multidisciplinary clinic over 8 months reviewed sitting/supine FVC(Forced Vital Capacity), NIF(Negative Inspiratory Force), SE(sleep efficiency), AHI(Apnea Hypopnea Index), RDI(Respiratory Disturbance Index) and ODI(Oxygen Desaturation Index).
Results: 5/26 patients (19.2 %) showed sitting FVC<50% qualifying for NIV. From 21/26 (80.8 %) with sitting FVC>50%, 3/21 (14.2 %) showed supine FVC<50% qualifying for NIV. Out of 18/26(69.2 %) who could not qualify for NIV based on sitting/supine FVC< 50%; 14/18 (77.8 %) showed elevated AHI (>5) while 16/18 (88.9 %) showed elevated RDI (>5) during home based unattended sleep study qualifying for NIV.
Conclusion: While sitting/supine FVC<50% qualified only 8/26(30.8%) of ALS patients for NIV; home-based unattended sleep study additionally qualified 77.8 %(based on elevated AHI) and 88.9%(based on elevated RDI) who would not have qualified otherwise. Thus, current standard diurnal respiratory measures minimize the degree of RI in ALS. Identification of sleep-related hypoventilation by unattended home based sleep study accelerates NIV treatment in ALS patients which could improve survival and quality of life and help minimize current practice limitations. We propose that such assessment should be an integral component of each initial ALS multidisciplinary clinic evaluation.
Support (If Any): Supported in part by Carolinas ALS Endowment, Carolinas ALS Research Fund and Pinstripes Foundation at the Carolinas HealthCare Foundation and Muscular Dystrophy Association-ALS Division Clinic grants.

0855

PREVALENCE AND SEVERITY OF SLEEP DISORDER BREATHING (SDB) IN AMYOTROPHIC LATERAL SCLEROSIS (ALS) PATIENTS

Elamin EM[1,2], Shah RM[1,2], Anderson M[1,2]
[1]Pulmonary, critical care and sleep medicine, James A. Haley Veterans' Hospital, Tampa, FL, USA, [2]Pulmonary, critical care and sleep medicine, University of South Florida College of Medicine, Tampa, FL, USA

Introduction: ALS is a neurodegenerative disorder characterized with neuronal gliosis and progression to respiratory failure. We investigated the prevalence and severity of SDB to allow early intervention for respiratory symptoms among ALS patients in a single center population.

Methods: We performed a prospective, un-blinded evaluation of all ALS patients referred to J.A. Haley VA Hospital from 1/1/2010 to 6/3/2011. Patients' demographic data, comorbid conditions, Berlin Questionnaire (BQ) scores, forced vital capacity (FVC) and a type 3 sleep portable monitor (PM) data were recorded.
Results: Thirty patients [M/F: 29/1] with an ALS diagnosis as per standard criteria were evaluated. Mean ± standard deviation for patients age was 64.29 ± 10.9 years, body mass index was 25.98 ± 4.30 kg/m^2 and FVC was 2.9 ± 0.91 liters (64.44 ± 19.57% predicated). The BQ scores indicated significant SDB in 93% (28/30) of our patients and confirmed by the PM with a mean ± standard deviation for respiratory disturbance index (RDI) of 22.09 ± 17.92 and desaturation index of 19.9 ± 14.58 respectively.
Conclusion: In this referred population of patient with ALS, there is high prevalence of moderate to high severity of SDB with only mild restrictive ventilatory impairment. Further studies are needed to determine if SDB is an earlier indicator of ventilatory impairment in patients with ALS.

0856

SECONDARY NARCOLEPSY DUE TO NEUROMYELITIS OPTICA, SEVEN CASE SERIES

Kanbayashi T[1], Sagawa Y[2], Kikuchi Y[1], Tokunaga J[1], Ito W[1], Sato M[2], Hayashi Y[3], Takemura T[4], Aizawa R[5], Shimizu T[1]
[1]Neuropsychiatry, Akita University, Akita, Japan, [2]Sleep and Circadian Neurobiology Laboratory, Stanford University, Palo Alto, CA, USA, [3]Kita Mental Clinic, , Nagoya, Japan, [4]Division of Neuropsychiatry, Sendai City Hospital, Sendai, Japan, [5]Aino UNiversity, Takatsuki, Japan

Introduction: Narcolepsy is a chronic sleep disorder, characterized by EDS, cataplexy, and other REM sleep abnormalities. The idiopathic form of narcolepsy with cataplexy is highly associated with a deficiency in a hypothalamic neuropeptide, hypocretin/orexin. Narcolepsy also occurs during the course of various neurological conditions (i.e. symptomatic narcolepsy or narcolepsy due to medical conditions). A recent meta-analysis indicated that 10 out of 116 symptomatic cases of narcolepsy are associated with multiple sclerosis, a disease of autoimmune demyelination. Symptomatic narcoleptic cases consist of heterogeneous disease conditions, but the hypocretin systems are often impaired in these narcolepsy/EDS cases.
Methods: Seven Japanese patients whose diagnoses were neuromyelitis optica (NMO) related disorder and who were exhibiting EDS. Lesions on magnetic resonance imaging, cerebrospinal fluid hypocretin-1 levels, and serum anti-aquaporin 4 (AQP4=NMO) antibody titer were examined.
Results: Bilateral and symmetrical hypothalamic lesions associated with marked or moderate hypocretin deficiency were found in all 7 cases. Four of these patients met the ICSD 2 narcolepsy criteria.
Conclusion: Since AQP4 is highly expressed in the hypothalamic periventricular regions, an immune attack on AQP4 may be partially responsible for the bilateral and hypothalamic lesions and hypocretin deficiency in narcolepsy/EDS associated with autoimmune demyelinating diseases. Gaining the basic knowledge of symptomatic narcolepsy in immune mediated conditions will be not only useful for selecting the most appropriate treatment and predicting the prognosis of the disease but also for understanding the etiological mechanism of narcolepsy.

0857

RESTLESS LEGS SYNDROME, DAYTIME FATIGUE, AND POOR SLEEP QUALITY ARE COMMON IN MYOTONIC DYSTROPHY TYPE 2

Lam EM[1,2], St. Louis EK[1,2], Slocumb NL[1], Milone M[2]
[1]Center for Sleep Medicine, Mayo Clinic, Rochester, MN, USA, [2]Department of Neurology, Mayo Clinic, Rochester, MN, USA

Introduction: Sleep disturbance in myotonic dystrophy type 1 (DM1) has been previously well described and includes sleep disordered breathing, hypersomnia, and fatigue, however little is known in regards to the occurrence of sleep disorders in myotonic dystrophy type 2 (DM2).
Methods: Twenty-one participants (16 F, 5 M) with genetically confirmed DM2 completed a series of questionnaires including the Epworth Sleepiness Scale (ESS), Daytime Sleepiness Scale (DSS), Pittsburgh Sleep Quality Index (PSQI), Cambridge-Hopkins Restless Legs Syndrome Questionnaire (CH-RLSq11), Sleep Apnea portion of the Sleep Disorders Questionnaire (SA-SDQ), Mayo Sleep Questionnaire for REM sleep behavior disorder, Fatigue Severity Scale (FSS), and a modified pain scale.
Results: Definite RLS was present in 71% (15/21) of participants surveyed with 9 patients reporting moderate or severely distressing symptoms and 9 patients reporting symptoms at least 2 days per week. Sleep quality was poor (PSQI>5) in 76% of participants. Daytime fatigue was present (FSS>4) in 60%, while ratings of excessive daytime sleepiness (EDS) were higher on the Daytime Sleepiness Scale (mean score=6.71, EDS cut-off >6) than on the Epworth Sleepiness Scale (mean score=8.76, EDS cut-off >10). Moderately severe or very severe pain was present in roughly 30% of those surveyed. SA-SDQ mean score was 27 in females (range 19-36) and 29.25 in males (range 22-34), suggesting that significant sleep disordered breathing was unlikely in the majority of these patients. One patient reported features of dream enactment (6.3%).
Conclusion: Restless legs syndrome (RLS) is frequent and often severe in DM2. RLS symptoms without significant co-morbid sleep disordered breathing may be distinguishing clinical features between DM2 and DM1, since sleep apnea is common DM1, yet prominent RLS symptoms have not been previously described in DM1. Poor sleep quality, fatigue, sleepiness, and pain are other common findings in DM2.

0858

CO-MORBID OBSTRUCTIVE SLEEP APNEA AND INTERICTAL QUALITY OF LIFE DETERMINANTS IN REFRACTORY EPILEPSY: A PROSPECTIVE PILOT STUDY

St. Louis EK, Enke A, Shepard P, McCarter S, Dresow M, Dueffert LG
Center for Sleep Medicine, Depts. of Neurology and Medicine, Mayo Clinic and Foundation, Rochester, MN, USA

Introduction: Co-morbid obstructive sleep apnea (OSA) may increase seizures. However, the impact of OSA on interictal quality of life determinants is unknown. We hypothesized that co-morbid OSA is associated with depressed mood, cognitive impairment, and antiepileptic drug adverse effects in refractory epilepsy.
Methods: Subjects aged 18-60 with refractory primary generalized or partial epilepsy (1 or more seizures per month) without co-morbid cognitive, psychiatric, or medical disorders were recruited. All subjects completed a sleep apnea questionnaire (SA-SDQ), Adverse Events Profile (AEP), Zung Depression Scale (ZDS), CNS Vitals Signs Neurocognitive Index (NCI), Quality of Life in Epilepsy-31 (QOLIE-31), and overnight oximetry studies. Linear regression was performed utilizing JMP.
Results: 20 subjects, 11 men and 9 women with a mean age of 30.7 (range 21-58) participated. 10 had partial epilepsy, 7 were unclassified, and 3 had primary generalized epilepsy syndromes with a mean duration of 6.4 years (range 3-11 years) and a mean of 4.3 seizures/month (range 1-30, sd=8.3). Mean SA-SDQ scores were 21.2 (range 17-37), with 4 (20%) subjects scoring above gender specified SA-SDQ cut-offs for epi-

lepsy patients. ODI mean was 2.47/hour (range 0-13.8/hour, sd=3.68), with 4 abnormal studies (ODI=5-13.8). Trends for potential association were seen between ODI and Adverse Event Profile (AEP) scores (F=21.2, p=0.136), CNSVS NCI (F=5.54, p=0.30), and ZDS Scores (F-2.13, p=0.38). Lower QOLIE-31 scores were associated with higher AEP scores (F=7.78, p=0.02), ZDS scores (F=2.89, p=0.12), and seizure frequency (F=3.30, p=0.09).
Conclusion: Co-morbid OSA is frequent in refractory epilepsy and may contribute to interictal state problems with mood, medication side effects, and cognitive functioning. Ongoing enrollment and continued analyses are planned to clarify the impact of OSA on these crucial quality of life determinants, potentially informing clinical management strategies and the design of future treatment trials that could improve the well-being of epilepsy patients.
Support (If Any): Mayo Clinic Clinical and Translational Science Grant Number 1 UL1 RR024150 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH), and the NIH Roadmap for Medical Research.

0859

CENTRAL SLEEP APNEA AND COMPLEX SLEEP APNEA IN PATIENTS WITH EPILEPSY

Jackson S[1], Vendrame M[1], Syed S[1], Lehan W[1], Kothare SV[2], Auerbach S[1]
[1]Neurology, Boston University, Boston, MA, USA, [2]Clinical Neurophysiology, Children's Hospital Boston, Boston, MA, USA

Introduction: Although ictal and postictal central apneas may be implicated in the pathogenesis of sudden-unexpected-death-in-epilepsy(SUDEP), the prevalence of central-sleep-apnea(CSA) and complex-sleep apnea(CompSA) in patients with epilepsy is unknown. We sought to examine the prevalence of CSA and CompSA in patients with epilepsy and to examine their clinical profile, with respect to epilepsy type, etiology, medication use, and EEG-abnormalities.
Methods: We undertook a retrospective analysis of 719 consecutive patients with epilepsy who underwent polysomnography (PSG) at our institution between 2004 and 2011. Of the 485 patients with complete data, we excluded 42 patients with congestive heart failure or left ventricular ejection fraction <40%. OSA was defined as apnea-hypopnea-index(AHI)≥5/hr, CSA was diagnosed when ≥50% of total AHI was purely central; CompSA was diagnosed when CPAP titration eliminated obstructive events, but the residual CSA-index was ≥5/hour. Comparison of clinical and PSG variables between the 3 groups were conducted with Fisher exact-test and analysis of variance.
Results: Out of 416 patients tested, 315(75%) had OSA, 16(3.7%) had CSA, 33(7.9%) had CompSA. There were more males in the CSA and CompSA groups than in the OSA-group(81.2%, 81.8% and 59.6% respectively, p=0.04). CSA-patients tended to have higher BMI than OSA and CompSA patients (p=0.06). Comparison of epilepsy-related variables between groups showed that 62.5% of CSA patients had focal seizures, while 26% and 21.1% of patients with OSA and CompSA had focal seizures (p=0.02). No relationship to seizures was observed accompanying the CSA/OSA/CompSA; these events occurred independent of seizures.
Conclusion: About 11% of epilepsy-patients have CSA, and focal seizures are more common in patients with CSA than OSA or CompSA. No other epilepsy-related features differ between patients with OSA or CSA. Further research should investigate the role of ictal and postictal CSAs, and their potential role in the pathogenesis of SUDEP.

0860

IN ADULTS, SEIZURES FROM SLEEP ARE ASSOCIATED WITH MORE SEVERE DESATURATION

Abdennadher M[1], Dworetzky BA[1], Zarowski M[1], Katz E[2], Kothare SV[2], Pavlova M[1]
[1]Brigham and Women's - FaulknerHospital, Boston, MA, USA, [2]Neurology, Children's Hospital, Boston, MA, USA

Introduction: Sudden unexpected death is 20 times more common in the epilepsy population (SUDEP) than in the general population, often appears to occur during sleep, and may be related to respiratory abnormalities associated with a seizure. Therefore, we examined the respiratory abnormalities associated with seizures in sleep and wakefulness.
Methods: Subject were electively admitted patients, undergoing Video-EEG monitoring at a large epilepsy center. Standard (10-20 EEG system, XLTEK), along with oximetry, respiratory inductance plethysmography (RIP) (chest, abdomen, sum), and a one-lead electrocardiogram were placed after consent was obtained.
Results: Forty-three adult-patients were enrolled from October 2010 to August 2011. Twenty-two patients had 55 definite epileptic seizures, while 17 did not have seizures. These patients' ages ranged from 22 to 62 years old (mean 37, median 32.5 years), and 59% were women. Twenty-two seizures occurred during sleep (43.6%). There were 11 seizures arising from the frontal lobe, 37 from the temporal lobe, and 7 from other epieptogenic regions. Frontal lobe seizures were more likely to occur from sleep than from wakefulness (64% in sleep vs. 36% in wake), while temporal lobe seizures occurred preferentially from wakefulness (35% in sleep vs. 65% in wake). Generalization of seizures occurred equally from sleep and from wakefulness and duration did not differ significantly. Seizures from sleep were however more likely to be associated with desaturation. The average of the minimum oxygen saturation during a seizure from sleep was 86% (range 49%-100%), while it was 92% (range 63-99%, p=0.04) from wakefulness (p=0.04).
Conclusion: Seizures from sleep tend to be associated with more significant desaturation. Further research on a larger number of patients is needed to confirm this finding and its relationship to SUDEP.
Support (If Any): Harvard CATALYST.

0861

POLYSOMNOGRAPHIC ANALYSIS OF CAP SLEEP IN PATIENTS WITH BENIGN AND REFRACTORY EPILEPSY

Junna M[1], St. Louis EK[1], Dennhardt J[2], Shepard P[3], Westholm H[3], Connor A[3], Pemberton L[4], Wynn R[5]
[1]Center for Sleep Medicine, Departments of Neurology and Internal Medicine, Mayo Clinic, Rochester, MN, USA, [2]University of Memphis School of Medicine, Memphis, TN, USA, [3]St. Olaf College, Northfield, MN, USA, [4]Rice University, Houston, TX, USA, [5]Cornell College, Mount Vernon, IA, USA

Introduction: Seizure disorders are a vital public health problem. Several risk factors are associated with the development of epilepsy, and final clinical outcomes between patients do vary. The reasons for this are poorly understood. Accurate predictors of better or worse outcomes may prove to be useful in prognosis and treatment. We aimed to determine whether CAP sleep rates differed between patients with medically responsive/benign epilepsy (BE) versus medically refractory epilepsy (RE).
Methods: Polysomnographic data of 16 (10 BE, 6 RE) consecutively referred and diagnosed patients from the Mayo Center for Sleep Medicine were manually analyzed using Hypolab CAP scoring software (ATES Medica Labs, Verona, Italy). CAP sleep rate during diagnostic polysomnography in all patients was obtained. Group averages were compared utilizing Wilcoxon Rank Sum tests in JMP (Chicago, IL).
Results: The median age in the BE group was 11 years (range, 1-48). The median age in the RE group was 11 years (range, 6-42). There were

7 males in the BE group and 4 males in the RE group. CAP rate was not significantly different between BE vs. RE groups (58.4 vs. 48.8, p=0.25).
Conclusion: There was no significant difference in CAP rate between patients with BE vs. RE. Further analysis of a larger group of subjects may reveal significant differences between groups, though based upon this small number of patients, a firm conclusion cannot be drawn.

0862

EFFECT OF PAP THERAPY ON SEIZURE CONTROL IN ADULTS WITH EPILEPSY AND OBSTRUCTIVE SLEEP APNEA

Kim H[1,2], Andrews ND[1], Moul DE[1], Foldvary-Schaefer N[1]
[1]Neurological Institute, Cleveland Clinic, Beachwood, OH, USA, [2]Neurology, Chosun University School of Medicine, Gwangju, Republic of Korea

Introduction: Small uncontrolled reports suggest that treatment of obstructive sleep apnea (OSA) in patients with epilepsy may improve seizure control. We investigated the effect of PAP therapy on seizure control in adults with epilepsy and OSA.
Methods: This was a retrospective review of clinical and polysomnographic data of adults with epilepsy seen at the Cleveland Clinic Neurological Institute from 1997 to 2010. OSA was defined as AHI >5. Seizure outcome was classified as improved (>50% reduced mean monthly frequency excluding auras) or not improved (<50% reduced) between baseline and one year after PSG. We compared seizure outcome in groups without OSA, OSA on PAP therapy, and OSA untreated (not on PAP therapy).
Results: 139 subjects were included. Sixty (43.2 %) had no OSA. Of the 79 subjects with OSA, 45 (32.4 %) were on PAP therapy, and 34 (24.5%) were untreated. At baseline, 20 (33.3%) without OSA, 22 (48.8%) with treated OSA, and 13 (38.2%) with untreated OSA were seizure free. Of those not seizure free at baseline, seizure outcome was improved in 17 (42.5%) without OSA, 17(73.9%) OSA on PAP therapy, and 3 (14.3%) untreated OSA subjects. Patients on PAP were more likely to have improved seizure control at one year than those with untreated OSA (p=0.00001 with fisher's exact test). Patients without OSA were more likely to have improved seizure control than those with untreated OSA (p=0.043).
Conclusion: In this limited sample of adults with epilepsy who underwent PSG for OSA evaluation, patients with epilepsy and OSA on PAP therapy had an improvement in seizures post PAP therapy, whereas untreated OSA patients did not. This study expands prior work suggesting that treatment of sleep disorders reduces seizures in people with epilepsy.

0863

INSOMNIA IN EPILEPSY PATIENTS. CLINICAL AND POLYSOMNOGRAPHIC CHARACTERISTICS. A RETROSPECTIVE STUDY

Koziorynska E[1], Rodriguez A[2,3]
[1]Neurology, SUNY Downstate Medical Center, Brooklyn, NY, USA, [2]Neurology, NYU School of Medicine, New York, NY, USA, [3]Neurology, New York Sleep Institute, New York, NY, USA

Introduction: Patients with epilepsy have multiple sleep problems, including insomnia. Mood disorders are a significant co-morbidity in epilepsy. There is a high prevalence of insomnia in patients with mood disorders. The clinical and polysomnographic (PSG) characteristics of patients with epilepsy and insomnia have not been described.
Methods: The medical records of all patients seen at Sleep Disorders Center affiliated to a Epilepsy Center were reviewed over a 6 months period. All adults with epilepsy presenting with insomnia were selected. These patients were matched with consecutive patients presenting with insomnia and no epilepsy (controls).
Results: Seventeen adult patients with epilepsy met inclusion criteria. Among epilepsy patients, 76.7% were women, the mean age was 40.7 years and 58.8 % had partial seizures. Difficulties to fall asleep was present in 76.4% patients with epilepsy vs. 88.2% of controls, and 68.7% of epilepsy patients had troubles staying sleep vs. 82.4 of controls (there was no statistically significant differences). At time of presentation 52.9% of patients were using a sleep medication vs. 64.7% of controls. Sleep medication was used in the past by 76.5% of patients and 88.5% of controls. Zolpidem was the most common sleep medication prescribed among patients and controls (64.7 % and 76.5% ,respectively) followed by melatonin (41.2 % and 41.2%, respectively). These results were not statistically significant. Patients with epilepsy had a statistically significant higher percentage of depression compared to controls (52.9% vs. 17.6%, p=0.028). PSG showed a mean sleep efficiency of 69.0% with a mean sleep latency of 48.8 minutes among epilepsy patients. These results did not differ from controls. Sleep disordered breathing was present in 50.0 % of patients and 44.4% of controls.
Conclusion: Adults patients with epilepsy and insomnia have a higher prevalence depression compared to insomnia patients. There is a high percentage of use of sleep medications among these patients and zolpidem is the most common medication used. The clinical and PSG characteristic did not differ when compared with controls.

0864

FATIGUE, TIREDNESS, LACK OF ENERGY, AND SLEEPINESS IN MULTIPLE SCLEROSIS PATIENTS REFERRED FOR CLINICAL POLYSOMNOGRAPHY

Braley TJ, Chervin RD
Neurology, University of Michigan, Ann Arbor, MI, USA

Introduction: Although excessive daytime sleepiness is common in obstructive sleep apnea (OSA), many patients report fatigue, tiredness, or lack of energy rather than sleepiness. These complaints are also common in multiple sclerosis (MS) patients, many of whom have comorbid OSA. We examined relationships between these terms among patients with and without MS, who were referred for polysomnography, and compared the extent to which the apnea/hypopnea index (AHI) or sleep efficiency may explain these symptoms.
Methods: We analyzed retrospective polysomnographic and questionnaire data from n=24 MS patients and n=24 controls, matched for age, gender, and body mass index. The Sleepiness Impact Assessment (Chervin RD, Chest 2000) allowed patients to rate in a parallel manner, on 5-point Likert scales, the frequency of each symptom.
Results: More MS patients than controls reported fatigue, tiredness, and lack of energy to occur often or almost always (88% vs. 20%, 71% vs. 0%, and 88% vs. 4%; Chi-square p<0.0001 for each), but sleepiness was reported similarly by both groups (50% vs. 67%, p=0.25). A non-significant difference in OSA frequency was seen among MS patients versus controls (83% vs. 63% respectively, p=0.19). In contrast to controls, among MS patients, tiredness correlated with fatigue, lack of energy, and sleepiness (Spearman's rho=0.79, 0.50 and 0.52; p<0.0001, 0.01 and 0.009). Decreased sleep efficiency correlated with fatigue and lack of energy in MS patients (rho=-0.51, p=0.01; and rho=-0.43, p=0.04), but not with any symptom among controls. The AHI did not explain sleep efficiency or any symptom ratings among MS patients or controls (all p>0.05).
Conclusion: MS patients in comparison to matched controls, all referred for polysomnography, report more fatigue, tiredness, and lack energy, but not sleepiness. Significant symptoms other than sleepiness may arise from MS itself, or in relation to sleep efficiency that is diminished through mechanisms other than OSA.

0865

HEART RATE VARIABILITY IN SLEEP-RELATED MIGRAINE

Vollono C, Gnoni V, Testani E, Losurdo A, Dittoni S, Colicchio S, Di Blasi C, Mazza S, Della Marca G
Department of Neurosciences, Catholic University, Rome, Italy

Introduction: Migraine has a close relationship with sleep and circadian rhythms. The activity of the autonomic nervous system (ANS) is characterized by circadian and ultradian oscillations, which are deeply linked with wake and sleep stages. The aim of our study was to investigate the reciprocal interactions among sleep, ANS and occurrence of migraine attacks.
Methods: We studied 8 consecutive migraineurs (two men and six women, mean age 41.9 ± 13.9), with high frequency of attacks (> 5 per month), sleep-related (> 50% of the attacks occurred during sleep). Patients were evaluated during a headache-free period. Patient underwent polysomnography and HRV analysis, and results were compared with a large sample of normal subjects. All subjects underwent a full-night laboratory video-PSG. For the HRV analysis, in time and frequency domain, we selected periods of 5 minutes period, from quiet wakefulness (W), stage 2 (N2) and 3 (N3) of N-REM, and REM sleep (R).
Results: PSG and HRV data obtained in patients were compared with data recorded in 55 healthy subjects (23 men and 32 women, mean age 44.2±13.0) randomly selected from the database of our Sleep Laboratory. We found a statistically significant reduction of LF/HF ratio during N2 and N3 sleep stages in migraineurs compared with controls. Conversely, during REM sleep, the HF/LF ratio showed a trend to increase in patients, which however did not reach statistical significance.
Conclusion: The ANS activity in migraineurs showed an higher level of fluctuation compared with normal subjects, a lower parasympathetic activation during N-REM and an higher parasympathetic activation during REM sleep. This findings demonstrate an instability, during sleep, of the sympathetic/parasympathetic balance in migraineurs. Moreover, the sharp reverse of the sympatho-vagal balance during REM, more rapid than in normal subjects, is probably correlate to increased occurrence of migraine attacks during REM sleep.

0866

SLEEP DISTURBANCES IN NEUROPATHIC PAIN

Ohayon MM
Stanford University, Palo Alto, CA, USA

Introduction: Sleep disturbances are common in individuals experiencing chronic pain. Subjective measures of sleep in various chronic pain conditions mostly demonstrate a high number of complaints of disrupted and unrefreshing sleep. Neuropathic pain (NeP) is a common pain syndrome affecting up to 25% of individuals with chronic pain and is the most difficult pain to manage. This study examines the sleep differences between chronic pain without neuropathy (non-NeP) and NeP.
Methods: A random sample of 3,011 participants (>=15 years), representative of Germany, was interviewed by telephone. Chronic pain duration was set at three months. Neuropathy, frequency, severity, duration, impacts on functioning, and health care utilizations were investigated. Sleep and psychiatric disorders were assessed using DSM-IV-TR criteria and ICSD-2. ICD-10 was used for organic diseases.
Results: Overall, 24.9% (95% confidence interval: 23.4% to 26.4%) of the sample reported having chronic pain: 18.4% of the sample had non-NeP and 6.5% had NeP features. NeP presented several differences from non-NeP: individuals NeP features reported higher pain severity and higher interference of pain in daily activities compared to the non-NeP group. After adjusting for age and gender. sleep disturbances occurring at least three nights/week for at least 1 month remained more frequent among NeP individuals compared to Non-NeP: Difficulty initiating sleep (OR: 2.8 [1.7-4.7]; nocturnal awakenings (OR: 1.7[1.2-2.4]) and early morning awakenings (OR: 3.8 [2.0-7.4]). Sleep duration, non-restorative sleep and excessive sleepiness were similar for the two groups.
Conclusion: These differences in prevalence and comorbidities between non-NeP and NeP features show how important it is to regard these different modalities of pain separately. Participants with NeP features suffer more, they have greater impairment in their daily life and greater insomnia than those with non-NeP.
Support (If Any): Pfizer.

0867

A META-ANALYSIS OF THE EFFECTS OF POSITIVE AIRWAY PRESSURE TREATMENT ON HYPERTENSION

Montesi S[1,2], Malhotra A[2], Bakker J[2]
[1]Pulmonary and Critical Care Unit, Massachusetts General Hospital, Boston, MA, USA, [2]Sleep Disorders Research Program, Brigham and Women's Hospital/Harvard Medical School, Boston, MA, USA

Introduction: Previous meta-analyses investigating effects of positive airway pressure (PAP) treatment on hypertension in patients with obstructive sleep apnea (OSA) have found small but statistically significant effect estimates. We aimed to conduct an updated meta-analysis of the literature to identify sub-groups of patients likely to achieve marked reductions in blood pressure (BP) with PAP treatment.
Methods: A systematic search of the PubMed database was conducted independently by two investigators in September 2011. 1008 studies were screened, which identified 33 randomized controlled trials of at least one week duration comparing PAP with a sub-therapeutic control in a sample of adult (>18 years) OSA patients without significant comorbidity that reported BP (office or 24-hour ambulatory measures). The mean, standard deviation, and sample size for daytime systolic and diastolic BP were extracted from each paper. Random effects meta-analysis models were applied to all trials and pre-selected sub-groups, and the Q-statistic and I^2 were calculated.
Results: The 33 eligible studies contained n=2,263 randomized subjects in total (ranging from 13 to 374 in individual studies), with a wide range of OSA severity (mean apnea-hypopnea index (AHI) range 12.9-63.8 events/hour). Analyzable BP data were published in 27 trials (pooled n=1,851). PAP reduced systolic and diastolic BP by -2.4mmHg (95% CI -3.4 to -1.3) and -1.6mmHg (95% CI -2.1 to -0.8) respectively, compared to control. The Q-test indicated no significant heterogeneity with I^2 values <10%. Pre-specified dichotomous sub-group analyses found significant reductions in both daytime systolic and diastolic BP in parallel studies, studies with a mean baseline AHI ≥30/h, arm duration ≥4 weeks, and mean PAP adherence ≥4 hours. Data collection and analyses are ongoing.
Conclusion: Preliminary meta-analysis of available literature suggests BP reductions occur in subjects with severe OSA using PAP for at least 4 hours per night for at least 4 weeks.

0868

INITIAL HYPERTENSION SEVERITY DETERMINES THE EXTENT OF BLOOD PRESSURE REDUCTION IN CPAP-TREATED OSA PATIENTS

Wawrzyniak TD[2], Goswami U[3], Adams AB[1], Bijwadia JS[2]
[1]Pulmonary/Critical Care, Regions Hospital, St. Paul, MN, USA, [2]Sleep Medicine, Healthpartners, Maplewood, MN, USA, [3]Sleep Medicine, University of Minnesota, Minneapolis, MN, USA

Introduction: A primary goal of cardiovascular morbidity and mortality risk management is hypertension control. Hypertension (HTN) is prevalent in obstructive sleep apnea (OSA) and continuous positive airway pressure therapy (CPAP) is reported to reduce blood pressure (BP) in OSA patients above a compliance threshold (>5.6 hours/night) and after 3-6 months of CPAP.
Methods: We studied the extent of HTN reduction achieved by CPAP therapy in patients referred to a sleep diagnostic center by analyzing electronic health records (EHR) of OSA patients diagnosed and treated from June 2009 - Nov 2011. EHR were compared for BP and weight (BMI) changes between a pre-CPAP primary care visit and followup visits after 6 months and 1 year of CPAP Rx.
Results: Of the 723 patients studied, 294 were hypertensive with systolic blood pressure (SBP) > 130mmHg. Changes in mean SBP (mmHg) by deciles from the initial visit to 6 months after CPAP therapy were: 160-170 (n=15) 167.5→146.1, p<.001, SBP 150-160 (n=33) 152.4→131.9, p<.001, SBP 140-150 (n=87) 143.0→132.4, p<.001, SBP 130-140 (n=159) 133.5→128.2, p<.001 with no CPAP effect if SBP =120-130 123.4→124.9, NS. The changes by descending decile SBP categories were, respectively, -21.4, -20.5, -10.6, -5.3, +1.5. Corresponding significant reductions in DBP were -5.8, -5.9, -4.1, -3.5 and -0.7 (NS). There were no differences in mean SBP or DBP between 6 month and 12 month visits. Initial mean BMI decreased with descending SBP category 41.1, 39.1, 39.3, 37.3, 36.8, however, no significant changes in BMI occurred between visits.
Conclusion: We conclude that significant BP reduction occurs in OSA patients after 6 months of CPAP therapy in relation to initial pre-CPAP blood pressure readings. The reduction is sustained at 12 months with a graduated effect, the reduction being greater in patients with a higher baseline BP. The effect is unrelated to weight change.

0869

THE CONSEQUENCE OF CIRCADIAN RHYTHM ON BRONCHODILATOR RESPONSE IN VETERANS WITH OBSTRUCTIVE AIRWAYS DISEASE

Van Wert R[1,2], Sierra N[2], Holty JC[1,2]
[1]Division of Pulmonary and Critical Care Medicine, Stanford University, Palo Alto, CA, USA, [2]Pulmonary, Critical Care and Sleep Section, Veterans Affairs Palo Alto Health Care System, Palo Alto, CA, USA

Introduction: Circadian variation in airway function is well described. The bronchodilator responsiveness test (BDR) constitutes part of the diagnosis of obstructive airways disease, but does not correlate with outcomes of long-term bronchodilator therapy. We sought to determine whether BDR is subject to circadian variability to account for this discordance.
Methods: Consecutive pulmonary function tests (PFTs) performed between October 2009 to October 2011 were retrospectively reviewed. PFTs (i) with BDR testing, and (ii) with and without evidence of airflow obstruction by American Thoracic Society criteria were analyzed. The eight-hour workday was divided into four time blocks and the proportion of subjects with a positive BDR test assessed according to the time block that the test was performed.
Results: During the study period 2085 PFTs with BDR testing were performed (94% male, mean age 62±14, body mass index (BMI) 29±6, pre-bronchodilator forced expiratory volume in 1 second (FEV_1) 2.4±0.9L). Sixty-six percent reported a history of tobacco use and 39% had pre-bronchodilator airflow obstruction. The proportion of positive BDR tests significantly differed between the four time blocks, with the highest number of positive tests observed in the first time block (25.2%, 07:30-09:30, N=484) and the lowest observed in the last time block (17.3%, 13:30-15:30, N=510; p=0.002). Similarly, in subjects with airflow obstruction (mean age 65±11& FEV_1 1.9±0.8L, N=823), BDR positivity in the first time block (44%, N=195) was significantly different from the last time block (34%, N=190, p=0.046). Multivariate regression analysis confirmed BDR positivity was lowest during the last time block (odds ratio 0.65, p=0.003) independent of age, gender, BMI or baseline lung function.
Conclusion: Circadian variability in airway function appears to be an important determinant of whether or not a BDR is observed. This may have implications for both the diagnosis and treatment of obstructive airways disease.

0870

SLEEP PREDICTS RESTING BRAIN ACTIVITY IN FIBROMYALGIA PARTICIPANTS WITH INSOMNIA

Vatthauer KE[1], Craggs J[1], Robinson ME[1], Staud R[2], Berry RB[2], Price DD[3], Perlstein WM[1], Waxenberg LB[1], McCrae C[1]
[1]Clinical and Health Psychology, University of Florida, Gainesville, FL, USA, [2]Medicine, University of Florida, Gainesville, FL, USA, [3]Oral & Maxillofacial Surgery, University of Florida, Gainesville, FL, USA

Introduction: Cognitive Activation Theory (CAT) describes increased arousal due to stress, which may represent a developmental mechanism for chronic insomnia and chronic pain. Both of which are characteristics of fibromyalgia syndrome (FM). The effects of chronic insomnia and pain on resting brain activity of FM patients are unknown. Using fMRI, we investigated whether resting brain activity of FM patients with (FM-I) and without insomnia (FM) could be predicted by total sleep time (TST) and total wake time (TWT).
Methods: 33 adults [FM-I: n=26; age=53.30(SD=14.05); FM: n=7; age=43.57(SD=16.57)] completed sleep diaries to obtain TST and TWT. They also underwent fMRI scans, during which they experienced alternating intervals of thermal pain and rest. Only the rest intervals were used for this analysis. In a GLM regression, pain was first controlled for as a covariate. Then TST and TWT were used to predict brain regions exhibiting greater activity during rest and group differences (FM-I>FM) in these regions.
Results: TST predicted activity in: left caudate tail, left dorsal posterior cingulate (BA31), right superior frontal gyrus (BA8), right medial temporal gyrus (BA20), right superior parietal lobule (BA7), and right precuneus (BA23). TWT predicted activity in: caudate tail (bilateral), left thalamus, left medial globus pallidus (Lentiform nucleus), left parahippocampal gyrus (BA19), left inferior frontal gyrus (BA44), left medial temporal gyrus (BA22), left supramarginal gyrus (BA40), several right superior frontal gyri (BA6, 8, 9), and right occipitotemporalis (BA37).
Conclusion: Regions associated with TST are primarily involved with integrating pain, affective, and somatosensory processes. TWT was associated with regions involved in language, pain, sleep regulation, planning, and integration related processes. Sleep problems and decreased sleep could be related to emotional dysregulation and exaggerated somatic focus for painful events. These findings are consistent with CAT, and future work will investigate a neural additive effect of comorbid insomnia and fibromyalgia.
Support (If Any): The project described was supported by Award Number R01AR055160 and R01AR055160-S1 ARRA Supplement from the National Institute of Arthritis And Musculoskeletal And Skin Diseases. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Arthritis (Christina S. McCrae, Ph.D., PI; Michael E. Robinson, Ph.D., co-PI).

0871

ARE SLEEP DISPARITIES ASSOCIATED WITH DOWNSTREAM HEALTH OUTCOMES? RESULTS FROM THE BOSTON AREA COMMUNITY HEALTH (BACH) STUDY

Piccolo RS, Araujo AB, McKinlay JB
New England Research Institutes, Watertown, MA, USA

Introduction: Sleep problems concern many adults, and appear to disproportionately affect those of lower socioeconomic (SES) and racial/ethnic minorities. Length of sleep and sleep quality are reportedly associated with downstream health consequences, including increased risk for obesity, diabetes (DM), hypertension (HTN), cardiovascular disease (CVD), and mortality. Research is still unclear on whether disparities in sleep may manifest themselves in disparities in health.
Methods: The BACH baseline study is a population-based random-sample cohort (2002-2005) of 5,503 participants aged 30-79. We subsequently surveyed 4,415 of these subjects (2007-2010) for disease incidence.
Results: We found significant racial/ethnic and SES disparities in the number of men reporting short sleep duration (defined as ≤5h/night over the past week). Black men and middle class men were the most likely to report ≤5h sleep (p<.001 for race/ethnicity and SES). SES disparities in restless sleep were found among both men and women (Men, p=.01; Women, p<.001.) Results reveal no significant racial/ethnic differences in the incidence of DM, HTN, CVD or obesity by either of our measures of sleep. We observed effect modification in the relationship between SES and the incidence of DM and CVD by sleep parameters. Short sleep and restless sleep increased the incidence of diabetes among lower class adults in particular (p=.001 and <.001, respectively). Restless sleep also differentially affected lower class women in the development of CVD (p=.01).
Conclusion: Our results indicate upstream sleep disparities are associated with downstream adverse health outcomes. Future analyses of the BACH cohort may offer information on the mechanisms of these associations.
Support (If Any): This work was supported by the National Institute of Diabetes and Digestive and Kidney Diseases (grants DK081844 and DK56842).

0872

PREVALENCE OF DIABETES INCREASES WITH SLEEP DISORDERED BREATHING SEVERITY IN THE GENERAL POPULATION: THE HYPNOLAUS STUDY

Haba-Rubio J[1], Andries D[1], Tobback N[1], Vaucher J[2], Marques-Vidal P[2], Vollenweider P[2], Waeber G[2], Tafti M[1,3], Heinzer RC[1,4]
[1]Center for Investigation and Research in Sleep (CIRS), Lausanne University Hospital, Lausanne, Switzerland, [2]Internal Medicine department, Lausanne University Hospital, Lausanne, Switzerland, [3]Center for Integrative Genomics (CIG), Lausanne University, Lausanne, Switzerland, [4]Pulmonary Department, Lausanne University Hospital, Lausanne, Switzerland

Introduction: The prevalence of type II diabetes (T2DM) is reportedly increased in patients with sleep disordered breathing (SDB). The aim of our study was to determine the prevalence of T2DM in a large unselected middle-aged European population according to SDB severity.
Methods: 1066 subjects (47.8% women, 50.2±5.7 years old, BMI 25.3±4.1 kg/m2) participating in an ongoing population-based sleep cohort study (HypnoLaus, Lausanne, Switzerland) underwent complete polysomnographic recordings at home. SDB severity was assessed using the apnea-hypopnea index (AHI) defined according to the AASM 2007 criteria. All subjects had an extensive clinical workup including fasting glucose and insulin level measurements. T2DM was defined as a fasting glucose level ≥126 mg/dL (7.0 mmol/l) or the use of an antidiabetic treatment.
Results: Mean AHI was 6.4±10/h. Prevalence of SDB defined as an AHI >5/h, >15/h and >30/h was 36.5%, 11.2% and 3.6%, respectively. Mean ESS score was 6.9±4.1. Mean neck circumference was 36.6±5.1 cm. There was a positive correlation between AHI and plasma glucose levels (r=0.28, p<0.0001) and between AHI and insulin levels (r=0.27, p<0.0001). The prevalence of T2DM was 3.1% for an AHI<5/h, 7.4% for an AHI between 5 and 14.9/h, 11.0% for an AHI between 15-29.9/h and 20.5% for and AHI ≥30/h (p< 0.0001). Fasting glucose level (mg/dL) was: 99±10; 105±18; 108±16; and 116±19 (p< 0.0001); Insulin level (mU/l) was 6.17; 8.45; 8.81 and 11.94 respectively (p< 0.0001) for the corresponding AHI categories. These differences remained significant after adjustment for age, sex, BMI, waist and neck circumference: p=0.0014 (glucose level) and p =0.008 (insulin level).
Conclusion: In HypnoLaus population-based study, there is a positive correlation between AHI and glucose and insulin levels. The prevalence of T2DM as well as glucose and insulin levels increase with increasing

AHI. These differences remain highly significant after adjustment for the main confounding factors.

0873

C-REACTIVE PROTEIN (CRP) AND HABITUAL SLEEP DURATION: A COMPLEX, NON-LINEAR RELATIONSHIP DEPENDENT ON SEX, RACE/ETHNICITY, AND PRESENCE OF SLEEP DISORDER AND/OR MEDICAL COMORBIDITY

Grandner MA[1,2], Buxton OM[3,4], Jackson NJ[1,2], Pandey A[5,6], Pak VM[1,2], Jean-Louis G[6]

[1]Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [2]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [3]Medicine, Brigham and Women's Hospital, Boston, MA, USA, [4]Sleep Medicine, Harvard Medical School, Boston, MA, USA, [5]Cardiology, SUNY Downstate Medical Center, Brooklyn, NY, USA, [6]Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA

Introduction: Sleep duration is associated with cardiometabolic disease; though the mechanisms are not well-elucidated, increased systemic inflammation is a potential pathway. We hypothesize that extreme sleep durations are associated with elevated C-Reactive Protein (CRP), an inflammatory marker for cardiovascular disease.
Methods: Data from the 2007-2008 NHANES (n=5,587 adults) included CRP and self-reported Total Sleep Time (TST) in analyses stratified by sex and adjusted for age, race/ethnicity, body mass index (BMI), and BMI-squared. Later models add insomnia symptoms (>1 night/week), sleep apnea (diagnosis or snorting/gasping 3-4 nights/week), active medical illness, and antidiabetic/antihypertensive treatment. Interactions examined differences based on race/ethnicity. Nonlinear relationships between CRP and TST were assessed using polynomial and multinomial regression models (TST coded <5,5,6,7,8,9,10+hrs).
Results: Linear and squared terms were significant in all models. Among men, CRP was elevated in <5hrs and 10+hrs. A significant race/ethnicity interaction was found, reflecting different elevations among Non-Hispanic-Whites (<5hr and 10+hr), Hispanics/Latinos (none), Blacks/African-Americans (<5hr), and Asians/Others (10+hr). Adding sleep disorders and medical comorbidities, the elevation in 10+hr sleepers and race/ethnicity interaction remain; Non-Hispanic Whites had elevated CRP in 10+hrs, Hispanics/Latinos had no elevations, Blacks/African-Americans had elevations in <5hrs, and Asians/Others had elevations in 9hrs and 10+hrs. Among women, CRP was elevated in 10+hrs only. A significant race/ethnicity interaction revealed differential patterns of elevations among Non-Hispanic-Whites (<5hrs and 10+hrs), Blacks/African-Americans (<5hrs), Hispanics/Latinos (none), and Asians/Others (9hrs and 10+hrs). Adding sleep disorders and medical comorbidities, the 10+hr effect remained, as did the race/ethnicity interaction. Here, elevations were seen among Whites (10+hrs) and Asians/Others (10+hrs) only.
Conclusion: In a representative sample of American adults, elevated CRP was associated with extreme sleep durations. Individuals' sex and race/ethnicity, as well as the presence of sleep disorders and medical comorbidity, influenced these associations. Differences in CRP along these dimensions should be considered in future research on sleep-related disparities and cardiometabolic disease risk.
Support (If Any): This work was supported by T32HL007713, R01MD004113, R01HL107240, and a pilot grant from the University of Pennsylvania CTSA(UL1RR024134). Also, we wish to thank the Centers for Disease Control and Prevention for collecting these data and making them available and the NHANES participants for providing data.

0874

UNVEILING THE CAUSAL ASSOCIATION BETWEEN SHORT SLEEP DURATION AND THE INCIDENCE OF OBESITY

Vgontzas AN[1], Fernandez-Mendoza J[1], Shaffer M[2], Basta M[1], Kritikou I[1], Calhoun S[1], Liao D[2], Bixler EO[1]

[1]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA

Introduction: Several epidemiologic, longitudinal studies have reported that short sleep duration is a risk factor for the incidence of obesity. However, the vast majority of these studies used self-reported measures of sleep duration and did not examine the role of objective sleep duration, subjective sleep disturbances, or emotional stress.
Methods: We studied a random sample of 1,111 non-obese adults from the Penn State Cohort in the sleep laboratory for one night using polysomnography (PSG) and followed them up for a mean of 7.5 years. Subjective and objective (PSG) measures of sleep were obtained at baseline. Emotional stress was assessed using the MMPI-2 at baseline. Obesity was defined as a body mass index (BMI) ≥ 30kg/m2.
Results: The incidence of obesity was 15%. Individuals who developed obesity reported shorter sleep duration (7.0±1.2 vs. 6.6±1.2; p<.05), more subjective sleep disturbances (13.3% vs. 22.9%; p<.01), and higher emotional stress (0.6±1.2 vs. 1.2±1.8; p<.01) at baseline when compared to non-obese individuals. There was a synergistic effect between these variables as individuals with subjective sleep disturbances reported shorter sleep duration (7.0±1.1 vs. 6.6±1.4; p<.01) and scored higher for emotional stress (0.6±1.1 vs. 1.2±1.9; p<.01). There was no association between objective short sleep duration and incident obesity (6.0±1.2 vs. 6.1±1.1). Subjective sleep disturbances and emotional stress were significant predictors of incident obesity after controlling for gender, age, depression, sleep apnea, and BMI. Self-reported short sleep duration did not predict incident obesity after controlling for confounding factors, including emotional stress.
Conclusion: Self-reported short sleep duration in non-obese individuals at risk of developing obesity is a surrogate marker of emotional stress and subjective sleep disturbances. Objective short sleep duration per se does not predict the development of obesity. The detection and treatment of sleep disturbances and emotional stress should be the focus of our preventive strategies against obesity.
Support (If Any): NIH R01 HL40916, R01 HL 51931.

0875

A PILOT STUDY EXAMINING EMOTIONAL FUNCTION AS A MEDIATOR OF THE RELATIONSHIP BETWEEN SLEEP QUALITY AND FATIGUE IN COPD

Kapella MC[1], Herdegen J[2], Carley DW[1]

[1]Biobehavioral Health Science, University of Illinois, Chicago, IL, USA, [2]Pulmonary, Critical Care, Sleep & Allergy, University of Illinois, Chicago, IL, USA

Introduction: Fatigue is associated with sleep quality in COPD and there is evidence that therapy which improves sleep quality also reduces fatigue. We examined emotional function as a possible mediator of the relationship between sleep quality and fatigue in COPD using path analysis.
Methods: This was a secondary analysis of post-treatment data collected for a study of cognitive-behavioral therapy for insomnia versus COPD wellness education for COPD patients with insomnia. Subjects completed the Pittsburgh Sleep Quality Index (PSQI) and the Chronic Respiratory Disease Questionnaire (CRQ). Path analysis was performed on data from 23 subjects with bootstrap sampling of 3000 (AMOS 19®).
Results: Enrolled participants were aged (mean±SD) 63±10 years, with an FEV1% predicted of (mean±SD) 62±18 indicating moderate COPD. The post-treatment PSQI Global score was 6.5±3.4 (scores greater

than 5 indicate clinically meaningful poor sleep). The post-treatment score on the CRQ fatigue subscale was 4.6±.9 (potential range 1-7) indicating moderate fatigue. The indirect effect of emotional function on the relationship between sleep quality and fatigue was significant (p=.032, two-tailed) and fit indices indicated a good model fit (RMR=.000). The model accounted for 22% of the variance in emotional function and 28% of the variance in fatigue.

Conclusion: These findings provide initial evidence that emotional function is an important mediator of the relationship between sleep quality and fatigue in COPD. This supports the notion that people with comorbid COPD and insomnia may obtain additional benefit from therapy that targets emotional function.

Support (If Any): Funded by NIH KO1 NR010749, NIH/NNRR 5K30RR022271, NIH/NINR 5 P30.

0876

ASSOCIATION BETWEEN SLEEP DURATION AND CARDIOVASCULAR DISEASE: RESULTS FROM THE NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY (NHANES 2005 - 2008)

Agarwal S[1], Bae C[2]

[1]Cardiovascular Medicine, Cleveland Clinic, Cleveland, OH, USA, [2]Neurological Institute, Cleveland Clinic, Cleveland, OH, USA

Introduction: Small studies have described independent associations between depression with cardiovascular disease and depression with sleep duration. Despite the known connections between sleep and depression, there is an absence of literature examining the conjoined effects of sleep and depression upon cardiovascular and cerebrovascular disease (CCVD).

Methods: Cross-sectional data from the NHANES (2005-2008) were used. The composite outcome of CCVD was determined using self-reported histories of stroke, angina, heart attack, coronary artery disease and congestive heart failure. Major depression was defined by a score > 15 on the Patient Health Questionnaire 9. Sleep duration was assessed via self-report. Sleep duration < 6 hours or > 10 hours was considered abnormal.

Results: Abnormal sleep duration was present in 50.0 % (SE 2.1%) subjects with CCVD versus 38.8 % (1.0) subjects without CCVD ($p<0.001$). Major depression was present in 4.0 % (0.3) subjects reporting a sleep duration < 6 hours versus 3.9 % (0.9) subjects reporting a sleep duration > 10 hours. Major depression was present in 6.2 % (1.0) subjects with CCVD versus 2.3 % (0.2) subjects without CCVD ($p<0.001$). Logistic regression analysis adjusted for demographic and clinical parameters including major depression and self-reported sleep apnea showed there were significantly higher odds of CCVD in patients with abnormal sleep durations [OR (95% CI): 1.3 (1.1 - 1.7)]. In the short sleeper group, there were progressively increasing odds of CCVD with shorter sleep times, and there was a trend towards increasing odds of CCVD with progressively longer sleep times.

Conclusion: There is a significant association between abnormal sleep duration and CCVD in this large representative database of the US population. This association was significant even after adjustment for depression and sleep apnea. There may be an independent link between sleep duration and CCVD that warrants further investigation.

0877

PROSPECTIVE CHANGES IN SLEEP PATTERNS BEFORE, DURING AND AFTER TREATMENT FOR LUNG CANCER

Dean GE[1,2], Lee E[1], Ziegler P[3], Dickerson SS[1,2]

[1]School of Nursing, SUNY at Buffalo, Buffalo, NY, USA, [2]Nursing, Roswell Park Cancer Institute, Buffalo, NY, USA, [3]Medicine, VA Western NY Healthcare System, Buffalo, NY, USA

Introduction: Research suggests that sleep problems among patients with lung cancer are common. One challenge, however, is determining if sleep problems are caused by lung cancer treatments. This study provides data on sleep patterns before, during, and after treatment in patients with inoperable lung cancer.

Methods: Eligible participants were recruited from a VA medical center and a comprehensive cancer center. Prospective longitudinal design using subjective and objective measures of sleep: Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS) and 7-day actigraphy (Ambulatory Monitoring, Inc.). Descriptive and inferential statistics were used.

Results: Among 29 participants, 90% with advanced stage (III/IV) lung cancer, mean age was 67 years (sd=9.5, range 49-86), 83% Caucasian and 62% male. PSQI data revealed that mean nocturnal sleep duration gradually increased from pretreatment 6.3 (sd=1.2) to 6.9 (sd=1.0) hours, sleep efficiency increased from 84% (sd=13) to 87% (sd=13), sleep latency gradually declined from 26 (sd=20) to 16 (sd=13) minutes and global scores declined from 7.3 (sd=3.8) to 5.4 (sd=3.8) at six months. However, mean daytime sleepiness (ESS) increased from 7.7 (sd=3.3) to 8.6 (sd=4.5) after chemotherapy cycle two, but then decreased to 6.7 (sd=2.9) below pretreatment levels, at six months. Actigraphy data differed from self-report data: mean nocturnal sleep duration declined from pretreatment 5.9 (sd=2.8) to 5.2 (sd=2.9) hours, sleep efficiency declined from 77% (sd=17) to 71% (sd=19), sleep latency increased from 51 to 106 minutes and WASO increased from 100 to 131 at six months.

Conclusion: Lung cancer patients enter treatment with poor sleep quality and display poor objective sleep across the treatment trajectory. Daytime sleepiness increased during treatment. Results should be verified in a larger sample. Patients receiving treatment for advanced lung cancer should be routinely assessed for sleep disturbances.

Support (If Any): 2008 Oncology Nursing Society and National Lung Cancer Partnership Lung Cancer Research Grant (RE27) (Dean).

0878

SLEEP, FATIGUE, DEPRESSION AND QUALITY OF LIFE IN WOMEN WITH BREAST CANCER BEFORE AND AFTER CHEMOTHERAPY: A CONTROLLED STUDY

Liu L[1], Rissling M[2], Faierman M[1], Natarajan L[3,4], Palmer B[1], Parker BA[4,5], Ancoli-Israel S[1,4,5]

[1]Department of Psychiatry, University of California, San Diego, La Jolla, CA, USA, [2]SDSD/UCSD Joint Doctoral Program in Clinical Psychology, San Diego, CA, USA, [3]Department of Family and Preventive Medicine, University of California, San Diego, La Jolla, CA, USA, [4]Moores UCSD Cancer Center, La Jolla, CA, USA, [5]Department of Medicine, University of California, San Diego, La Jolla, CA, USA

Introduction: Sleep disturbances, fatigue, depression are three of the most disturbing complaints in cancer patients undergoing treatment, and are often the major factors contributing to lower quality of life (QOL). Although studies of these symptoms within cancer patients are popular, results compared to cancer-free controls in prospective studies are still rare.

Methods: 74 women with newly diagnosed stage I-III breast cancer (BC) and scheduled to receive ≥4 cycles of chemotherapy, and 66 cancer-free women (CFW) with matched for age and education were studied. Sleep quality (Pittsburgh Sleep Quality Index, PSQI), fatigue (Multidimensional Fatigue Symptom Inventory-Short Form, MFSI-SF), depressive symptoms (Center of Epidemiological Studies-Depression, CES-D) and QOL (Medical Outcomes Study Short Form, SF-36, with norm-based Physical Component Scale (PCS) and Mental Component Scale (MCS) calculated) were assessed. Data were collected at 3 time points according to patients' treatment schedules: before the start of chemotherapy (baseline, BL), at the end of cycle 4 chemotherapy (C4) and one year after the start of chemotherapy (Y1).

Results: Compared to baseline, BC patients reported lower sleep quality, more fatigue, and more depression at C4 (all p's<0.02), but not at Y1 (all p's>0.3). BC patients' PCS and MCS scores did not change from

baseline to either C4 or Y1, but were below the US norms of 50 at all three time points (all p's<0.02, except MCS at Y1, where p=0.2). Compared to controls, at all three time points, BC patients reported lower sleep quality (all p's<0.007), more fatigue (all p's<0.003), more depression (all p's<0.03), and lower QOL (all p's≤0.0001, except MCS at Y1, where p=0.5).

Conclusion: Women with breast cancer experienced more symptoms of sleep, fatigue and depression immediately after chemotherapy but recovered to baseline levels one year later. QOL in the BC patients was lower than the US populations' at all time points. On the other hand, all symptoms were worse than those of women with no BC before, during and one year after chemotherapy. These data suggest that the management of these symptoms should be started from before chemotherapy and be extended to at least one year after the treatment, so as to improve patients' QOL.

Support (If Any): NCI CA112035, UL1RR031980 (CTRI), the UCSD Stein Institute for Research on Aging and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

0879

SLEEP STUDY ON PATIENTS WITH BRONCHIECTASIS

Faria Junior N[1], Pasqual RM[1], Santos IR[1], Aguiar I[1], Sampaio LM[1], Marcelo Bigatão A[2], Ricardo Santos S[2], Studart Leitão Filho FS[3], Roberto Jardim J[2], Oliveira LF[1]

[1]Nove de Julho University - UNINOVE, Sao Paulo, Brazil, [2]Pneumology, Federal University of Sao Paulo, UNIFESP, Sao Paulo, Brazil, [3]Medicine, Fortaleza University, UNIFOR, Fortaleza, Brazil

Introduction: Bronchiectasis represent a chronic disorder characterized by permanent, irreversible, abnormal dilation of the bronchi and bronchioles, accompanied by alterations in the elastic and muscle components of the walls as well as the pulmonary parenchyma. Due to irreversible dilation of the bronchi, the presence of secretions and airflow obstruction, subjects with bronchiectasis may be predisposed to hypoxemia during sleep or symptoms that might lead to arousal. Therefore, we describe sleep characteristic through the standard overnight polysomnography.

Methods: An observational study was carried out involving 21 patients with bronchiectasis at the Sleep Laboratory of the Nove de Julho University in the city of Sao Paulo, Brazil. Personal and clinical data; abdominal and neck circumference were collected. The Berlin Questionnaire (BQ) and the Epworth Sleepiness Scale (ESS) also were administered.

Results: Mean age was 51.6 ± 15.1 years; 57.1% of the patients were female and mean body mass index was 23.9 ± 3.7 kg/m2. Mean income was 1.3 times the minimum wage and only 28.6% had completed high school. The median ESS was 7.5 (0-23). A low risk for the obstructive sleep apnea (OSA) syndrome was found in 61.9% (BQ) of the subjects and there was a predominance of obstructive lung disease. Mean total sleep time was 282.7 ± 69.5 min, with sleep efficiency of 79.2 ± 29.2%. Sleep stages 1 and 2 were altered and the mean value of AHI was 3.7 ± 4.9 events/hour. The number of arousals was 5.6 ± 2.9/h. The oxyhemoglobin desaturation index was 5.9 ± 8.9/h and minimum oxyhemoglobin saturation was 84.5 ± 5.8%, during sleep.

Conclusion: In our study, patients with bronchiectasis had a low risk of OSA and changes in sleep quality.

Support (If Any): The authors thank Fundaçao de Ampara a Pesquisa do estado de Sao Paulo (Fapesp, acronym in Portuguese) and Conselho Nacional de Desenvolvimento Cientifico e tecnologico (CNPq, acronym in Portuguese) for supporting this research.

0880

SLEEP DISORDERS AND DIALYSIS MODALITY: PREDICTORS OF HR-QOL AMONG MEXICAN PATIENTS WITH END-STAGE RENAL DISEASE

Reynaga-Ornelas L[1,2], Baldwin CM[2], Arcoleo K[3,2], Quan SF[4,5]

[1]Health Sciences, Universidad de Guanajuato, Leon, Mexico, [2]ASU College of Nursing and Health Innovation, Phoenix, AZ, USA, [3]Ohio State University, Columbus, OH, USA, [4]University of Arizona Health Sciences Center, Tucson, AZ, USA, [5]Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Prevalence of sleep disorders among persons with end-stage renal disease (ESRD) is higher compared to the general population and affects their health-related quality of life (HR-QOL). Previous findings suggest that patients on hemodialysis (HD) report more sleep problems compared to patients on peritoneal dialysis (PD). This study describes the impact of sleep disorders and dialysis modality on HR-QOL of Mexican patients with ESRD.

Methods: Patients receiving continuous ambulatory peritoneal dialysis (CAPD), automated peritoneal dialysis (APD) and HD provided demographics and clinical health data. Measures included the Short Form (SF)-36 HR-QOL survey and a Spanish-language validated Sleep Habits Questionnaire. Data were analyzed using SAS software (V9.1) with signifi¬cance set at p<0.10 for this pilot study.

Results: Demographics and clinical data showed participants (N=121) to be 59 (SD=13) years, predominantly men (55%), married (67%), Catholic (93%), and not currently working (78%). The majority were diabetic (72%) and slightly overweight (BMI M=26.1; SD=5.1). The CAPD group (n=39) demonstrated significantly poorer HR-QOL scores compared to the APD (n=42) and HD (n=40) groups. Patients on HD reported higher rates and greater numbers of sleep disorders, including insomnia symptoms (48%), non-restorative (43%) and insufficient sleep (30%) compared to patients on CAPD/APD. Overall linear regression for HR-QOL found dialysis type and sleep disorders to be significant predictors and the model accounted for 31% of the variance (F=3.36, p=.002). Modeling for mental health was highly significant for dialysis type, sleep disorders and income, accounting for 34% (F=4.02, p=.0004).

Conclusion: Sleep disorders and dialysis modality contribute significantly to poorer mental health of Mexican patients with ESRD. Findings hold implication for sleep literacy of nurses and other health providers to improve HR-QOL outcomes and reduce costs for patients with ESRD in Mexico.

Support (If Any): Arizona State University College of Nursing and Health Innovation Bardewyck Foundation Scholarship and the Mexican Ministry of Education PROMEP Scholarship.

0881

SELF-REPORTED AND ACTIGRAPHICALLY-ESTIMATED SLEEP AMONG OLDER COPD PATIENTS

Zeidler MR[1], Martin JL[2], Badr M[3], Jouldjian S[2], Alessi CA[2]

[1]Pulmonary, Critical Care, and Sleep, Greater Los Angeles VA, Los Angeles, CA, USA, [2]Geriatric Research, Education and Clinical Center, Greater Los Angeles VA, Los Angeles, CA, USA, [3]Pulmonary, Critical Care, and Sleep, Wayne State University School of Medicine, Detroit, MI, USA

Introduction: COPD is associated with multiple sleep disturbances including sleep onset and maintenance insomnia, low sleep efficiency with multiple EEG arousals, obstructive sleep apnea, and increased daytime fatigue. Research on sleep in COPD patients is limited. To date no studies have utilized actigraphy to obtain a multi-night, home-based assessment of sleep in the COPD population.

Methods: Participants in a larger VA study (n=406) of sleep during and after hospitalization completed a comprehensive sleep evaluation during hospitalization, and again at home 3 months after discharge. At the 3-month follow-up assessment, participants completed the Pittsburgh

Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI), plus one week of wrist actigraphy with sleep diary (Octagonal Actiwatch-L, Ambulatory Monitoring Inc) to objectively estimate nighttime total sleep time (NTST), sleep%, and daytime total sleep time (DTST). 31 individuals (mean age=76 years; 100% male) had pulmonary function testing at the VA Medical Center, and 25 (81%) had confirmed COPD based on GOLD diagnostic criteria.

Results: Among COPD patients, mean % predicted (SD) FEV1 = 61% (26%); mean % predicted (SD) RV = 193% (77%); and mean % predicted (SD) DLCO = 62% (22%). Mean (SD) PSQI score=8.7 (3.8) and mean (SD) ISI=6.0 (SD=5.5). By actigraphy, mean (SD) NTST=372 (167) minutes, mean (SD) sleep%=70% (21%), and mean (SD) DTST=155 (101) minutes.

Conclusion: These data confirm that sleep quality is poor among COPD patients based on both self-report and actigraphically-measured sleep parameters. Findings demonstrate the utility of 24-hour actigraphy monitoring among COPD patients and may facilitate development of large-scale studies on sleep among COPD patients.

Support (If Any): VA HSR&D IIR 04-321-2 (Alessi), NIH/NIA K23 AG028452 (Martin), UCLA Claude Pepper Older Americans Independence Center (P60 AG010415; PI Reuben), and VAGLAHS GRECC.

0882

SYMPTOM PROFILES OF SLEEP DISTURBANCE IN BREAST CANCER SURVIVORS

Lowery AE[1], Starr T[1], Li Y[1], Reinsel R[2], Kavey N[3,4], O'Sullivan B[4], Passik S[5]

[1]Psychiatry and Behavioral Sciences, Memorial Sloan-Kettering Cancer Center, New York, NY, USA, [2]Anesthesiology, School of Medicine, Stony Brook University, Stony Brook, NY, USA, [3]The Rockefeller University, New York, NY, USA, [4]New York Presbyterian Hospital, Columbia University Medical Center, New York, NY, USA, [5]Department of Psychosomatic Medicine, Vanderbilt University Medical Center, Nashville, TN, USA

Introduction: Poor sleep can negatively impact quality of life (QoL), symptoms (i.e., pain, fatigue) and medical course during survivorship. Using biological, medical, demographic and psychosocial factors, we identified subgroups of poor sleepers with different symptom clusters. We aimed to define correlates of sleep disturbance to aid in the development and delineation of clinical treatments.

Methods: We examined 10 factors (age, race, marital status, disease stage, depressive symptoms, menopausal symptoms, and worry about death, health, role functioning and recurrence, respectively) in 200 post-treatment early-stage breast cancer survivors reporting sleep disturbances. Participants completed demographic, sleep quality (Pittsburgh Sleep Quality Index), mood, physical symptom, and QoL questionnaires.

Results: Classification and Regression Trees (CART) analyses using the statistical language R identified eight unique symptom profiles of sleep disturbance (shown in graphs). The severity of menopausal symptoms (i.e., night sweats, hot flashes) was the greatest contributing factor of sleep problems for the majority of survivors (n=121, 60.5%). For example, the largest subgroup (n=77, 38.5%) reported mild sleep disturbances (PSQI M=6.2) associated only with menopausal symptoms. The subgroup (n=8, 4%) with the most severe sleep disturbances (PSQI M=14.9) was associated with severe menopausal symptoms (total score >63). In both subgroups, sleep problems were not associated with other factors. For the remaining 79 survivors (39.5%), disease stage, younger age, and concerns about death and health played a greater role.

Conclusion: Addressing menopause-related symptoms may improve sleep disturbances for a majority of breast cancer survivors. For others, screening for health-related anxieties and interventions targeting worry may be indicated. Overall, sleep disturbances in our sample were largely due to biology, not psychology. Future research should include data on biomarkers. Treatment history, time since treatment and medication use are correlates that have been found in other studies and will be included in future analyses of this data.

Support (If Any): Memorial Sloan-Kettering Foundation; Supported in part by grant # UL1RR024143 to Rockefeller University from the National Center for Research Resources, National Institutes of Health.

0883

UNDERSTANDING THE DEVELOPMENT OF PERSISTENT INSOMNIA IN BREAST CANCER PATIENTS

Randell K[1], Espie CA[1], Morrison D[2], Paul J[3], Fleming L[1]

[1]Sleep Centre, University of Glasgow, Glasgow, United Kingdom, [2]Public Health, University of Glasgow, Glasgow, United Kingdom, [3]CRUK Clinical Trials Unit, Beatson Oncology Centre, Glasgow, United Kingdom

Introduction: Acute and persistent insomnia are particularly prevalent among women with breast cancer. Sleep problems often occur around diagnosis and are exacerbated by the effects of cancer treatments. However, disturbed sleep can persist long after cessation of active treatment, with a significant negative impact on patient quality of life. Before implementing evidence based interventions to improve sleep in this population, it is necessary to further our understanding of factors which may predict development of a chronic sleep complaint, and identify potential 'critical' periods where intervention may be most effectively implemented.

Methods: This ongoing longitudinal prospective study is collecting data on sleep and related symptoms among 250 newly diagnosed female breast cancer patients, over the first year following diagnosis. Sleep quality is measured retrospectively (pre-diagnosis) and then monthly, using the Insomnia Severity Index (ISI). The ISI was modified to include items on frequency of sleep symptoms, and use of sleep medication. At each time point participants are classified into: Good Sleepers, those with Insomnia Symptoms, and those with Insomnia Syndrome.

Results: This interim analysis reports data from the first 52 patients recruited to the study (mean age= 56.5 years; mean time since diagnosis=2.5 months; 72.7% Stage 1). Preliminary analysis of sleep data reveal a pre-diagnosis median ISI score of 1.0, increasing markedly to 9.0 at month 0 (shortly after diagnosis). Scores peaked at month 1 (median= 13.0) and remained in the sub-clinical sleep disturbance range at months 2 (8.5) and 3 (9.0). Of participants who were good sleepers pre-diagnosis (n=16), 37.5% had developed insomnia symptoms by month 0 and 18.8% syndrome level insomnia.

Conclusion: Early results suggest significant disruption of sleep occurring around diagnosis, which does not return to pre-diagnosis levels in the months after the acute initial stressor. On completion, this study will provide important information about the natural history of sleep disturbance in this population, with implications for treatment and prevention.

Support (If Any): The study is funded by: Breast Cancer Campaign.

0884

DIFFERENCES IN THE SLEEP PATTERN BETWEEN MALES AND FEMALES WITH SICKLE CELL DISEASE

Roizenblatt S[1], Figueiredo M[2], Roizenblatt M[2,1], Pollack Filho F[2,1], Matsuda S[2], Perini V[1], Sato JR[3], Tufik S[1]

[1]Psychobiology, Universidade Federal de Sao Paulo, São Paulo, Brazil, [2]Hematology and Hemotherapy, Universidade Federal de Sao Paulo, São Paulo, Brazil, [3]Centro de Matemática, Computação e Cognição, Universidade Federal do ABC, Sao Paulo, Brazil

Introduction: Periodic limb movements (PLM) and oxyhemoglobin desaturation during sleep are frequently reported in children with sickle cell anemia (SCD), but little is known about adults. This study evaluated the sleep pattern in adults with SCD and correlate PLM and respiratory findings to clinical aspects of the disease.

Methods: This was cross sectional study of 70 SCD patients (50% of each gender), matched for age, body mass index, and pulmonary in-

volvement. Participants underwent clinical evaluation (questionnaire and physical exam) and all-night polysomnography to assess their association with sleep abnormalities.
Results: Higher PLM index was verified in females than in males (16.5±10.7/h vs. 8.7±8.2/h. p< 0.05), and 88.6% of them exhibited PLM index ≥ 15/h, in contrast to 22,6% of the men, p<0,01. Females also exhibited correlation of increased PLMS index and clinical parameters such as pain score (rho =0.71), indirect bilirrubin (rho =0.42) and LDH (rho =0.38), p<0.01 all. Male patients presented higher apnea hypopnea index than females (9.1 ± 8.9 vs. 3.1 ± 3.9) as well as higher desaturation index (9.9 ± 7.3 vs. 4.8 ± 2.8), percentage of TST with oxyhemoglobin saturation below 90%, (29.3 ±38.5 vs. 7.0 ±23.3), p<0.01, all. but not lower baseline oxyhemoglobin saturation (93.5 ± 3.8 vs. 95.0 ± 3.1, p=0.08). In men desaturation index was related to priapism history, rather than to pulmonary involvement or hyper-hemolysis.
Conclusion: Elevated PLMS were more common in females with SCD and was associated with hyper-hemolysis whereas sleep-disordered breathing was more frequent in males. and desaturation index was related to priapism history.
Support (If Any): AFIP and CEPID-FAPESP 98/14303-3.

0885

PREVALENCE OF SLEEP DISORDERS IN LUNG TRANSPLANT RECIPIENTS

Sawhney V[1], Seethamraju H[2], Bourguet C[3], Hirshkowitz M[1,4], Sharafkhaneh A[1,4]
[1]Sleep Medicine, Baylor College of Medicine, Houston, TX, USA, [2]Pulmonary and critical care medicine, The Methodist Hospital, Houston, TX, USA, [3]Family and Community Medicine, Northeast Ohio Medical University, Rootstown, OH, USA, [4]Pulmonary, critical care and sleep medicine, Michael E. DeBakey VA Medical Center, Houston, TX, USA

Introduction: Lung transplantation is a last resort treatment for end-stage lung disease and has been shown to improve quality of life (QOL). Various chronic organ dysfunctions due to therapy or rejection are prevalent in lung transplant recipients. The chronic medical and respiratory conditions may affect sleep and further impair QOL. We conducted a survey to investigate prevalence of sleep complaints and their association with QOL in recipients of lung transplantation.
Methods: We surveyed a cohort of individuals who received lung transplantation between Jan 1, 2003 and March 31, 2010 at lung transplant center at Baylor College of Medicine/The Methodist Hospital. A compilation of questionnaires, including Pittsburgh Sleep Quality Index (PSQI), Cambridge-Hopkins RLS (CH-RLSq), Berlin, Epworth Sleepiness Scale (ESS) and SF36, was mailed to measure the sleep quality, screen for RLS and OSA, excessive daytime sleepiness and quality of life, respectively. A descriptive analysis was performed on the responses.
Results: Out of 167 mailed surveys, 54 individuals responded (32.3%) with mean age 60.6 years (SD 9.8), gender proportion of 48% males and 52% females, and mean post-transplant BMI 27 (SD 4.7). The non-respondents showed mean age of 56.5 years and slightly higher proportion of males (M=56.6%, F=43.4%). The respondents reported a long mean sleep latency of 33.2 min (SD 32.5), poor sleep quality (74% with PSQI score > 5), high prevalence of RLS (33.3%), excessive daytime sleepiness (ESS > 9 in 29%), poor physical QOL with SF36 mean score of 41.3 (SD 9.4), and high risk for OSA (48.2%).
Conclusion: In the studied population, sleep complaints were prevalent and associated with poor QOL. Thus, in clinical practice, a closer attention to sleep complaints is warranted in this type of patients. Further studies are needed to define incidence and relationship between the sleep complaints and worse QOL.

0886

SLEEP IN PERSONS WITH SELF-REPORTED COPD

Budhiraja R[1,2,3], Budhiraja P[1,2], Goodwin JL[3], Quan SF[4,3,1]
[1]Medicine, Southern Arizona VA Healthcare System, Tucson, AZ, USA, [2]Medicine, University of Arizona, Tucson, AZ, USA, [3]Arizona Respiratory Center, University of Arizona, Tucson, AZ, USA, [4]Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Sleep Heart Health Study (SHHS) baseline data was analyzed to evaluate sleep-related complaints in persons with self-reported chronic obstructive pulmonary disease (COPD).
Methods: Persons who reported history of emphysema, chronic bronchitis or COPD were classified as 'COPD'. Insomnia was defined as difficulty falling or staying asleep, waking up early or nonrestorative sleep. Restless legs syndrome (RLS) was defined as the presence of all four International RLS Study Group criteria, with symptoms occurring at least 5 days a month and associated with at least moderate distress.
Results: COPD was present in 335 participants and 3772 constituted non-COPD controls. COPD group was older (65.5±9.8 years vs. 62.4±10.5 years, P<0.001) and had lower FEV1 (2.1±0.7L vs. 2.7±0.7L, P<0.001) compared to controls. RLS was present in 7.3% of the entire sample and in 10.7% of those who reported COPD. Female gender (OR=1.86 [95% CI 1.44-2.40], P<0.001), COPD (OR=1.50 [1.03-2.18], P=0.03) and age (OR=1.02 [1.01-1.02], P=0.003) were independent predictors of RLS. Insomnia symptoms were present in 36.5% of the entire sample and in 46.7% of those who reported COPD. COPD (OR=1.84 [1.22-2.75], P=0.002), RLS (OR= 1.89 [1.29-2.77], P=0.001) and female gender (OR= 1.61 [1.21-2.13], P=0.001) were independently associated with insomnia. Within persons with COPD, presence of frequent cough, phlegm, sinus problems or runny nose predicted insomnia (OR= 2.38 [1.32-4.27], P=0.004) Similar proportion of persons with COPD reported snoring frequently (31.5% vs. 30.7%, P=0.84) or stopping breathing during sleep at least once a week (15.6% vs. 18.3%, P=0.84) as controls. Epworth Sleepiness Score, while slightly higher in COPD in univariate analysis, were similar in those with or without COPD (8.1 vs. 7.6, P=0.08) when adjusted for insomnia, RLS, age and BMI.
Conclusion: Self-reported COPD is independently associated with worse insomnia symptoms and RLS. Respiratory symptoms in COPD predict insomnia.

0887

PREVALENCE OF SLEEP DISORDERS AND THEIR DETERMINANTS IN PATIENTS WITH CHRONIC PULMONARY DISEASE

Sawhney V[1], Baringer BC[3], Rosen JB[1], Majid H[1], Hirshkowitz M[1,2], Sharafkhaneh A[1,2]
[1]Pulmonary, critical care and sleep Medicine, Baylor College of Medicine, Houston, TX, USA, [2]Pulmonary, critical care and sleep medicine, Michael E. DeBakey VA Medical Center, Houston, TX, USA, [3]Allied Health Department, Baylor College of Medicine, Houston, TX, USA

Introduction: Chronic medical conditions are commonly associated with sleep disorders. Chronic obstructive pulmonary disease (COPD) has been linked to a higher prevalence of sleep disorders. However, determinants of poor sleep in chronic respiratory diseases are not known. We investigated prevalence of sleep disorders and their relation with quality of life (QOL) in patients with chronic respiratory diseases.
Methods: We surveyed a cohort of veterans who underwent pulmonary function testing for respiratory complaints at VA Medical Center in Houston between 2000 and 2008. We administered St.George's Respiratory Questionnaire (SGRQ), SF12, Pittsburgh Sleep Quality Index (PSQI), International RLS Study Group questionnaire and CES-D to measure the QOL, sleep quality, symptoms of RLS, and depression, respectively.

Results: Out of 1927 mailed surveys, 340 individuals responded (17.2%) with mean age 69 years (SD 10), 97% males, and mean FEV1 68% (SD 23%). The respondents reported a long mean sleep latency of 32.9 min (SD 31.9), poor sleep quality (83.5% with PSQI score > 5), high prevalence of RLS (34.4%), and poor QOL with mean SGRQ score of 56.8 (22.9), SF12 mean Physical score of 30.4 (11.8) and Mental score of 44.9 (12.8) and higher depression score (CES-D 18.7). Poor sleep was not associated with presence of FEV1/FVC ratio of <0.7 and FEV1 (%predicted). Poor sleep correlated with other indices of poor QOL and high depression scores. More importantly, poor sleep correlated with nocturnal respiratory symptoms including cough, dyspnea and wheezing. The patients with RLS were noted to have worse QOL scores and poor sleep quality as compared to patients without RLS.
Conclusion: Prevalence of sleep complaints was high in this cohort and correlated with respiratory symptoms rather than the degree of abnormality on pulmonary function tests or presence of airflow obstruction. More attention should be given to sleep complaints in patients with respiratory symptoms.

0888

CHANGES IN COGNITION ARE ASSOCIATED WITH CHANGES IN SLEEP AND CIRCADIAN ACTIVITY RHYTHMS IN WOMEN WITH BREAST CANCER UNDERGOING CHEMOTHERAPY

Ancoli-Israel S[1,2,3], Rissling M[1,3], Faierman M[1], Liu L[1], Natarajan L[4], Neikrug AB[1,3], Palmer B[1,3]
[1]Department of Psychiatry, University of California San Diego, La Jolla, CA, USA, [2]Medicine, UCSD, La Jolla, CA, USA, [3]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, , La Jolla, CA, USA, [4]Preventive and Family Medicine, UCSD, La Jolla, CA, USA

Introduction: Women with breast cancer (BC) undergoing chemotherapy often complain of impaired cognitive functioning (ICF). As part of a larger study on ICF in women with BC, we examined the relationship between ICF and sleep, fatigue, mood and circadian activity rhythms before and after chemotherapy.
Methods: 69 women (mean age=55.2±9.5y) with stage I-III BC scheduled to receive ≥4 cycles of chemotherapy were included. ICF was assessed with a neuropsychological test battery (NP) and a composite score of the NP function was calculated. Other assessments were sleep (Pittsburgh Sleep Quality Index, PSQI); fatigue (Multidimensional Fatigue Symptom Inventory-Short Form, MFSI-SF); mood (Center of Epidemiological Studies-Depression, CES-D). The f-statistic (representing the strength of the circadian activity rhythm, i.e., goodness-of-fit) was calculated with an extended-cosine model based on actigraphy (Actiwatch-L, Philips) worn for 72-hours. Data were collected at 3 time-points: before chemotherapy (baseline; BL), at end of cycle 4 chemotherapy (C4) and one year after the start of chemotherapy (Y1).
Results: After adjusting for BL, NP composite score, age and college degree (yes vs no), changes in the NP composite score were significantly associated with changes in total PSQI from BL to C4 (C4-BL; Beta= -0.0235, p=0.04) and C4 to Y1 (Y1-C4; Beta= -0.0310, p=0.003); 16% of the variance of change in cognition from C4-BL and 27% from Y1-C4 was explained by the model, and poor sleep, low baseline NP score, being older and not having a college degree predicted decrease in cognition. Changes in the composite score at each time point were significantly correlated with changes of the f-statistic (C4-BL: Beta=0.000119, p=0.03; Y1-BL: Beta=0.000219, p=0.02; Y1-C4: Beta=0.000165, p=0.03); 15% of the variance of change in cognition at C4-BL, 18% at Y1-BL, and 9% at Y1-C4 was explained by the model, and reduction in strength of rhythm, low baseline NP score, greater age and no college degree predicted decrease in cognition. Changes in cognition were not associated with changes in fatigue or mood.
Conclusion: More impaired cognitive function was predicted by worse sleep quality and by more desynchronization of circadian activity rhythms, but not by fatigue or mood. Studies are needed to examine whether improving patients' sleep and strengthening circadian activity rhythms before the start of chemotherapy may prevent impaired cognitive function during and after chemotherapy.
Support (If Any): NCI CA112035, UL1RR031980 (CTRI), the UCSD Stein Institute for Research on Aging and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

0889

CHRONIC FATIGUE, PAIN, DEPRESSION AND DISORDERED SLEEP IN CHRONIC HIV AND POST SARS PATIENTS

Moldofsky H, Brott K, Kim J, Kwong T
Centre for Sleep and Chronobiology, Toronto, ON, Canada

Introduction: Because the HIV and SARS viruses enter the brain during the acute phase of these diseases, we hypothesized that such chronically ill patients would share similar disturbances in sleep physiology, fatigue, pain, and mood symptoms.
Methods: A night of standard measures of PSG sleep with EEG CAP analyses, and self-reported sleep, fatigue, pain and mood symptoms were carried out with 25 HIV patients(23 males, 2 females, mean age 47.32, (+/-10.25yrs, BMI 26.7 (+/-4.7) and compared to 20 chronic post SARS patients (17 female, 3 male, mean age 46.29, +/-. 11.02 yrs, BMI 28.29,+/-.6.88).
Results: Both HIV and chronic post SARS patients showed similar self -ratings of disordered sleep (Sleep Assessment Questionnaire: 25.82 (+/-8.36) vs. 29.29 (+/-4.79, p=0.14); Beck Depression Inventory 14.17 (+/-9.50), vs. 15.76 (+/- 8.44) p=0.23; somatic symptoms (Whaler Physical Inventory: 7.91(+/-.5.15) v. 10.3, (+/-5.24,)p=0.14, including frequent fatigue, muscular pain and poor sleep), pre and post sleep fatigue[1-7], sleepiness (Stanford Sleepiness Scale [1-7]), and widespread pain (0-30). More HIV patients had significant obstructive sleep apnea/hypopneas disorder with AHI> 15/hr. (n=14 vs. n=3), and PLMS >15/hr. (n=8 vs. n=1), vs. SARS , Both groups had similar unstable sleep with measures of CAP A2 (p=0.31)and CAP A3 (p=0.84) EEG sleep, but HIV vs. SARS patients had less stable CAP A1sleep (p=0.001), more stage 1 (p=0.01), and more movement arousals from EEG sleep (p=0.01) but no difference in SWS.
Conclusion: Patients with chronic viral induced illnesses such as HIV and post SARS, report a similar constellation of fatigue, pain, depression and poor sleep. HIV subjects were more likely to show disturbances in sleep physiology over Post SARS subjects with more disturbed EEG sleep, decreased stabilizing A1 CAP, increased movement arousals, increased stage N1 sleep and previously unrecognized OSAS in male HIV subjects.

0890

DECREASED RESPIRATORY-SPECIFIC QUALITY OF LIFE IS ASSOCIATED WITH EXCESSIVE DAYTIME SLEEPINESS, FATIGUE, AND DEPRESSIVE SYMPTOMS INDEPENDENT OF SLEEP APNEA STATUS

Zutler M[3,1], Blanc PA[3,1,4], Holty JC[2,5]
[1]Pulmonary, Critical Care, Allergy and Sleep Medicine, University of California, San Francisco (UCSF), San Francisco, CA, USA, [2]Pulmonary, Critical Care and Sleep Medicine Section, VA Palo Alto Health Care System, Palo Alto, CA, USA, [3]Cardiovascular Research Institute, University of California, San Francisco, San Francisco, CA, USA, [4]Occupational and Environmental Medicine, University of California, San Francisco, San Francisco, CA, USA, [5]Division of Pulmonary, Stanford University School of Medicine, Palo Alto, CA, USA

Introduction: Concomitant obstructive sleep apnea (OSA) and lung disease (LD) is common among Veterans Administration (VA) patients, making symptom attribution difficult. We hypothesized that poorer respiratory-specific health-related quality of life (HRQL), an attribute of

LD, would be associated with daytime sleepiness, fatigue, and depressive symptoms, independent of sleep apnea.
Methods: We analyzed data from sequentially referred patients at a VA-based sleep clinic. All referrals completed a structured sleep questionnaire prior to sleep testing. Questionnaire data included the revised Airways Questionnaire 20 (AQ20-R), a 20-item respiratory-specific HRQL instrument, as well as symptom batteries including the Epworth Sleepiness Scale (ESS), the Fatigue Severity Scale (FSS), and the Beck Depression Inventory (BDI). Electronic medical records (EMR) were reviewed for prior diagnoses of LD (COPD, emphysema, interstitial lung disease, or asthma). Body mass index (BMI) was extracted from the EMR. We used multiple logistic regression analyses to assess risk of increased ESS, FSS, or BDI associated with poorer HRQL, adjusting for OSA, BMI, and demographics.
Results: There were 131 referred patients (mean age 58.8±12.7 years; 94.7% male; mean BMI 35.4±13.4 kg/m2) who completed a structured questionnaire and a sleep study. Of those, 114 (87%) were found to have OSA [defined as apnea-hypopnea index (AHI) ≥5]; 22 (16.8%) had LD, 18 (13.7%) had both. The mean ESS score was 10.9±5.3; ESS>10 was present in 49.6%. AQ20-R scores ranged from 0-19 (mean 4.8±4.9); in those with LD, AQ20-R scores were greater (poorer HRQL) in LD (10.3±5.3 vs 3.7±3.9; p<0.001). In univariate logistic regressions, a one standard deviation (SD) difference in the AQ20-R score was associated with daytime sleepiness (ESS>10; p=0.02), fatigue (FSS>36; p<0.001), and depressive symptoms (BDI>10; p<0.001). Neither the presence of OSA (dichotomous) nor the AHI (continuous) was associated with any of these outcomes in univariate analyses (p>0.05 for all). Controlling for age, gender, BMI, and the presence of OSA, the AQ20-R remained associated with excessive daytime sleepiness (per 1 SD, OR 1.3; p<0.05), fatigue (OR 1.4; p<0.001) and depressive symptoms (OR 1.4; p<0.001).
Conclusion: Respiratory-specific HRQL, as measured by the AQ20-R, reflects co-morbid lung conditions and was associated with excessive daytime sleepiness, fatigue, and depressive symptoms, independent of the presence of OSA and after adjusting for age, gender, and BMI.
Support (If Any): This research was supported by the Flight Attendant's Medical Research Institute (FAMRI Bland Lane Center for Excellence in Secondhand Smoke), the University of California Tobacco-Related Diseases Research Program (17RT-0101), and the National Heart, Lung, and Blood Institute at the National Institutes of Health (5T32HL7185-34).

0891

LINKING CHRONIC KIDNEY DISEASE AND SLEEP DURATION: ANALYSIS OF THE NATIONAL HEALTH INTERVIEW SURVEY

Brown CD[1], Pandey A[1], Murray Bachmann R[1], Coicou C[1], Constant G[1], Salifu M[1], Jean-Louis G[1,2]
[1]Brooklyn Health Disparities Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [2]Sleep Disorder Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA

Introduction: Evidence suggests that chronic kidney disease (CKD) is associated with sleep disturbances. This study examined associations of sleep duration with the presence of self-reported chronic kidney disease.
Methods: Analysis was based on the National Health Interview Survey (NHIS), an annual cross-sectional household interview survey conducted annually by the National Center for Health Statistics and the Centers for Disease Control and Prevention. The survey utilizes a multistage area probability design that providing representative samples of U.S. households. A total of 128, 486 American adults (average age was 35.4, 51.6% were female) who participated in the 2005-2009 NHIS survey answered the question about whether they were diagnosed with chronic kidney disease.
Results: Compared with individuals reporting 7 hours habitual sleep, both short sleeper (<6 hours) and long sleepers (>8 hours) had a greater likelihood of reporting kidney disease (49.9% and 53.4%, p<0.0001; respectively). Multivariate regression analysis adjusting for In these sociodemographic factors (age, gender, income, body mass index), and medical factors (e.g. depression, hypertension and heart disease) showed that both short and long sleepers had a higher risk of reporting chronic kidney disease than individuals who reported sleeping 7 hours. [OR = 1.97, 99% CI = 1.96-1.97; OR = 1.78, 99 % CI = 1.77 - 1.79; p<0.0001]. Analyses indicated no significant interactions between sleep duration and race/ethnicity on the presence of kidney disease.
Conclusion: Short and long sleepers in America have a greater likelihood of reporting CKD than those estimating seven hours habitual sleep duration.
Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

0892

THE EFFECT OF THYROID CANCER ON SLEEP PATTERN AND OBSTRUCTIVE SLEEP APNEA

Ng R
Sleep Medicine, Woodbine Medical Centre, Markham, ON, Canada

Introduction: Thyroid cancer is one of the most common head and neck cancers and its exact etiology is largely unknown. Excessive stimulation of the thyroid by thyroid stimulating hormone (TSH) may be one of the factors in its pathogenesis. It is known that neuroendocrine secretion can be altered by sleep disorders, and both hypo- and hyperthyroidism has been associated with irregular sleep patterns. The complex relationship between thyroid function and sleep disturbances therefore warrants further investigation. As such, this study will attempt to better understand the relationship and potential effects between thyroid cancer and sleep patterns, especially deep sleep, wake after sleep onset levels (WASO), and obstructive sleep apnea (OSA).
Methods: A retrospective study analyzing key differences in sleep efficiency, duration of wake after sleep onset (WASO), and severity of obstructive sleep apnea were compared in patients with (n=74) and without (n=89) thyroid cancer. Subgroup analyses were performed after matching for gender. Polysomnography, lab tests, and fine needle aspiration were used to gather data for sleep and thyroid function.
Results: The results suggest that patients with thyroid cancer have worse sleep efficiency (M=75.6%, SD=13.1%) as compared to patients without thyroid tumor (M=80.7%, SD=13.4%). The mean difference was significant (t=-2.47, p<.05). The differences were found in both gender groups although the effect seems to be more pronounced in male. Conversely, the durations of stage 1 and 2 (light sleep) were identical for both groups. Similarly, thyroid cancer patients also have a significantly (t=3.18, p<.001) longer WASO duration (M=83.8, SD=47.4) as compared to patients without thyroid tumor (M=59.9, SD=46.9). These results suggest that there may be a relationship between disturbed, non-efficient sleep and the development of thyroid cancer. Interestingly, this study also identified a consistent and significant inverse relationship between severity of OSA and the presence of thyroid cancer, with the non-cancer group having higher apnea and hypopnea index (t=-3.0, p<.005).
Conclusion: Studies primarily looking at the relationship between thyroid cancer and potential disturbances in sleep patterns are limited. This study showed specific and significant patterns between thyroid cancer and sleep disturbances (i.e. deep sleep, WASO, and AHI). These findings warrants more detailed study into thyroid cancer and sleep disturbances.

0893

A PRELIMINARY ANALYSIS OF NIGHTMARES AND DISTURBING DREAMS AMONG PATIENTS WITH CHRONIC PAIN

Bryson W[1,2], Bryson TL[1]
[1]Alabama Psychological Services Center, Huntsville, AL, USA, [2]Psychology, Jacksonville State University, Jacksonville, AL, USA

Introduction: Chronic pain is commonly encountered in health care settings. Dreaming among those with chronic pain has received limited attention in the literature. This study sought to describe the presence of nightmares and disturbing dreams (NM/DD) among patients with chronic pain and to identify differences in cognitive-behavioral factors and affective disturbances. It was postulated that higher levels of pain catastrophizing (PC), somatic awareness (SA), and worry at bedtime (WBT), as well as anxiety and depression would be present among those experiencing NM/DD.
Methods: Participants included a heterogeneous sample of 111 adults (M=43.54, SD=10.94) with chronic pain. Each participant provided consent and completed a packet including a demographics survey, Pain Catastrophizing Scale, Modified Somatic Perceptions Questionnaire, Sleep Hygiene Index, and Hospital Anxiety and Depression Scale. Descriptive statistics were performed to assess the percentage of patients in the sample reporting NM/DD and the frequency of these experiences. Two MANOVAs were performed to compare cognitive-behavioral factors (PC, SA, and WBT) and affective disturbances (anxiety and depression) between those reporting and denying the presence of NM/DD.
Results: Sixty-three percent of the sample reported regular NM/DD experiences (M=7.19 events per month). MANOVA indicated that patients reporting NM/DD had higher levels of maladaptive cognitive-behavioral factors with PC, SA, and WBT each being significantly higher. MANOVA did not support differences in affective disturbances between the groups.
Conclusion: NM/DD experiences are likely to be present in a large percentage of patients with chronic pain and may be due to multiple factors that need further exploration. Patients with chronic pain reporting NM/DD have higher levels of PC, SA, and WBT compared to those not endorsing such experiences. Affective disturbances do not appear to differ with respect to NM/DD experiences. Further efforts to study dream phenomena among those with chronic pain are encouraged.

0894

EVALUATING THE VARIABILITY OF SLEEP ARCHITECTURE IN PATIENTS WITH CHRONIC PAIN

Wolfe VA, Dorhofer D
Physical Medicine and Rehabilitation/Chronic Pain, Kaiser Permanente Medical Group, Inc., Roseville, CA, USA

Introduction: The sleep of patients with chronic pain is often inefficient and non-restorative. Poor quality sleep amplifies pain levels, perpetuating the negative cycle of increased pain and insomnia. When patients with chronic pain experience improvements in sleep, their pain, level of disability and medication use decreases. Most of the literature regarding sleep and chronic pain is based on 1 to 4 nights of objective sleep study or subjective patient report. This study utilized at-home EEG sleep monitoring devices for 28 days.
Methods: Participants were recruited from patients attending an 8-session multidisciplinary chronic pain management course. Class #4 reviewed sleep and pain and sleep improvement strategies. Fourteen days of EEG data was collected before and after session 4. Participants also completed pre- and post-study questionnaires and daily logs of perceived sleep quality, energy, mood, medication use, caffeine use, naps and other variables.
Results: Twelve participants volunteered; all were female; mean age was 58 years. The most dramatic objective finding was the amount of variability in total sleep, REM sleep, deep sleep, sleep onset and wakings. For example, mean total sleep per night was 6 h 26 min, however, the range was 0 h 39 min to 10 h 54 min. Mean deep sleep was 45 min per night, range 0 h 0 min to 2 h 33 min. The mean of REM per night was 1 h 45 min; range 0 h 0 min to 3 h 57 min. Participants averaged 7 wakings per night (range 0 to 21 wakings). Mean time awake (after falling asleep) was 49 min; range 0 min to 3 h 55 min. At the end of the study, 92% of patients reported their understanding of sleep had improved, 58% reported their pain had decreased and 42% reported improvements in their sleep and mood.
Conclusion: While the average total sleep time, REM, deep sleep, wakings and wake time were all within normal limits, participants with chronic pain exhibited significant variability in their night to night sleep quality. Following 28 days of sleep monitoring and 6 classes regarding chronic pain management strategies, patients reported significant improvement in their sleep, mood and pain. The participants informed us that having the opportunity to participate in this clinical trial enhanced their understanding of sleep architecture and augmented satisfaction and engagement with the multidisciplinary chronic pain treatment program.
Support (If Any): Kaiser Permanente. EEG sleep monitoring devices were donated by Zeo, Inc.

0895

DISTURBED SLEEP IN PATIENTS WITH FIBROMYALGIA COMPARED WITH INSOMNIA OR WITH HEALTHY NORMAL SUBJECTS

Roth T[1], Bhadra P[2], Pitman V[2], Roehrs T[1], Resnick M[2]
[1]Sleep Disorders and Research Center, Henry Ford Sleep Research Center, Detroit, MI, USA, [2]Clinical Sciences, Pfizer Inc, New York, NY, USA

Introduction: Patients with primary insomnia (PI) as well as fibromyalgia (FM) report disturbed sleep; however the possible differential nature of sleep disturbances seen in these populations needs definition. We sought to determine the nature of sleep disturbances in PI and FM patients reporting insomnia, relative to healthy normal subjects.
Methods: Three groups of subjects (FM: n=132; PI: n=109; normals: n=52) were recruited for different studies. Patients with FM and PI were pre-selected to meet sleep disturbance criteria. Subjects with apnea, periodic limb movements, and other sleep and circadian disorders were excluded from all groups. Polysomnography was performed during 2 consecutive nights. In addition to traditional sleep measures, bout length and frequency (duration and number of sleep and wake episodes) were analyzed. Data are mean±standard deviation.
Results: Mean age was 48.4, 45.4, and 30.2 years for FM, PI, and normals, respectively, and 86.4%, 67.9%, and 73.1% were female. FM and PI subjects had decreased total sleep time (TST), sleep efficiency, and Stage 3-4 sleep, and increased latency to persistent sleep (LPS) and wake time after sleep onset (WASO) relative to normals. There were no differences in traditional polysomnography parameters between patients with FM vs. PI (WASO: 107.7±32.8 vs. 108.6±31.5 min; TST: 321.2±39.4 vs. 307.7±42.7 min). There was a directional difference between FM and PI subjects for Stage 3-4 sleep (48.1±32.4 vs. 27.2±23.6 min; $P<0.0001$) and LPS (58.2±29.8 vs. 70.7±31.5 min; $P=0.0017$). Despite comparable WASO and TST, FM patients showed shorter (4.64±2.42 vs. 5.87±3.15 min; $P=0.001$), but more frequent wake bouts (41.62±16.67 vs. 35.70±12.59; $P=0.0019$) than PI. FM and PI patients showed longer and more frequent wake bouts vs. normals (wake duration: 1.22±0.37 min; wake number: 31.18±8.56; $P<0.0001$ for both).
Conclusion: The decreased wake bout length and increased number, in conjunction with decreased LPS and increased Stage 3-4 sleep, suggest that sleep in FM is characterized by an inability to maintain continuous sleep, with increased sleep drive evidenced by more rapid resumption of sleep relative to subjects with PI.
Support (If Any): Sponsored by Pfizer Inc.

0896

THE LOUGHBOROUGH FIBROMYALGIA PATIENT SERIES STUDY

Yeung W[1,2], McKenna F[2], Morgan K[1]
[1]Clinical Sleep Research Unit, Loughborough University, Loughborough, United Kingdom, [2]Rheumatology Unit, Trafford General Hospital, Trafford, United Kingdom

Introduction: While fibromyalgia syndrome (FMS) is characterized by musculoskeletal pain, fatigue and non-restorative sleep, increasing evidence suggests an influential role for psychological constructs. The Loughborough Fibromyalgia Patient Series Study (LFPSS) has been designed to compare the polysomnographic and psychological profiles of newly diagnosed FMS patients and age matched osteoarthritis patients sequentially recruited from a single Rheumatology Facility in the UK. We report preliminary data on the feasibility of the LFPSS.
Methods: All referred patients are approached following their diagnosis and invited to participate. The protocol requires 2 nights domiciliary PSG using an Embla A10 recorder; the montage includes C3-A2, C4-A1, EOGL-A1, EOGR-A1 and SMG, and 2 bipolar channels observing frontal and occipital activity (FP1-F3 and O1-P3). Pilot data included 6 FMS patients (M=33.67) and 6 controls (M=32.83). All participants were female. Psychological evaluations included pain severity and impact (BPI), pain catastrophizing (PCS), depression (CES-D), anxiety (STAI), and the Multidimensional Scale of Perceived Social Support.
Results: The full assessment protocol showed 100% patient adherence. Using a manual visual counting method, alpha intrusions into delta wave sleep were found to be significantly greater ($t=3.85$, $p<.01$) in FMS (M=40.31) than in controls (M=10.77). While alpha in controls remained low and constant throughout the night, FMS was significantly greater in the first portion of the night and subsequently decreasing through the night. In FMS patients psychometric evaluations showed levels of pain severity (M=6.94, SD=2.44), pain interference (M=7.93, SD=1.50), pain catastrophizing (M=26.25, SD=3.40) CES-D depression ratings (M=27.25, SD=7.54), state (M=42.25 SD=12.50) and trait (M=57.50, SD=10.344) anxiety levels, higher than the normal population. Perceived social support (M=5.66, SD=1.27), however, was lower than a referenced group (M=5.81, SD=0.79).
Conclusion: The preliminary data supported the feasibility of the LFPSS.

0897

SLEEP DISORDERS IN PATIENTS WITH HEMATOLOGICAL MALIGNANCIES

Tallavajhula S[1], Balachandran D[2], Bashoura L[2], Murphy V[2], Aaron-Remmert BK[2], Faiz S[2]
[1]Pulmonary, Critical Care and Sleep Medicine, University of Texas Health Science Center, Houston, TX, USA, [2]Pulmonary, Critical Care and Sleep Medicine, University of Texas M.D.Anderson Cancer Center, Houston, TX, USA

Introduction: Sleep complaints and fatigue are common issues in patients with hematologic malignancies. Sleep disorders are under-recognized and may contribute significantly to fatigue. Few studies have objectively quantified sleep disturbances with polysomnography. We aim to describe the polysomnographic characteristics of sleep in this population.
Methods: Patients with hematological malignancies who were referred to the Sleep Center at the University of Texas M.D.Anderson Cancer Center from 2006-2011 were included. Clinical history and polysomnographic data were reviewed retrospectively. Preliminary data for 55 patients is presented.
Results: The patients consisted of 30 men and 25 women (age range 19-82 years). A total of 89 polysomnograms were conducted (45 baseline, 6 spilt night and 39 positive pressure titration studies). 19 patients (35%) were cancer survivors, while 36 patients (65%) had active cancer. 6 (11%) patients had acute leukemias, 9 (16.4%) chronic leukemias, 22 (40%) lymphomas, 10 (18%) multiple myelomas and 8 (14.5%) patients had other hematological malignancies. 21 (38.2%) had undergone stem cell transplant. 40 (72.8%) patients were referred for symptoms of sleep-disordered breathing. Out of the others, 6 (11%) were referred only for fatigue and daytime sleepiness, 2(3.6%) for insomnia, 1 (1.8%) for frequent nocturnal awakenings and 6 (11%) for other reasons. 11 (20%) patients had a prior history of sleep-disordered breathing. 24 (43.6%) patients had a Body Mass Index (BMI) < 30 kg/m^2 and 31 (56.4%) had a BMI> 30 kg/m^2. Epworth Sleepiness Scale scores were available on 40 patients, of whom 28 had scores > 10 and 16 patients < 10. Polysomnographically, the primary diagnosis in 36 patients (65.5%) was obstructive sleep apnea, central sleep apnea in 4 (7.3%), periodic limb movement disorder in 3 (5.5%), other diagnoses (e.g primary snoring, sleep-related hypoxemia and hypoventilation) in 10 (18.2%) while 2 (3.6%) had normal studies.
Conclusion: A large percentage of patients with hematological malignancies were found to have sleep disorders including sleep apnea. Underlying sleep disorders should be considered when evaluating fatigue in this population.

0898

ASSOCIATIONS BETWEEN SLEEP DURATION AND FIBROMYALGIA

Adedayo A[2], Pandey A[2,1], Nam D[2], Pandey AK[1], Nunes J[3], Casimir GJ[5,2], Jean-Louis G[2,4]
[1]Internal Medicine, A.P. Medical P.C., Brooklyn, NY, USA, [2]Brooklyn Health Disparities Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [3]Sophie Davis School of Biomedical Education, C.U.N.Y., New York, NY, USA, [4]Sleep Disorder Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [5]Psychiatry, SUNY Downstate Medical Center, Brooklyn, NY, USA

Introduction: The extant literature documents associations between habitual sleep durations and several medical conditions. This study investigated whether sleep durations are associated with fibromyalgia using data from a national representative sample.
Methods: Analysis was based on the 2007-2008 National Health Interview Survey (NHIS) survey, providing self-reported fibromyalgia and sleep duration data for 109,367 adult respondents (mean age was 45.3 ±17.3 and 52.6% were female). The NHIS is a cross-sectional household interview survey utilizing a multistage area probability design. Data was collected by trained personnel from the US Census Bureau in face to face interviews, using computer-assisted personal interviewing. Respondents provided anthropometric and socio-demographic data and information on health care professional diagnosed chronic conditions.
Results: Of the entire sample, 5.1% (n=525) reported a diagnosis of fibromyalgia, (M:F = 1:7). The prevalence of short (<6 hours) and long sleep (>8 hours) among those reporting fibromyalgia was 17.9% and 14.4%, respectively ($p<0.001$). Logistic regression analysis indicated that both short and long sleepers were more likely to report fibromyalgia than those reporting habitual sleep duration of 6-8 hours [OR=1.79, 95% CI: 1.78-1.79; OR=1.70, 95% CI: 1.70-1.71, respectively; $p<0.001$]. Among men, analyses adjusting for effects of age, race/ethnicity, education, income, smoking, alcohol use, body mass index (BMI), emotional distress indicated that male short and long sleepers were at lower risk of reporting fibromyalgia compared with those reporting habitual sleep duration of 6-8 hours [OR=0.96, 95% CI: 0.95-0.97, $p<0.001$ and OR=0.56, 95% CI: 0.55-0.56, $p<0.001$, respectively]. Adjusted analyses for women showed that short and long sleepers were also at greater risk of reporting fibromyalgia compared with those reporting habitual sleep duration of 6-8 hours [OR=3.30, 95% CI: 3.28-3.32; OR=1.86, 95% CI: 1.84-1.87; $p<0.001$, respectively].
Conclusion: Our findings suggest that sleep duration should be considered in the assessment of fibromyalgia.

Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

0899

SLEEP DURATION AND SLEEP SYMPTOMS ASSOCIATED WITH EXPOSURE TO ENVIRONMENTAL TOXINS

Abastillas AF, Ratanaumpawan P, Jackson NJ, Grandner MA
Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Sleep disparities associated with lower socioeconomic and minority status may be due to increased exposure to environmental toxins. The present analysis assesses environmental phenols and parabens and their relation to self-reported sleep symptoms.
Methods: The subjects in this study were 5,587 adults 18+ who participated in the 2007-2008 National Health and Nutrition Examination Survey (NHANES). Sleep duration was assessed as Very Short(<5h), Short(5-6h), or Long(>8h) relative to Normal(7-8h) sleep. Sleep latency assessed continuously was dichotomized relative to <30mins. Difficulty falling asleep, frequent awakenings, early morning awakenings, daytime sleepiness, unrestful sleep, snorting/gasping, and snoring were assessed on ordinal scales. Toxins were examined with gas chromatography-mass spectrometry(GC/MS) on urine samples. The phenols examined were 2,5-dichlorophenol; 2,4-dichlorophenol; 2,4,5-trichlorophenol; 2,4,6-trichlorophenol; benzophenone-3; bisphenol A; and triclosan. Parabens were butyl, ethyl, methyl, and propyl paraben. All binary (sleep latency), multinomial (sleep duration), and ordinal (symptoms) logistic regression analyses were adjusted for urinary creatinine levels, age, and sex. Exploratory multinomial regressions were also conducted for symptom variables.
Results: 2,5-dichlorophenol was positively associated with Very Short and Short sleep, latency >30min, and snorting/gasping. 2,4-dichlorophenol was positively associated with Very Short sleep and snorting/gasping. 2,4,5-trichlorophenol was negatively associated with early morning awakenings and snorting/gasping. Benzophenone-3 was negatively associated with Very Short and Short sleep and latency >30min. Butyl paraben was negatively associated with sleep latency >30min and early morning awakenings, and sleepiness. Methyl paraben was negatively associated with sleepiness and snoring. Multinomial regression results for sleep symptom variables showed that in the absence of an ordinal relationship, several toxins were related to one or more response categories of numerous symptoms (e.g., associated only with problems "rarely" or "almost always").
Conclusion: Many associations (both positive and negative) between toxin levels and sleep symptoms suggest that environmental toxins may influence sleep/wake regulation. Future studies should investigate potential mechanisms or additional confounders.
Support (If Any): This work was supported by T32HL007713 and a pilot grant from the University of Pennsylvania CTSA(UL1RR024134). Also, we wish to thank the Centers for Disease Control and Prevention for collecting these data and making them available and the NHANES participants for providing data.

0900

QUESTIONNAIRE ASSESSMENT OF SYMPATHETIC NERVOUS SYSTEM ACTIVITY AMONG FEMALES WITH IRRITABLE BOWEL SYNDROME: A PILOT STUDY

Broderick J[3], Gold M[4], Amin M[1,2], Gold AR[1,2]
[1]Pulmonary, Critical Care and Sleep, Stony Brook University, Stony Brook, NY, USA, [2]Pulmonary and Critical Care, Veterans Affairs Medical Center, Northport, NY, USA, [3]Department of Psychiatry and Behavioral Sciences, Stony Brook University, Stony Brook, NY, USA, [4]Biostatics, Novartis Consumer Health, Neptune City, NJ, USA

Introduction: Irritable bowel syndrome (IBS), one of the central sensitization syndromes (CSS), is characterized by gastro-intestinal complaints and non-specific symptoms like insomnia, non-restorative sleep and sleepiness / fatigue. There is little information available concerning how autonomic tone relates to the sleep quality and sleepiness / fatigue that often associated with IBS. We studied the relationship between Sympathetic Nervous System (SNS) tone and sleep among IBS patients. We tested the possibility that SNS tone can be assessed in patients through self-report. This hypothesis is tested by administering a somatic arousal questionnaire to cohorts of female IBS patients and matched healthy controls.
Methods: We recruited 12 female IBS participants and 12 healthy female controls matched for age and BMI. The following questionnaires were administered for both groups: MASQ Anxious Arousal Scale, Short Form -36, Epworth Sleepiness Scale (ESS), Fatigue Severity Scale (FSS), Pittsburgh Sleep Quality Index (PSQI) and Rome II Modular Questionnaire. Continuous variables were compared between IBS patients and healthy controls with unpaired T-tests. Correlation coefficients were tested for statistical significance using Fisher's z-transformation.
Results: The IBS participants experienced mild hypersomnolence/fatigue on ESS & FSS than were healthy controls. The mean Anxious Arousal Scale score was 7.6 points higher among IBS participants relative to controls, and the difference was highly significant. Thus, a Anxious Arousal Scale score > 20 identified IBS participants with a sensitivity of 1.0 and a specificity of 0.92. Among all the participants, Anxious Arousal Scale scores correlated significantly with the FSS score ($r = 0.66$, $p = 0.0005$), the ESS score ($r = 0.58$, $p = 0.003$), and the PSQI score (overall sleep quality; $r = 0.50$, $p = 0.01$).
Conclusion: Anxious Arousal scale can be useful clinical and research tool for CSS and sleep disorders.
Support (If Any): This study was funded by a Department of Veterans Affairs VISN 3 Seed Grant and the General Clinical Research Center at Stony Brook University (MO1 RR10710).

0901

CIRCADIAN ACTIVITY PATTERNS IN OLDER ADULTS WITH KNEE OSTEOARTHRITIS AND/OR INSOMNIA

Coryell VT[1], Spira AP[2], Kaufmann CN[2], Bounds SC[1], Liu L[3], Buenaver LF[1], McCauley L[1], Finan PH[1], Ancoli-Israel S[3], Smith MT[1]
[1]Psychiatry and Behavioral Sciences, Johns Hopkins School of Medicine, Baltimore, MD, USA, [2]Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA, [3]Psychiatry, University of California, San Diego, La Jolla, CA, USA

Introduction: Activity-based measures of circadian dysrhythmia have been linked with negative medical outcomes in epidemiologic studies of older adults, but whether aberrant circadian activity patterns are present in specific clinical populations is largely unknown. Using a cross-sectional design, we sought to examine the separate and combined effects of knee osteoarthritis (K-OA) and insomnia, both of which are common among older adults, on objective circadian activity rhythm.
Methods: Study participants (n=102, mean age = 60.3 ± 8.9 years) with no unstable medical or major psychiatric conditions comprised four groups: K-OA/insomnia (n=48), K-OA/no insomnia (n=14), no K-OA/insomnia (i.e., primary insomnia, n=16), and no K-OA/no insomnia (i.e., control, n=24). K-OA status was determined by the American College of Rheumatology criteria, and insomnia or good sleeper status was determined by clinical interview using research diagnostic criteria, standardized questionnaires, and polysomnography. Activity was measured continuously via wrist actigraphy for two weeks. We analyzed actigraphy data using an extended cosine model to compute the following circadian rhythm parameters: the F-statistic (a measure of overall rhythmicity, with higher F-values indicating more robust rhythms); activity peak height (the distance between the lowest and highest point); midline estimating statistic of rhythm (MESOR); and time of peak activity (acrophase). Group differences in circadian activity rhythm measures were examined using analyses of covariance controlling for age, sex, body mass index, and apnea-hypopnea index.

Results: The three symptomatic groups (i.e., K-OA/insomnia, K-OA/no insomnia, and no K-OA/insomnia) did not differ from each other, but each demonstrated a lower F-statistic compared to the control group (p's<.05).
Conclusion: These findings suggest that the circadian activity rhythms are weaker in older adults with K-OA and/or primary insomnia. Whether circadian dysrhythmia contributes to K-OA or insomnia symptomotology, is a consequence of these disorders, or is treatable in this clinical population requires investigation.
Support (If Any): Supported by the National Institute of Arthritis and Musculoskeletal and Skin Disease (NIAMS) grants 5R01AR054871 and 5R01AR059410. Dr. Spira is supported by a Mentored Research Scientist Development Award (1K01AG033195) from the National Institute on Aging.

0902

ASSESSMENT OF AUTOMATED DELTA ALPHA RATIOS IN PATIENTS WITH FIBROMYALGIA

Turner J[1], Bogan R[1,2], Rosenfeld V[3]
[1]SleepMed, Columbia, SC, USA, [2]School of Medicine, University of South Carolina, Columbia, SC, USA, [3]Neurology, South Coast Medical Group, Savannah, GA, USA

Introduction: Fibromyalgia is a chronic condition characterized by widespread pain, multiple tender points, and abnormal pain perception. Two common complaints are fatigue and unrefreshing sleep. The objective of this study is to assess delta/alpha ratios in fibromyalgia patients presenting to the sleep lab with a sleep complaint.
Methods: Delta/alpha quantitative analysis is performed with Respironic's automated system in patients with American College of Rheumatology (ACR) positive versus ACR negative criteria. Variables assessed included: Fatigue severity scale scores (FSS), Epworth Sleepiness Scale (ESS) scores, age, total sleep time, wake after sleep onset (WASO), apnea hypopnea index (AHI).
Results: 546 records of clinical patients presenting to a sleep clinic were reviewed. Any patients taking benzodiazepines were excluded from the dataset. Means/standard deviations are reported for 431 remaining patients who were either ACR-/+. For the 358 ACR- there were 142 females/216 males with mean age 52(154); BMI 32(7); ESS 11(6); TST 235 min (105); WASO 47 min (15); AHI 27(27); D/A ratio 19(32). For ACR- group 296 (83%) had FSS<50 and 62(17%) had FSS >50. Of the 73 ACR+ there were 71 female/2 males with mean age of 47(12); BMI 30(6); ESS 10(5); TST 324 min (87); WASO 63(44); AHI 7(12); D/A ratio 12(22). For ACR+ group 56 (77%) had FSS> 50 while 17 (23%) had FSS<50. T-test comparing D/A ratio in those with ACR- to ACR+ was significant P<0.05.
Conclusion: Our results indicate fibromyalgia patients D/A ratios are significantly reduced when compared to other ACR- patients. The proportions of those patients with FSS >50 are distinctly higher in ACR+ patients. The D/A ratio is a measure that may offer clinician insights into sleep instability in patients with fibromyalgia.

0903

SLEEP DISORDERS IN CHILDREN AND ADOLESCENTS WITH FIBROMYALGIA

Chaudhry H, Guo Y, Simakajornboon N
Sleep disorder center, childrens cincinnati hospital, Cincinnati, OH, USA

Introduction: Sleep problems are common in adult patients with fibromyalgia. Previous studies have shown that certain sleep disorders such as restless leg syndrome(RLS) are prevalent in this population. However, there is very limited data on sleep issues in children and adolescents with fibromyalgia.
Methods: A retrospective review of medical records and polysomnography was conducted in children and adolescents with fibromyalgia who were referred to sleep disorders center at Cincinnati Children's Hospital Medical Center from 2007 to 2011. Only patients who were evaluated in sleep clinics and underwent overnight sleep study were included in the study. Patients with incomplete data were excluded.
Results: A total of 19 patients with fibromyalgia met the criteria for entry into analysis. The average age was 16.4±1.5 yo (range 12-18 yo). The age when the first sleep complaints started was 11.8±4.3 yo. For subjective sleep complaints, 13/19 (68.4%) reported sleep onset problem, 14/19 (73.7%) reported sleep maintenance problem, 18/19 (94.7%) reported night time pain and all patients reported daytime sleepiness. For symptoms of specific sleep disorders, 6/19 (31.6%) reported symptoms of sleep disordered breathing (SDB) (snoring or breathing pauses), 4/19 (21.1%) reported parasomnia, 17/19 (89.5%) reported RLS symptoms (leg discomfort, leg jerking at night). From polysomnographic data, 5/19 (26.3%) was diagnosed with obstructive sleep apnea and 6/19 (31.5%) was diagnosed with periodic limb movements(PLM) in sleep. In addition to treatment for specific sleep disorders, cognitive behavioral therapy was started on 12/19 (63.2%) of patients. 11/19 (57.9%) of patients had improvement in daytime sleepiness and quality of life(QOL) after treatment.
Conclusion: Sleep complaints and sleep disorders are common among children and adolescents with fibromyalgia. In addition to insomnia, Other sleep disorders such as RLS, PLM and SDB are prevalent in this population. Treatment of sleep problems lead to improvement in daytime function and QOL. Further studies are needed to assess the effect of sleep disorders on clinical progression of fibromyalgia.
Support (If Any): This study is supported by Cincinnati Children's Hospital Research Fund.

0904

ASSESSING SLEEP QUALITY AND HEALTH AMONG BRAZILIAN IMMIGRANTS

Phillips McEnany G[1], Siqueira E[2], Garibaldi E[3], Foley L[1]
[1]Nursing, University of MA Lowell, Lowell, MA, USA, [2]Gaston Institute, University of MA Boston, Boston, MA, USA, [3]Massachusetts Alliance of Portuguese Speakers, Lowell, MA, USA

Introduction: Introduction: This study represents the second phase of pilot work to explore sleep and medical comorbidity among Brazilian immigrants in Massachusetts. The first phase of this work involved focus groups with Brazilian immigrants and lay community health workers (Promotoras) to explore the nature of sleep problems in the Brazilian community. Focus group data revealed that high consumption of caffeinated beverages is common to combat excessive daytime sleepiness. Drowsy driving or falling asleep at the wheel was commonly reported. Impaired work performance due to sleep deprivation was widespread. In addition to qualitative data, the Epworth Sleepiness Scale (ESS) and the Pittsburgh Sleep Disorders Questionnaire (PDSQ) were administered. Results of the initial study revealed significant sleep related complaints, work days of up to 17 hours and impairment in occupational and social life. PDSQ mean was 7.52 (SD 4.44; n=21; range 1-19) and the mean Epworth was 8.79 (SD 5.18; n=24; range 0-19). The current study aims to collect objective physiological data related to sleep, sleep dysregulation and medical health from members of two communities that are heavily populated with Brazilian immigrants in Massachusetts.
Methods: Methods: After consent was obtained, hemoglobin A1c and lipids were tested. Body mass index was calculated and blood pressure was measured. Participants completed the PDSQ, ESS and a general health questionnaire. Actigraphic data were collected for a week. The study utilized convenience sampling.
Results: Results: Complete data analysis is currently in progress with a sample of 45 study participants. Initial results reveal that sleep dysregulation is common, and that abnormalities across other measures are not uncommon.
Conclusion: Conclusion: Given the issues with excessive work schedules, risk for poor sleep quality/duration, socioeconomic stressors and

irregular access to healthcare, Brazilian immigrants represent a group that is at significant risk for negative health outcomes.
Support (If Any): University of Massachusetts Lowell Faculty Grant.

0905

SLEEPINESS AND SLEEP DISORDERS IN PATIENTS WITH ALLERGIC RHINITIS IN JAPAN

Chiba S[1,2], Yagi T[3], Sasaki M[3], Nishino S[1]
[1]Sleep & Neurocircadian Lab, Stanford University School of Medicine, Palo Alto, CA, USA, [2]Otorhinolaryngology, Jikei University School of Medicine, Tokyo, Japan, [3]Otorhinolaryngology, Ota general hospital, Kawasaki-city, Japan

Introduction: Recent epidemiological studies in the United States show that allergic rhinitis influences sleep more than expected, and a sleep disorder due to allergic rhinitis may influence symptoms in the daytime including sleepiness. However, details of the association between allergic rhinitis and sleep disorders are still unclear. And also, In an international classification of sleep disorder 2nd, sleep disorder related allergic rhinitis is not defined.
Methods: 24 untreated males with hay fever caused by cedar pollen were enrolled. To evaluate nasal obstruction using a Rhinomanometer, daytime sleepiness using the multiple sleep latency test, and sleep quality using PSG.
Results: As a result of the screening study, 22 were analyzed in the end, because two had been excluded. 1, WASO showed significant increase on season rather than off season. 2, There are no difference in most of sleep parameter between on and off season. 3,AHI did not change for the worse during on season. 4, A significant difference was not admitted in a nasal resistance. 5,There are no significant difference in MSLT between on and off season. MSLT has decreased during the season by 14 patients in 22. 6,As a result of the Multivariate Logistic Regression analysis, the strongest predictor of the patient who had accompanied an increase in daytime sleepiness on season was nasal resistance > 0.33pa/cm3/sec.
Conclusion: For some allergic patients, daytime sleepiness becomes worse overall during the on-season. The predictive factor of the sleepiness aggravation is nasal obstruction. Furthermore, in the high nasal resistance group, a significant decrease in REM sleep is showed during the on-season. Clearly, the relationship between nasal obstruction, allergic disease, sleep disorders, inflammatory mediators and the sleep/wake center are not yet clear. Further study is needed.

0906

DIFFERENCES IN SLEEP MEASURES BETWEEN CARIBBEAN- AND US-BORN BLACKS WITH METABOLIC SYNDROME

Benoit J[1], Pandey A[1], Racine C[1], Zizi F[1], Francois A[1], Brown C[1], Jean-Louis G[1,2]
[1]Brooklyn Health Disparities Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [2]Sleep Disorders Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA

Introduction: There is increased interest in determining effects of individuals' place of birth on health. The purpose of this study was to examine differences in self-reported sleep-related measures among US-born and Caribbean-born blacks.
Methods: Data (n = 495, mean age = 63±13 years; female = 61%) emanated from the Metabolic Syndrome Outcome Study (MetSO). This is an NHLBI-funded study investigating effects of OSA treatment among blacks in the primary care setting. Patients were diagnosed with metabolic syndrome using criteria articulated in the joint interim statement for harmonizing the metabolic syndrome (Circulation; Nov. 4, 2009). They completed a brief questionnaire on sleep problems, medical history, and use of medications. They also completed the Apnea Risk Evaluation System (ARES) Questionnaire; the ARES has a sensitivity of 0.94, specificity of 0.79 (based on a clinical cut-off of AHI >5). They also indicated their place of birth and duration of residence in the United States. Analyses were performed using SPSS 19.0.
Results: Of the sample, 92.3% were diagnosed with hypertension, 58.9% with diabetes, 77.8% with dyslipidemia, and 88.2% were overweight/obese. The most significant finding from our study was that the high prevalence of OSA risk among Caribbean- and US- born blacks was 75.0% and 77.6%, respectively. Chi square tests showed significant differences between the two groups for reported gasping/choking during sleep (16.3% vs. 25.4%; p=0.032) and difficulty staying awake while driving (7.8% vs. 15.6%; p=0.019). Other sleep measures (e.g., sleep duration, sleep quality, snoring, difficulty falling asleep, or difficulty maintaining sleep) did not show significant group differences.
Conclusion: The finding that rates of OSA risk among both US-born and Caribbean-born blacks were substantially higher than population estimates may be explained by the fact that patients had metabolic syndrome. Of interest was the observation that gasping/choking during sleep and difficulty staying awake while driving, two OSA-related symptoms, showed intra-ethnic group differences. Future studies should investigate whether degree of acculturation would have a negative effect on sleep-related measures reported by Caribbean-born blacks.
Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

0907

COMBINING SLEEP EXTENSION AND BEHAVIORAL WEIGHT LOSS IN OBESE ADULTS: A PILOT STUDY

Rogers A[1], Perlis ML[2], La Grotte C[3], Vander Veur S[3], Foster GD[3]
[1]Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, GA, USA, [2]Department of Psychiatry, University of Pennsylvania, Philadelphia, PA, USA, [3]Center for Obesity Research and Education, Temple University, Philadelphia, PA, USA

Introduction: Numerous epidemiologic studies have demonstrated a dose-related relationship between reduced sleep duration and increased body mass. It has been suggested--but never tested--that extending sleep will facilitate weight loss. The goal of this single arm pilot study, therefore, was to test the feasibility of implementing a sleep extension protocol as an adjuvant to a traditional weight loss program.
Methods: Four participants (2 females, 2 males), who met study criteria, enrolled in the study, and completed a 12-week protocol. Participants ranged in age from 30 to 41 years (mean 35.5) with BMIs ranging from 33.3 to 46.1 (mean 37.7). Sleep extension was accomplished in a systematic manner, one akin to, but the reciprocal of what is used for insomnia. Sleep durations were titrated upward in 15-minute increments. Sleep extension was combined with a weight loss protocol, which was based on the Diabetes Prevention Program. Emphasis was on making incremental behavioral changes, such as self-monitoring and stimulus control.
Results: Weight loss averaged 8.61 ± 3.25 kg (range 5.18 to 12.45 kg). Sleep duration, as measured by actigraphy, at the beginning of the study averaged 342 ±13 minutes (range 330 to 360 minutes). By the end of the 12-week study, sleep durations increased on average by 27.6 minutes to 370 ± 16 minutes (range 360 to 394 minutes). Sleep continuity, as measured by sleep efficiency, and wake after sleep onset was not affected by the sleep extension protocol and sleep latencies remained within normal ranges e.g., 12.0 ± 6.9 minutes (range 5.8 to 21.8 minutes).
Conclusion: This pilot study has demonstrated that it is feasible to increase sleep while producing clinically significant weight loss. RCTs are needed to compare behavioral weight loss with and without sleep extension.
Support (If Any): Study supported by NHLBI(1R21HL093637-01A1, Extending Sleep in Obese Adults to Promote Weight Loss).

0908

CLINICAL CHARACTERISTICS, FUNCTIONAL AND POLYSOMNOGRAPHIC VARIABLES OF PATIENTS IN A SLEEP DISORDERS RESEARCH LABORATORY

Santos I[1], Aguiar I[1], Hirata RP[1], Faria Junior N[1], Souza I[1], Giannasi L[2], Sampaio LM[1], Studart Leitão Filho FS[3], Nacif SR[1], Oliveira LF[1]
[1]Nove de Julho University - UNINOVE, Sao Paulo, Brazil, [2]Dentistry, Julio Mesquita Filho University, UNESP, Sao Jose dos Campos, Brazil, [3]Fortaleza University, Unifor, Fortaleza, Brazil

Introduction: Currently, the sleep disorders are recognized as a major public health problem, affecting a considerable percentage of the population. The aim of this study was to describe the demographic, clinical and polysomnographic variables in patients from the sleep disorders research laboratory an institution of higher education in the city of Sao Paulo, SP - Brazil.
Methods: This study is characterized as case series descriptive and retrospective. We assessed 252 subjects from October 2009 to October 2011, distributed in different study protocols regarding to sleep breathing disorders investigation in the fields of otorhinolaryngologic surgery, difficult to control asthma, morbid obesity, post-polio syndrome and sequelae, sleep apnea in commercial drivers and bronchiectasis.
Results: The distribution of the population studied was composed by 137 men and 115 women, with a mean age of 45.4±15.7 years, and weight of 82.6±18.6kg. Among the presented claims, snore was the principal when evaluation all the protocols (66.2%), followed by diurnal sleepiness/fatigue (7%). Regarding to polysomnographic variables, it was observed significant results relative to apnea/hypopnea index and arousals in most evaluation protocols.
Conclusion: With this study it was possible to delineate the clinical profile quality of sleep in patients from a sleep disorders research laboratory.
Support (If Any): The authors thank Fundação de Amparo a Pesquisa do estado de Sao Paulo (Fapesp, acronym in Portuguese) and Conselho Nacional de Desenvolvimento Cientifico e tecnologico (CNPq, acronym in Portuguese) for supoorting this reseach.

0909

PREVALENCE OF HYPOTHYROIDISM IN OBSTRUCTIVE SLEEP APNEA AND OBESITY HYPOVENTILATION SYNDROME PATIENTS

Gabrijelcic J, Sarc I, Ziherl K, Flezar M, Kosnik M
University Clinic of Respiratory and Allergic Diseases Golnik, Golnik, Slovenia

Introduction: Previous studies have shown conflicting results regarding prevalence of hypothyroidism in obstructive sleep apnea (OSA). The data concerning hypothyroidism in obesity hypoventilation syndrome (OHS) are lacking. We aimed to determine prevalence of hypothyroidism in a large cohort of middle European patients referred to laboratory for sleep-related breathing disorders.
Methods: We retrospectively reviewed medical records of consecutive patients who underwent diagnostic polysomnography during 2005-2010 in University Clinic Golnik. Only patients with available serum thyroid-stimulating hormone (TSH) values were included (92% patients in the study period), free-thyroxine (fT4) was measured in case TSH value was pathological. Data on other clinical and laboratory parameters were also extracted. Patients with apnea-hypopnea index - AHI <5 were used as controls.
Results: Final sample consisted of 943 patients (age 52±8y, men 79%, body mass index -BMI 33.5±7.0), of which 690 (73%) had OSA (age 53.1±10.6y, men 83%, BMI 33.3±6.2, AHI 40±24), 99 (11%) had OHS (age 56.4±9.8y, men 65%, BMI 41.1±7.6, AHI 53±26) and 154 (16%) were controls (age 49.3±12.3y, men 71%, BMI 29.2±5.7, AHI 2.4± 1.7). 3.6% of all patients had preexisting hypothyroidism and in 4.8% of patients hypothyroidism was newly diagnosed. The prevalence of newly diagnosed hypothyroidism in OSA, OHS and control group was 4.1% (females 6%), 8.1% (females 14%) and 5.8% (females 11%) and the prevalence of preexisting hypothyroidism was 3.8%, 5.1% and 1.9%, respectively. Differences between groups were not statistically significant. In multivariate analysis adjusted for age, sex, BMI and AHI, age (OR 1.04 CI 1.00-1.07) and female gender (OR 0.43, CI 0.22-0.83) predicted newly diagnosed hypothyroidism.
Conclusion: The prevalence of preexisting and newly diagnosed hypothyrodism did not differ in OSA, OHS and control group. However, the prevalence of newly diagnosed hypothyrodism was relatively high in all groups, especially in female OHS patients, probably warranting routine TSH testing.

0910

SLEEP STUDY IN MORBID OBESE PATIENTS UNDERGOING BARIATRIC SURGERY. PRELIMINARY RESULTS

Aguiar I[1], Hirata RP[1], Santos Faria Junior N[1], Santos IR[1], Souza Dias I[1], Giannasi L[2], Nacif SR[1], Studart Leitão Filho FS[3], Oliveira LF[1]
[1]Nove de Julho University - UNINOVE, Sao Paulo, Brazil, [2]Dentistry, Julio Mesquita Filho University, UNESP, Sao Jose dos Campos, Brazil, [3]Medicine, Fortaleza University, UNIFOR, Fortaleza, Brazil

Introduction: Obesity is a major public health concern in both developed and developing countries alike and leads to a series of changes in respiratory physiology. There is a strong association between sleep disordered breathing and obesity, which is the most important risk factor for obstructive sleep apnoea (OSA). The aim of this study was to describe clinical and anthropometric characteristic and to identify the presence of sleep disorders in a morbid obese population candidates for bariatric surgery.
Methods: Morbid obese patients (BMI≥40kg/m2 or ≥35kg/m2 with comorbidities) were previously screened at a hospital attendance in the city of Sao Paulo (Brazil). Patients were evaluated regarding to anthropometric measurements, full overnight polisomnography, Epworth Sleepiness Scale (ESS) and Berlin Questionnaire.
Results: The fifteen patients, 93,3% of the were female had a mean age was 46.6 ± 11.7 years and body mass index was 50.8±6.9 kg/m2. The mean value of neck circumference was 42.8±2.6 and abdomen circumference was 128±9.2; the mean value of AHI was 15.1±4.9 events/hour. oxyhemoglobin saturation nadir was 78.1±0.8%, during sleep. Mean total sleep time was 389.1±54.2 min, with sleep efficiency of 76.5±0.1%. The median Epworth Sleepiness Scale was 10 (2-21). A low risk for the OSA was found in 80% (Berlin Questionnaire) of the subjects.
Conclusion: Our preliminary results showed had a low risk of OSA and changes in sleep quality in obesity morbidity patients. Trial Registration: Brazilian Registry of Clinical Trials - ReBEC (RBR-9k9hhv).
Support (If Any): The authors thank Fundaçao de Amparo a Pesquisa do estado de Sao Paulo(Fapesp, acronym in Portuguese) and Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPq, acronym in Portuguese) for supporting this research.

0911

TWO CHANNEL PORTABLE MONITORING COMPARED TO FORMAL POLYSOMNOGRAPHY IN PATIENTS UNDERGOING BARIATRIC SURGERY

Swenson DL[1], Feider B[1], Zupon G[1], Svendsen C[2], Sempf T[2], Kathawalla S[1]
[1]Sleep Disorders Center, Park Nicollet Methodist Hospital, St. Louis Park, MN, USA, [2]Bariatric Surgery, Park Nicollet Methodist Hospital, St. Louis Park, MN, USA

Introduction: Obstructive Sleep Apnea (OSA) is a common sleep disorder in the Bariatric surgical population. ApneaLink is a 2-channel portable monitoring device (PM) that can be used to screen patients to determine if formal Polysomnography (PSG) is required in patients be-

ing evaluated for Bariatric Surgery (BS). This study was done to compare PM to the gold standard PSG.
Methods: A retrospective study was conducted to include 465 patients who completed the PM between February 1st, 2010 and November 30th 2011. Of these, 271 were negative and did not proceed to PSG: 207 with an RDI <5 and 64 with an RDI 5-15 but lacked co morbidities. Patients were considered positive if their Respiratory Disturbance Index (RDI) was either >15 or 5-15 with co morbidities such as Type II Diabetes Mellitus (DM2), Hypertension (HTN), Epworth Sleepiness score >10 or low SaO2 level <80%. The study compared PM RDI in 3 categories (mild 5-15, moderate 16-30 and severe >30) to PSG Apnea Hypopnea Index (AHI) in PSG alone (PMPSG) (n=119) or the diagnostic portion of a split night PSG (PMPSGsn) (n=75) and to all PSGs combined (PMPSGcomb) (n=194).
Results: There was statistically significant correlation in the AHI RDI to PMPSG: 0.78852 (P-value = <0.0001), PMPSGsn: 0.44881(P-value = <0.000.1) and PMPSGcomb: 0.69140 (P-value = <0.0001). The sensitivity and specificity of PMRDI to PMPSGcomb in mild was 79/59%, moderate was 38/80% and severe was 47/93%. There were no adverse perioperative complications in patients with negative PM results.
Conclusion: There is strong correlation and specificity between PM RDI and PSG AHI in all groups. PM could be used as an inexpensive screening tool to determine the need for formal PSG in pre-bariatric patients without adverse complications.

0912

ASSOCIATION OF SLEEP APNEA AND CARBOHYDRATE CRAVING AMONG DIABETICS

Siddique R[1], Cannon A[1], Siddique R[1], Siddique M[1,2]
[1]Sleep and Wellness Medical Associates, LLC, Hamilton, NJ, USA, [2]Robert Wood Johnson Medical School, New Brunswick, NJ, USA

Introduction: Studies have shown that there may be an association between diabetes and sleep apnea. However, there are no studies to date about the association of sleep apnea and carbohydrate craving among diabetics.
Methods: In this study, 55 patients were administered a validated Berlin questionnaire and a carbohydrate craving survey as part of a routine screening in a community practice. The Berlin questionnaire accurately measures the risk factors for sleep apnea. In sleep deprived patients, carbohydrate craving was measured on a likert scale from 1(highest) to 5 (lowest).
Results: The mean age was 62.5. Forty-three percent of the subjects were male. Fifty-four percent of the subjects were diabetic and 45% were non-diabetic. The total percentage of diabetics who scored 2-4 on the Berlin questionnaire was 82%. The risk of having sleep apnea among diabetics versus non-diabetics was very high (OR:5; 95% CI: 1.8 to 18.9). The risk of very high carbohydrate craving in diabetics was almost double compared to non-diabetics (33% to 14%). The odds of moderate to high carbohydrate craving was double in all patients scoring 2-4 on the Berlin questionnaire v ersus those scoring 0-1 (OR: 2.27; 95% CI :0.76 to 6.7).
Conclusion: In this study, the risk of sleep apnea was found to be very high among diabetics compared to non-diabetics. Sleep apnea appeared to be associated with carbohydrate craving. Further studies with larger sample sizes are needed to confirm these findings.

0913

OBESITY, HYPERTENSION, HYPERCHOLESTEROLEMIA AND RISK OF RESTLESS LEGS SYNDROME IN MEN AND WOMEN

De Vito KM[1], Li Y[2], Gao X[2,5], Han J[4], Batool-Anwar S[3], Ning Y[4]
[1]The Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA, [2]Channing Laboratory Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA, [3]Division of Sleep Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA, [4]The Department of Epidemiology and Community Health, Virginia Commonwealth University, Richmond, VA, USA, [5]The Department of Nutrition, Harvard School of Public Health, Boston, MA, USA

Introduction: Restless legs syndrome is a common sleep disorder, affecting 5-10% of the adults in the US and Europe. Previous cross-sectional studies suggested an association between obesity, other metabolic syndromes and RLS. We conducted a prospective study to evaluate whether obesity, hypercholesterolemia, and hypertension are associated with a higher risk of RLS in two well-established cohorts of US men and women, the Health Professionals Follow-up Study (HPFS) and the Nurses' Health Study II (NHS II).
Methods: Our study consisted of 42728 women and 12812 men, free of RLS at baseline (2002 for men and 2005 for women), and free of diabetes and arthritis though follow-up. Participants were considered incident RLS cases if they met four criteria recommended by the International RLS Study Group and had the symptoms ≥5times/month.
Results: Obesity was associated with a higher risk of developing RLS during 4-6 years of follow-up. Adjusted relative risk of RLS for BMI >30kg/m2 versus BMI ≤23kg/m2 were 1.45 (95% confidence interval (CI): 0.96, 2.18; p for trend=0.007) in men and 1.59 (95%CI: 1.33, 1.91; p for trend <0.0001). A similar significant association was found for waist circumference. The adjusted RRs for RLS comparing two extreme quintiles of waist circumference were 1.73 (95%CI: 1.21, 2.47; p for trend=0.006) in men and 1.51 (95%CI: 1.20, 1.88; p for trend <0.0001) in women. A significant association was also found between high cholesterol and RLS (men RR=1.32, 95%CI: 1.07, 1.61, women RR=1.20, 95%CI: 1.05, 1.36). There was not a significant association between high blood pressure and RLS risk (adjusted RR=1.03 in men and 1.18 in women; P >0.1 for both).
Conclusion: Obesity and high cholesterol, but not high blood pressure, were significantly associated with a higher risk of developing RLS. Further experimental studies are needed to explore potential roles of these metabolic symptoms in the etiology of RLS.
Support (If Any): 5R01NS062879-02 (PI: Xiang Gao).

0914

NON-PHARMACOLOGICAL SLEEP INTERVENTIONS FOR YOUTH WITH CHRONIC HEALTH CONDITIONS: A SYSTEMATIC REVIEW

Kuo MH[1], Brown CA[1], Phillips L[2], Berry R[1], Tan M[1]
[1]University of Alberta, Edmonton, AB, Canada, [2]Concordia University College of Alberta, Edmonton, AB, Canada

Introduction: Disordered sleep (DS) is one of the symptoms of many chronic health conditions. DS can also worsen symptoms of the illness. Although evidence for a range of effective non-pharmacological sleep interventions (NPSIs) for youth exists, the methodological quality of NPSI research has not yet been evaluated and synthesized so as to guide best practice. This study aims to evaluate and synthesize the evidence of NPSIs for children and adolescents with chronic health conditions.
Methods: Literature from January 2000 to May 2012 in the Medline, CINAHL, and PsycINFO was searched to locate NPSI studies published in English that included children (2-11 years old) and adolescents (12-19 years old) with chronic health conditions; measured outcomes related to

sleep; and used non-drug interventions. Additional studies were located by cross-checking reference lists. Studies were excluded if they used substance-based interventions, sleep apnea, continuous passive airway pressure devices, hypnosis, and other interventions requiring specialized training beyond the scope of most entry-level health care providers. The Effective Public Health Practice Project Quality Assessment Tool was used to analyze the quality of each reviewed study, and to synthesize and categorize the strength of the evidence.
Results: Forty-one papers met the inclusion criteria. Ten of the studies were RCT design, 13 were single-case design, 10 were case study, and 8 were before-after design. The most common diagnoses of the participants included ADHD, autism spectrum disorders, Down syndrome, intellectual disabilities, and visual impairments. The interventions were grouped into two categories: behavioral interventions (31 studies; extinction, graduated extinction, faded bedtime with response cost, sleep restriction, sleep hygiene guidelines, cognitive behavioural approach, and non-specific behavioural intervention), and non-behavioral interventions (10 studies; chronotherapy, phototherapy, elimination diet, aerobic exercise, and massage therapy). All of the research demonstrated positive findings, and none reported adverse effects. The evidence for all interventions reviewed was weak, except massage therapy and phototherapy which had moderate evidence.
Conclusion: Although strong evidence is lacking, the findings suggest that the NPSIs are promising and warrant further, more targeted and rigorous study. There is a clear need to improve the amount and quality of research on NPSI for youth with chronic health conditions.
Support (If Any): Health Research Transfer Network of Alberta (RTNA).

0915

A PILOT STUDY ON SLEEP QUALITY AND REST-ACTIVITY PATTERNS IN PERSONS LIVING WITH HIV (PLWH)

Taibi DM, Price C, Voss J
Biobehavioral Nursing and Health Systems, University of Washington, Seattle, WA, USA

Introduction: As many as 73% of persons living with HIV (PLWH) experience sleep disturbances. It has been over 10 years since the last study that objectively measured sleep behaviors in persons with HIV. The purpose of this study was to explore subjective and objective data on sleep quality and rest-activity patterns in PLWH.
Methods: The study design is one-group pilot feasibility study of a mind-body intervention. Baseline data are reported here. Participants (N=8) were low income individuals (mean age=48 years) enrolled in a day program for HIV medication management. Sleep was measured for one week using a sleep diary and 24-hour actigraphy (Actiwatch2). Descriptive statistics were calculated for diary and actigraphy sleep outcomes, and rest-activity patterns were examined using non-parametric circadian rhythm analysis.
Results: Sleep diaries showed mild to moderate sleep disturbance compared to norms for "good sleepers" on sleep onset latency (34.5±40.0 min.), sleep efficiency (84.9±8.1%), and sleep quality (2.5±0.4 on a 1-9 scale). On sleep diaries, total sleep time (7.9±1.3h) and wake after sleep onset (21.1 ±35.0 min.) were normal. Actigraphy showed severe sleep disturbance: total sleep time = 6.1±1.6h, total wake time = 142.2±56.2 min., and sleep efficiency =72.4±12.6%. Bedtime was variable from day-to-day (RMSSD = 32.6 ± 28.6 min). Bedtime variability was correlated with poorer sleep efficiency (r= -0.785, p=0.02) and higher wake time (r=0.864, p=0.006) on actigraphy. Rest-activity analyses showed reduced consistency of rest-activity patterns from day-to-day (interdaily stability = 0.48±0.12), but relatively well-structured and robust activity levels within days (intradaily variability =0.71±0.20, relative amplitude= 0.90±0.12).
Conclusion: Findings from this pilot study suggest that sleep disturbance remains problematic in PLWH. Further research is needed to characterize sleep disturbance and examine potentially useful behavioral interventions such as improving sleep hygiene (i.e., adhering to stable bedtimes and rise times).
Support (If Any): University of Washington RIFP grant.

0916

ASSOCIATIONS OF BODY MASS INDEX WITH SUBSEQUENT SLEEP MEDICATION: A PROSPECTIVE REGISTER LINKAGE STUDY

Lallukka T, Lahelma E, Rahkonen O
Department of Public Health, Hjelt Institute, University of Helsinki,, Helsinki, Finland

Introduction: Obese people tend to have poorer sleep. However, objective, longitudinal data are sparse. In this study, we aimed to examine whether overweight, obese, and morbidly obese have higher risk for subsequent sleep medication over a five-year follow-up.
Methods: The data were derived from the prospective Finnish Helsinki Health Study (HHS) cohort. The HHS baseline surveys were conducted in 2000-2002 among 40-60-year employees of the City of Helsinki. Baseline data were prospectively linked to the Social Insurance Institution's register data on prescribed reimbursed sleep medication (ATC codes) covering all reimbursed medication from 1995 to 2007 for those with written consent to such linkages (n=6606, 80% women). Weights and heights to calculate body mass index were derived from the baseline surveys alongside background factors. Cox regression models were fitted, adjusting for age, prior sleep medication, baseline sleep problems, heavy drinking, and physical activity.
Results: Of women, 17% and of men 12% had at least one purchase of sleep medication during follow-up. Strong associations between baseline weight and sleep medication were found among men. After adjusting for age and prior medication, being overweight (HR, hazard ratio, 1.93; CI 95% 1.31-2.84), obese (HR 2.30; CI 95% 1.38-3.82), and morbidly obese (HR 3.13; CI 95% 1.63-6.03) was strongly associated with subsequent sleep medication. Adjusting for further covariates had only modest contribution to the above associations. In contrast, no differences in sleep medication were found between normal weight, overweight, obese, and morbidly obese women.
Conclusion: Body mass index is a strong predictor for subsequent sleep medication among men but not among women. Further research to confirm reasons for gender difference is needed.

0917

MEASUREMENT OF NIGHT SWEATING DURING POLYSOMNOGRAPHY: A PILOT STUDY

Goodrich S[1], Shepherd K[1], Mold J[2], Orr W[1,2]
[1]Lynn Health Science Institute, Oklahoma City, OK, USA, [2]University of OK Health Sciences Center, Oklahoma City, OK, USA

Introduction: Night sweating is a common complaint of patients in primary care settings, but very little experimental research has been done to investigate it. A novel device has been developed which allows accurate measures of sweat gland activity. This device was used in the present study to obtain normative data concerning objective sweat activity during sleep.
Methods: Ten individuals without any health complaints, or any complaints of night sweating, were recruited. All participants were males who were not taking any medications that would be expected to affect night sweating. Participants came to our sleep laboratory approximately two hours before their usual bedtime. All participants were set up for standard polysomnography with the addition of six electrodes to wirelessly measure sweat gland activity. Participants were asked to fill out a standard sleep questionnaire and a night sweats questionnaire before bed. A Friedman nonparametric test for related measures was done to test for differences in sweating between different stages of sleep.
Results: Although all participants denied that they had any problem with night sweats, several participants did have objective evidence of

nighttime sweating. The most sweating was seen at the forehead and the forearm electrode locations, while palm and chest electrodes showed very low levels of sweat activity. When we examined sweating during different stages of sleep, the most sweating was noted during wake (mean sweat activity = 11.2) and during deep sleep (mean = 8.3) versus stage N2 (mean = 5.5) and REM (mean = 3.9). These means were not significantly different from one another, however.
Conclusion: Based on this pilot data, it appears that the forehead and forearm are sensitive locations for the measurement of sweat activity during sleep. It also appears that a relatively high degree of sweat activity occurs during wakefulness and during deep sleep, although no differences were statistically significant.

0918

PILOT STUDY TO VALIDATE PORTABLE SLEEP RECORDING AS A TOOL BY WHICH TO ACCURATELY ASSESS SLEEP QUALITY IN CRITICALLY ILL PATIENTS

Malik V[1,2,3], Frankel S[1,2,3], Lee-Chiong T[1,2,3]
[1]Medicine, National Jewish Health, Denver, CO, USA, [2]Medicine, University of Colorado, Aurora, CO, USA, [3]Medicine, Swedish Medical Center, Engelwood, CO, USA

Introduction: Sleep in critically ill patients is characterized by severe fragmentation and disrupted circadian patterns. However, the ability to assess sleep quality and staging in larger patient populations has remained limited by the expense and logistical challenges of performing full EEG monitoring in the critical care setting.
Methods: Consecutive, critically ill patients with septic shock and acute respiratory failure requiring mechanical ventilation were enrolled in the study after informed consent. Portable sleep monitoring device (Alice PDx) was connected to 11 leads including EEG, EOG, EMG and EKG channels and one ground channel. Data was recorded continuously for a 24-hour period was scored manually.
Results: Subject 1 2 3 4 5 6 7 8 9 10 11 12 13 14 N1% 9.2 36.1 47.3 42.9 27 4.8 26.4 17.1 9.9 6.7 11.8 0.7 7.2 7.2 N2% 90.7 63 52.7 56.9 67.6 91.4 73.6 82.3 90.1 89 75.6 87.5 92.5 75.7 N3% 0.1 0 0 0 0.5 0 0 0 0 0.6 0 10.8 0 0 R% 0 0.9 0 0.2 4.9 3.8 0 0.6 0 3.7 12.6 0.9 0.3 17.1 SLEEP EFFICIENCY% 90.8 87.3 87.4 89.9 75.8 88.8 62.7 50.3 62.7 76.3 76.1 97.8 41.1 81.7
Conclusion: Portable sleep recording devices with two EEG channels can be used to objectively assess sleep versus awake stages in critically ill patients providing total time spent in objectively confirmed sleep Majority of the sleep in critically ill patients is spent in lighter stages of sleep N1 and N2 There is near complete absence of deeper stages of sleep (N3 and R) Sleep efficiency is lower than expected but may be due to daily sedation interruption from the administration of pharmacologic agents as per ICU protocol.

0919

NOCTURIA IN SUBJECTS WITH OVERACTIVE BLADDER SYNDROME (OAB): WHAT WAKES THEM UP?

Preud'homme XA[1,4], Lohri J[2], Amundsen CL[3], Peterson A[2], Webster GD[2], Krystal AD[4]
[1]Department of Internal Medicine, Duke University, Durham, NC, USA, [2]Division of Urology, Department of Surgery, Duke University, Durham,, NC, USA, [3]Division of Urogynecology, Department of Obstetrics and Gynecology, Duke University, Durham,, NC, USA, [4]Insomnia and Sleep Research Program, Department of Psychiatry and Behavioral Sciences, Duke University, Durham,, NC, USA

Introduction: How nocturia disrupts sleep is poorly understood. The proposed study aims to improve our understanding of these mechanisms by examining whether detrusor overactivity (DO) is associated with nocturic voids in OAB subjects (Ss) that commonly present with co-morbid nocturnal polyuria (NP), and if so, by examining whether DO occurs specifically during sleep preceding micturition-related awakenings.
Methods: To detect DO during sleep, 6 Ss with confirmed OAB on a 7-day combined bladder-and-sleep diary and without OSA underwent a PSG with simultaneous cystometrography recording, requiring the placement of a 4F and 9F catheters in the urethra and rectum to measure vesical and abdominal pressures respectively.
Results: Over an 8-hour PSG, 2 Caucasian and 4 African-American women with a mean age of 46 ±16 years and a mean BMI of 30.4 ± 6.5 provided a total of 24 voids, 19 of which met criteria for nocturia by being preceded and followed by sleep. All 16 nocturic voids recorded while the catheters were still in place were included (2 to 3 per Ss) with a total of 6 during the first third of the night, followed by 3, then 7. Younger age, normal BMI, and greater volume-per-void were associated with DO+ voids. While in average it took 91.7 seconds of EEG wake time prior to requesting voiding (WT), contrasting with a self-report of 4 minutes, WT was twice longer for DO- voids. Yet, DO occurred not only significantly less often than expected, with only 5 DO+ voids (Chi2 $p<0.002$), but also significantly less often during preceding sleep than during WT (Chi2 $p<0.02$).
Conclusion: DO might not have a predominant role in micturition-related awakenings in OAB Ss, at least in presence, and possibly because of co-morbid NP, suggesting why anticholinergic agents are often less effective in this indication.
Support (If Any): NIDDK research grant R01-DK087717.

0920

THE INTRIGUING ASSOCIATION AMONG SILDENAFIL, SLEEP DEPRIVATION AND SEIZURES: A PRECLINICAL APPROACH

Matos G[1], Polesel DN[1], Amorim BO[3], Garcia VA[1], Covolan L[3], Scorza FA[2], Cavalheiro EA[2], Tufik S[1], Andersen ML[1]
[1]Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [2]Neurologia Experimental, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [3]Neurofisiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: Preclinical studies suggest influences of sildenafil on occurrence of seizures, however the results are controversial. In parallel, little knowledge among sildenafil, sleep deprivation and seizures has been described in the current literature. OBJECTIVE: To evaluate the effects of sildenafil in sleep-deprived rats submitted to pentylenetetrazole (PTZ)-induced seizures.
Methods: This study was conducted in Wistar-Hannover male rats at 8 weeks of age. Sildenafil (2.5; 5.0 and 10mg/Kg) was administrated orally to home cage controls and to those who have been deprived of paradoxical sleep (PSD) for 4 days (N=8-11/group). Thirty minutes after sildenafil administration, animals were challenged with PTZ (50 mg/Kg; i.p.). Latency and incidence of generalized seizures as well as mortality were measured.
Results: The dose of 5 mg/kg of sildenafil induced a significant increase of tonic-clonic seizures compared to vehicle-injected groups. PSD per se also promoted a significant enhancement of seizure activity in relation to control (normal sleep) rats. Interestingly, PSD attenuated proconvulsivant effect induced by sildenafil.
Conclusion: The results indicate that the proconvulsivant action of sildenafil can be minimized by selective sleep loss.
Support (If Any): Associação Fundo de Incentivo à Pesquisa (AFIP), Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Ministério da Ciência e Tecnologia (MCT).

0921

SLEEP IN NON-DIABETIC PATIENTS WITH AND WITHOUT IMPAIRED FASTING GLUCOSE

Meira e Cruz M, Rebocho S, Paiva T
Sleep Center - CENC, Lisboa, Portugal

Introduction: It is well established that high levels of blood glucose may affect sleep of diabetic patients. However there is a lack of knowledge about the impact of impaired glucose metabolism on sleep of otherwise healthy patients. The aim of this study was to compare objective and subjective sleep parameters among non-diabetic patients with and without impaired fasting glucose (IFG).
Methods: The study included 15 non-diabetic patients (5 Males) with IFG (fasting glucose from 100 to 125 mg/dl) and 16 (5 Males) normoglycemic patients (fasting glucose <100 mg/dl), selected among those applying to in Lab polysomnography in multidisciplinary sleep clinic. Subjective Sleepiness (Epworth Sleepiness Scale) and objective (Polysomnographic) sleep data were collected.
Results: Mean fasting glucose was 107.8±6.3 mg/dl among IFG group and 88.9±9.2 mg/dl in the normoglycemic patients. Groups were not different ($p \geq 0.05$) regarding either to age or anthropometric and body composition-related measures (height, weight, body mass index, neck circumference, relative amount of fat mass as measured by bioelectrical impedance, abdominal circumference and waist to hip ratio). Regarding polysomnographic parameters, only sleep latency was significantly different between groups (33±36 versus 19±26 minutes). In the IFG group a significant negative correlation was found between fasting glucose levels and slow wave sleep ($p<0.003$); this was not observed in normoglycemic patients.
Conclusion: The results of this study suggest that patients with IFG may experience more difficulties on sleep onset than otherwise healthy matched controls. The negative correlation between fasting glucose and slow wave sleep is a possible indicator of the impact of mild increases of fasting glucose upon the homeostatic process.
Support (If Any): Abbott has supported this study through the supply of glucose monitors.

0922

A LINK BETWEEN SLOW-WAVE SLEEP AND SERUM ADIPONECTIN: AN EXERCISE TRAINING STUDY IN OLDER MEN

Melancon MO[1,2], Lorrain D[1,3], Riesco E[1,2], Dionne IJ[1,2]
[1]Research Centre on Aging, University Institute of Geriatrics of Sherbrooke, Sherbrooke, QC, Canada, [2]Dept of Kinanthropology, University of Sherbrooke, Sherbrooke, QC, Canada, [3]Dept of Psychology, University of Sherbrooke, Sherbrooke, QC, Canada

Introduction: Sleep depth decreases with normal aging which might affect an array of bodily functions. For example, sleep loss has proved to cause immediate adverse effects on glucose tolerance in healthy men. Albeit it is known that the fat tissue-derived hormone adiponectin (an adipokine inversely related to body fat) promotes insulin sensitivity, the interplay between sleep and adiponectin is yet obscure. The current study used exercise training, an intervention having potential impacts on either adiponectin or sleep, to verify if adiponectin is linked to particular stages of sleep in older men.
Methods: Thirteen nonobese men (64±3 yrs) with no sleep complaints served as their own controls in a 4-month supervised, moderate-intensity training program. Repeated DXA-scans and maximal cardiopulmonary tests served to assess changes in body fat and aerobic fitness. Sleep electrophysiology was evaluated based on 20-lead polysomnographic laboratory settings; delta waves were quantified using a 75-µV cut-off at C4-A1/C3-A2 electrodes. Fasting, resting venous blood was drawn for 2-antibody immunoassays of total-adiponectin in duplicate (ELISA).
Results: Training increased endurance capacity, as indicated by gains in VO2 at the respiratory compensation point (+6.3%, $p<.05$). Body fat was not affected by training (-0.4 kg, n.s.), and was unrelated to adiponectinemia, which varied from 4.67±1.96 to 4.72±1.90 µg.ml-1 (n.s.). Interestingly, however, a significant correlation was found between serum adiponectin levels and the deepest portion of sleep encountered at night (slow-wave sleep, %total sleep time) after training ($r=+.65$, $p<.05$). Noteworthy, no relation could be found at baseline.
Conclusion: A correlation is reported, apparently for the first time, between slow-wave sleep and circulating adiponectin levels. This link was observed in healthy older men only after 4 months of exercise training which thus appears to tighten the link between sleep and adiponectin. These results ultimately suggest adiponectin as one putative mediator of the effects of sleep depth on adiponectin-related functions.
Support (If Any): Grant from the Research Centre on Aging, Sherbrooke (QC) CANADA.

0923

SLEEP CHANGES THROUGH WEIGHT LOSS 2 YEARS AFTER ADJUSTABLE GASTRIC BANDING

Fusco M[1], Okerson T[2,3], Cornell C[2]
[1]General Surgery, Melbourne Internal Medicine Associates, Melbourne, FL, USA, [2]Global Medical Affairs, Allergan, Inc., Irvine, CA, USA, [3]University of California, Irvine, Orange, CA, USA

Introduction: Obesity is one of several factors associated with an increased risk of obstructive sleep apnea (OSA) and several studies have reported that weight loss through laparoscopic adjustable gastric banding (LAGB) can effectively resolve this condition and improve patient quality of life (QOL). This study reports the resolution/improvement of OSA and improvements in sleep-related QOL after surgical placement of the LAP-BAND® AP (LBAP; Allergan).
Methods: The APEX study is an ongoing 5-year, prospective, observational study assessing weight reduction, comorbidity changes and QOL after LBAP implantation. This is an interim analysis of subjects with evaluable data at 24 months who had OSA prior to LAGB surgery (all data being last observation carried forward).
Results: At baseline, 117/395 (29.6%) of subjects [mean body mass index (BMI) of 44.9 kg/m^2] reported OSA; of these, 57 had evaluable patient reported outcome data at 2 years. At 1 year, 36% of subjects had resolution or improvement of OSA; at 2 years, this proportion increased to 86%, with 14% reporting no change. The mean BMI at 2 years for those that resolved or improved was 35.7 kg/m^2, representing a 20.2% loss of body weight. Subject populations reporting resolution, improvement, or no change in OSA experienced mean changes in BMI and % weight loss of -9.7/-21.7, -8.3/-18.7 and 5.7/-13.2, respectively (n=54). Mean 2 year BMI was not statistically significantly different between the resolved, improved and no change groups (p=NS; one-way ANOVA). Compared to baseline, mean scores for all Epworth Sleepiness Scale (ESS) responses for the OSA population improved, ranging from -0.10 (sitting and talking to someone) to -0.65 (being a passenger in a motor vehicle for an hour or more without a break). The overall mean change in score across all questions in the ESS for the OSA group was -0.43 ($p<0.0001$; n=78) compared to 0.29 for subjects who did not have OSA at baseline (n=177), with the difference between the two groups being statistically significant ($p=0.037$). In addition to OSA benefits, the overall study population experienced resolution and/or improvement in other obesity-related comorbidities such as type 2 diabetes (96%) and hypertension (91%).
Conclusion: These data support that surgically-facilitated weight loss can affect the resolution or improvement of OSA and sleep-related QOL; the degree of weight loss may be related to these changes.

0924

LINKING COUNTRY OF ORIGIN TO REPORTED SLEEP DURATIONS: ANALYSIS OF THE NATIONAL HEALTH INTERVIEW SURVEY

Pandey A[1,5], Pandey A[5], Sarpong DF[4], Robinson L[3], Oulds F[6], Brown C[1], Jean-Louis G[1,2]

[1]Brooklyn Health Disparities Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [2]Sleep Disorder Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [3]Department of Kinesiology, Auburn University, Auburn, AL, USA, [4]Biostatistics, Jackson State University, Jackson, MS, USA, [5]Internal Medicine, A.P. Medical P.C., Brooklyn, NY, USA, [6]Pediatrics, SUNY Downstate Medical Center, Brooklyn, NY, USA

Introduction: There is emerging literature examining associations between country of origin and health outcomes, but evidence on its association with sleep durations is sparse. We examined differences in short and long sleep durations comparing US-born and foreign-born Americans.

Methods: Analysis was based on the 2004-2010 National Health Interview Survey (NHIS) survey (n=434,849; mean age=45.4 ±17.4yrs; female=53.1%; 77.9% were US-born Americans and 57.3% of foreign-born Americans have spent ≥ 15 years in America). The NHIS is a cross-sectional household interview survey utilizing a multistage area probability design. Probability samples of the civilian population of all 50 states and D.C. were obtained. Data was collected by trained personnel from the US Census Bureau in face-to-face interviews. Respondents provided anthropometric and socio-demographic data and information on physician-diagnosed chronic conditions. These included self-reported sleep durations, country of origin and years spent in the United States. Final weights were applied to adjust for the use of complex design.

Results: The mean sleep duration was 7.2 ±1.4 hours. Indian-born Americans (89.3%) were more likely to report 6-8 hours of sleep, African-born Americans (10.5%) were more likely to report short sleep (<6 hours), and US-born Americans (9.3%) were more likely to report long sleep (>8 hours). Regression analyses indicated that foreign-born Americans were less likely to report short or long sleep than US-born Americans [OR=0.778, 95% CI: 0.778-0.779; OR=0.784, 95% CI: 0.784-0.785; respectively, p<0.001]. Adjusting for effects of age, sex, education, income, smoking, alcohol use, body mass index, emotional distress, analyses showed that US-born Americans had a higher risk for reporting short or long sleep compared with foreign-born Americans [OR=1.196, CI: 1.195-1.197; OR=1.421, CI: 1.420-1.422, respectively; p<0.001].

Conclusion: Our findings suggest that the country of origin may have a significant influence on sleep duration and should be considered in the analysis of epidemiologic sleep data.

Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

0925

POLYSOMNOGRAPHY AS A VALUABLE TOOL FOR PROGNOSTIC ASSESSMENT OF PRIAPISM IN SICKLE CELL ANEMIA

Roizenblatt S[1], Figueiredo M[2], Roizenblatt M[2,1], Pollack Filho F[2,1], Matsuda S[2], Perini V[1,2], Arruda M[2], Sato JR[3,1], Tufik S[1]

[1]Psychobiology, Universidade Federal de Sao Paulo, São Paulo, Brazil, [2]Hematology and Hemotherapy, Universidade Federal de Sao Paulo, São Paulo, Brazil, [3]Centro de Matemática, Computação e Cognição, Universidade Federal do ABC, Sao Paulo, Brazil

Introduction: This study accessed penile rigidity during sleep and to which extent sleep abnormalities are associated with priapism in adult patients with sickle cell disease (SCD).

Methods: This was case-control study of 18 SCD patients with and 16 SCD controls without history of priapism during the previous year, matched for age, body mass index, and pulmonary involvement. Participants underwent all-night polysomnography coupled with Rigiscan TM.

Results: Priapism group presented apnea-hypopnea index (AHI) and oxyhemoglobin desaturation parameters higher than controls. Despite increased desaturation index and percentage of total sleep time (TST) elapsed with oxyhemoglobin saturation below 90% (T90), there was no difference in peak end-tidal CO2 assessed in the patients with T90 higher than 10% (2 controls and 14 with priapism). In controls, but not in priapism group, AHI correlated with relative duration of oxyhemoglobin desaturation events (rS=0.76, p=0.01), suggesting longer desaturation periods in this group. Penile rigidity events were, not only observed in rapid eye movement (REM) sleep, but also in stage 2 of non-REM sleep, particularly in the priapism group and relative duration of penile rigidity associated to respiratory events was higher in the priapism group than in controls. Regression analysis evidenced that desaturation index, rather than REM or lung involvement, was a significant predictor of priapism and may account for rigidity distribution throughout TST. In addition, T90 showed to be a predictor of the priapism condition, rather than lung involvement, hyper-hemolysis, or AHI. Finally, arousal and periodic limb movement (PLM) indexes were also associated with the priapism condition, adjusting for the presence of lung involvement or hyper-hemolysis.

Conclusion: Oxyhemoglobin desaturation during sleep, shed new light on the understanding of the sleep influence on priapism in sickle cell disease.

Support (If Any): AFIP, FAPESP/CEPID 98/14303-3.

0926

DOES SLEEP PREDICT THE DEVELOPMENT OF UROLOGIC SYMPTOMS?

Araujo AB, Piccolo RS, McKinlay JB

New England Research Institutes, Inc., Watertown, MA, USA

Introduction: Current thinking regarding the association between urologic symptoms and sleep implicitly assumes that two are linked in one direction, i.e., that urologic symptoms (urinary incontinence (UI), lower urinary tract symptoms (LUTS), and nocturia) lead to sleep disturbance in men and women. However, it is plausible that sleep disturbance, which is associated with obesity and systemic inflammation, leads to the development of urologic symptoms. We tested whether sleep predicts the development of UI, LUTS, and nocturia in a 5-year longitudinal study.

Methods: Analyses of 1610 men and 2535 women who completed baseline and follow-up phases of the population-based random sample Boston Area Community Health (BACH) survey. Short sleep duration (men only) defined as sleeping <5 hours/night and sleep quality defined as having restless sleep in the past week. Lower urinary tract symptoms (LUTS), urinary incontinence (UI) and nocturia were measured with validated questionnaires. Logistic regression models of incidence among those without baseline symptoms yielded odds ratios (OR) and 95% confidence intervals (CI) adjusted for age, race/ethnicity, diabetes, heart disease, alcohol use, physical activity and anti-depressant use. Further adjustments were made for body mass index (BMI) and C-reactive protein (CRP) to test for mediation.

Results: Mean age was 48 years. Prevalence of short sleep duration was 18% (men) and restless sleep was 34% (men) and 42% (women). Incident LUTS was related to short sleep duration among men (OR=1.97, 95% CI=1.02-3.78) and restless sleep among men (OR=2.03, 95% CI=1.26-3.28) and women (OR=1.66, 95% CI=1.10-2.49). Incident UI (OR=1.78, 95%=1.06-2.96) and nocturia (OR=1.90, 95% CI=1.26-2.88) were associated with restless sleep among women. Findings persisted with adjustment for BMI and CRP; ORs were altered with adjustment for CRP.

Conclusion: Sleep may be a novel and modifiable risk factor that precedes urologic symptoms, perhaps operating through inflammatory and other pathways.

Support (If Any): This study was supported by awards R21MD006769 from the National Institute on Minority Health and Health Disparities and U01DK056842 from the National Institute of Diabetes and Digestive and Kidney Disorders. The content is solely the responsibility of the authors and does not necessarily represent the official views of NIMHD, NIDDK, or NIH.

0927

ASSOCIATION BETWEEN SLEEP DURATION AND HYPERTENSION IN NAGAHAMA 0-DEGREE COHORT STUDY

Kadotani H[1,2], Yamaguchi M[1,2,3], Nagai Y[1,2]

[1]Center for Genomic Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Nagahama 0-degree Cohort Study group, Kyoto University, Kyoto, Japan, [3]Amelief Co. Ltd., Tokyo, Japan

Introduction: Nagahama city (Shiga prefecture, Japan) and Kyoto University made a contract to perform a genome-cohort study and biobanking (Nagahama 0-degree cohort study).

Methods: The first cross-sectional survey with questionnaire and physical examination was conducted between 2008 and 2010. 9853 residents (30-74 years, 32.8% male) participated in the study. Sleep duration (-5, 5-6, 6-7, 7-8 or 8- hrs.) and current medical condition were asked in the questionnaire. Arterial stiffness was measured by CAVI (Cardio-ankle vascular index) with VaSera (Fukuda, Tokyo, Japan). Blood pressure was measured by HEM-9000AI (Omron, Kyoto, Japan). Logistic regression models were constructed to examine the independent associations of important covariates (age, gender and BMI) with hypertension and arterial stiffness.

Results: Mode of sleep duration was 6hrs (6-7hrs.). Compared to 7-8hrs of sleep, longer sleep (8- hrs.) was related to a significantly increased risk for hypertension. This association was significant only in males, but not in females. Unlike the previous reports in US, our population did not showed association between short sleep duration and hypertension. Arterial stiffness was also associated with longer sleep duration only in males.

Conclusion: Long sleep duration is associated with cardiovascular changes in Japanese. Sleep duration might affect differently on Japanese and Caucasians.

0928

AUTONOMIC CARDIOVASCULAR CONTROL DURING SLEEP IN HYPERTHYROIDISM

Tobaldini E[1], Pecis M[2], Bulgheroni M[1], Muratori M[3], Bevilacqua M[3], Porta A[4], Montano N[1]

[1]Department of Clinical Sciences, L.Sacco Hospital, University of Milan, Milan, Italy, [2]Pneumology Unit, L. Sacco Hospital, Milan, Italy, [3]Endocrinology Unit, L. Sacco Hospital, Milan, Italy, [4]Department Of Techonologies for Health, Galeazzi Orthopedic Institute, University of Milan, Milan, Italy

Introduction: Hyperthyroidism is characterized by an altered autonomic cardiovascular control, with a predominant sympathetic and a reduced parasympathetic modulation. It has been reported that sleep quality is impaired in these patients. However, data on the autonomic control during sleep in hyperthyroid subjects before and after therapy are still lacking.

Methods: We performed a polysomnographic study (PSG) in 6 newly diagnosed hyperthyroid subjects (age 30-45, BMI < 25), with a first diagnosis of Graves' disease or hyperfunctioning nodule, at baseline (HyperT) and once the normal thyroid hormones profile had been restored after the treatment (EuT). The autonomic control was assessed using spectral analysis of heart rate variability (HRV) and entropy-derived indices during each sleep stage (Wake, NREM 1,2,3 and REM). With spectral analysis, two main components of HRV can be identified: low frequency (LF), marker of sympathetic modulation when expressed in normalized units (nu), and high frequency (HF), marker of vagal modulation. Regularity index (Ro) is derived by dividing Corrected Conditional Entropy by the Shannon entropy and it ranges from 1 (maximum regularity, lowest complexity) to 0 (lowest regularity, maximum complexity).

Results: Heart rate (HR) was significantly lower in EuT during Wake and sleep (N1, N2 and N3). Total variability significantly increased in EuT while no changes have been observed in LF and HF components in nu and in respiratory frequency. Ro was significantly lower in EuT compared to HyperT during N1, N2 and N3. The sleep analysis revealed that periodic leg movements were reduced in EuT group.

Conclusion: These data suggest that autonomic control is significantly altered during sleep in HyperT, being these differences more evident during NREM sleep. The decrease of total variability in HyperT could be related to the changes in HR per se, rather than to modifications in sympatho-vagal balance or respiration. Finally, complexity of autonomic regulation during sleep is restored after treatment.

0929

ESTIMATION OF SLEEP DISTURBANCES USING WRIST ACTIGRAPHY IN PATIENTS WITH POSTURAL TACHYCARDIA SYNDROME

Bagai K[1,2], Wakwe C[2], Malow BA[1,2], Black BK[2], Biaggioni I[2,3], Robertson D[2,3], Raj SR[2,3]

[1]Department of Neurology, Division of Sleep Disorders, Vanderbilt University, Nashville, TN, USA, [2]Paden Dysautonomia Center, Vanderbilt University, Nashville, TN, USA, [3]Department of Pharmacology, Vanderbilt University, Nashville, TN, USA

Introduction: Patients with postural tachycardia syndrome (POTS) commonly complain of fatigue, unrefreshing sleep, daytime sleepiness and diminished quality of life. The objective of this study was to assess the sleep quality in patients with POTS as compared with healthy control subjects using wrist actigraphy.

Methods: A prospective study was conducted with patients with POTS and a control group. Patients with POTS (n= 36) and healthy control subjects (n = 36) completed a detailed sleep log and actigraphy for an average of 7 days. Continuous variables including sleep latency, wake after sleep onset (WASO) and sleep efficiency, and subjective complaints of tiredness or restless sleep were compared in the patients with orthostatic intolerance and healthy control subjects.

Results: Compared with healthy control subjects, patients with POTS have more self-reported problems including restless sleep (52.7% ± 29.6 vs 20.5 % ± 19.7; p <0.001) and tiredness % (75.2 % ± 22.6 vs 39.2% ± 27.0; p <0.001). Using actigraphy, patients with POTS have lower sleep efficiency (72.9 % ± 12.8 ± vs. 78.9 % ± 6.3; p < 0.01), higher WASO in minutes (62.6 ± 33.3 vs 50.06 ± 20.20; p = 0.05). The actigraphy determined mean sleep onset latency did not vary significantly in the two groups. In patients with POTS, there were significant correlation between complaints of tiredness and sleep efficiency (Rs= -0.36; R2= 0.15.; p = 0.018).

Conclusion: Patients with POTS have more sleep-related symptoms including restless sleep, daytime tiredness, increased nocturnal awakenings and longer time to sleep onset as compared with normal controls. Objective assessment of sleep quality with actigraphy confirmed poor sleep efficiency and increased WASO suggesting underlying sleep-maintenance insomnia may be responsible for the complaints of daytime tiredness and dimished quality of life. Activation of the stress system may contribute significantly to the hyper-arousal state and consequent insomnia, poor mental and physical health in patients with POTS.

Support (If Any): Supported in part by NIH grants K23 RR020783 (SRR), R01 HL102387 (SRR), R01 HL071784 (DR), R01 NS055670 (IB), P01 HL56693 (DR), 1 UL1 RR024975 (Clinical and Translational Science Award), and the Paden Dysautonomia Center.

0930

INFLAMMATORY MARKERS IN PREHYPERTENSIVE AND HYPERTENSIVE PATIENTS UNDERGOING EXPERIMENTALLY EXTENDED SLEEP DURATION

Rivera AR[1], Haack M[2,1], Mullington JM[2,1]
[1]Harvard Medical School, Boston, MA, USA, [2]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Insufficient sleep duration and poor sleep quality have been linked to inflammation, hypertension, increased sympathoadrenal activation, and increased cardiovascular mortality. It is not known whether these effects are reversible. This study tests the hypothesis that extension of sleep duration in habitually short-sleeping pre-hypertensive or hypertensive individuals would lead to a decrease in blood pressure and circulating inflammatory markers.
Methods: Twenty-two otherwise-healthy hypertensive type 1 (SBP 140-159 mmHg, DBP 90-99 mmHg) or pre-hypertensive (SBP 120-139 mmHg, DBP 80-89 mmHg) participants were recruited through online advertising and paper fliers in the Boston area. Participants had a habitual sleep duration of <7 hours as determined by 2-week sleep log and actigraphy. Participants were randomized to habitual sleep or extended sleep groups for six weeks. Both groups received sleep hygiene training. The extended sleep group went to bed 30 minutes earlier and stayed in bed 30 minutes later than usual, resulting in 35±9 minutes of additional sleep as measured by actigraphy. Control participants received sleep hygiene training in the absence of an extended sleep opportunity, and slept additional 4±9 minutes per night. Participants' blood pressure, WBC count, IL-6, CRP, VCAM-1, and ICAM-1 were measured at baseline and follow-up.
Results: Participants in the sleep extension group experienced significant SBP decreases of 14±3 mmHg and DBP decreases of 8±3 mmHg. Participants in the control group experienced non-significant SBP decreases of 7±6 mmHg and DBP decreases of 3±4 mmHg. WBC count, CRP, and IL-6 showed non-significant decreases in both groups. Circulating sVCAM-1 was not significantly affected in either group. Relative to the sleep maintenance group, sICAM-1 trended towards elevation in the sleep extension group (p=0.052).
Conclusion: These results suggest that sleep extension is an effective blood pressure lowering strategy for habitually short-sleeping individuals. Preliminary data does not support the hypothesis that modest sleep extension over six-weeks decreases circulating inflammatory markers.
Support (If Any): The parent study was funded by AHA 0535241N to Monika Haack; CAM research was supported by a grant from Harvard Medical School to ARR.

0931

OSA AND COPD DISEASE: AN ASSESSMENT OF THE COMORBIDITY ASSOCIATED WITH THE OVERLAP SYNDROME AND ITS LINK TO THE CHRONIC INTERMITTENT HYPOXIA-RELATED INFLAMMATION

Macrea M[1,2,3], Martin T[1,2], Neeraj N[1], Lala D[1,2], Misra H[3]
[1]Pulm/CCM/Sleep/Palliative, Salem VAMC, Salem, VA, USA, [2]Medicine, University of Virginia, Charlottesville, VA, USA, [3]Virginia Tech Corporate Research Center, VEdward Via College of Osteopathic Medicine, Blacksburg, VA, USA

Introduction: It is estimated that obstructive sleep apnea (OSA) and chronic obstructive pulmonary disease (COPD) co-exist as overlap syndrome (OS) in up to 29% of OSA population and both diseases are being known as independent risk factors for cardiovascular disease (CVD). As patients with OS have more severe nocturnal oxygen (O2) desaturations with increased chronic intermittent hypoxia (CIH)-related oxidative stress (OxS) and inflammation, they are conceivably at higher risk of developing CVD than patients with OSA-only. We therefore hypothesized that OS patients have a higher degree of comorbidities than OSA-only patients possibly due to the CIH-related inflammation as identified by IL-6 levels.
Methods: Age, BMI, vital signs and medical history were obtained from the Computerized Patient Record System (CPRS) for 6 male adults (OS group) recruited consecutively from those diagnosed with severe and very severe COPD after Pulmonary Function Testing (PFT) at the Salem Veterans Affairs Medical Center (VAMC) between January 2009 and June 2011 and subsequently diagnosed with OSA after a polysomnogram at the same institution. The OS group was matched for age and BMI with another group (OSA-only group) of 6 adults previously prospectively screened and diagnosed with OSA. The degree of comorbidities was assessed using a well validated comorbidity measure, the Charlson Comorbidity Index (CCI). All patients underwent laboratory blood drawn for fasting serum IL-6, cortisol, lipids between 7am and 8am the morning after nocturnal oxymetry (OS).
Results: Patients with OS had a higher CCI (p=0.043; CI=0.06-3.5) than OSA-only patients; no differences between the 2 groups were otherwise found for cortisol, IL-6 and lipids; the IL-6 levels correlated with the history of ischemic CVD in the OS group (p=0.023; r=0.99).
Conclusion: Patients with OS are more comorbid than OSA-only patients; IL-6 as a marker of CIH-related inflammation and possible sentinel marker of future CVD comorbidity deserves further attention in this subgroup of OSA patients.
Support (If Any): This research has been partially funded by the Salem Research Institute, Salem, Virginia.

0932

PREVALENCE OF OBSTRUCTIVE SLEEP APNEA AMONG PATIENTS WITH RESISTANT HYPERTENSION

Kalra K[1,2,3], Mahmud S[2], Brimah P[2], Olafiranye O[2], Brown C[2], Zizi F[2], Jean-Louis G[2,4]
[1]Family Medicine, SUNY downstate medical center, Brooklyn, NY, USA, [2]Brooklyn Health Disparities Center, Department of Medicine,, SUNY Downstate Medical Center, BROOKLYN, NY, USA, [3]Family Health Services, SUNY Downstate Medical Center, BROOKLYN, NY, USA, [4]Sleep Disorders Center, Department of Medicine, SUNY Downstate Medical Center, BROOKLYN, NY, USA

Introduction: Estimates suggest that 25% of hypertensive patients in the general population have resistant hypertension (RH). No epidemiologic or clinical studies have assessed whether the prevalence of RH differs among racial/ethnic groups. This study ascertained the prevalence of RH among black patients. It also determined whether patients with RH are at greater risk for Obstructive Sleep Apnea (OSA) than hypertensives.
Methods: Data emanated from MetSO, a study investigating metabolic syndrome among blacks in the primary-care setting. A total of 200 patients (mean age=63±13 years; female=61%) with a diagnosis of hypertension provided subjective and clinical data. RH was defined using the JNC 7 and European Society guidelines (uncontrolled BP despite treatment with 3 medications or controlled BP with 4 or more medications [including a diuretic] in suitable combination and recommended dosage). We assessed OSA risk using the Apnea Risk Evaluation System ARES), defining high risk as a total ARES score ≥6. Patients provided informed consent under the supervision of the IRB at SUNY Downstate Medical Center. Analysis was performed with SPSS 18.0.
Results: Of the sample, 68% were diagnosed with diabetes, 83% dyslipidemia, 38% heart disease, and 11% stroke; 89% were overweight/obese. Average systolic and diastolic BP were 135±19mmHg and 75±11mmHg, respectively; blood glucose levels averaged 145±64mg/dl, triglycerides 147±85mg/dl, and LDL 97±38mg/dl. Overall, 26% met criteria for RH and 40% were at high OSA risk. Logistic regression analysis, adjusting for effects of age, gender, and medical comorbidity, showed that patients with RH were nearly 2.5 times more likely to be at high OSA risk, relative to those with hypertension [OR=2.46, 95%CI: 1.03-5.88, p<0.05].

Conclusion: Our findings show that patients with RH are at significantly greater risk of OSA compared with hypertensive patients. Future studies should investigate whether risks are greater for blacks.
Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

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VERY SHORT-TERM HEART RATE VARIABILITY DURING SLEEP IN PATIENTS WITH CHRONIC FATIGUE SYNDROME

Togo F[1], Natelson B[2]
[1]Graduate School of Education, The University of Tokyo, Tokyo, Japan, [2]Pain and Fatigue Study Center, Beth Israel Medical Center and Albert Einstein Medical Center, New York, NY, USA

Introduction: We determined whether alterations in heart rate dynamics during sleep in patients with chronic fatigue syndrome (CFS) differed from controls and/or correlated with changes of sleepiness before and after a night in the sleep laboratory.
Methods: Beat-to-beat RR intervals (RRI) during nocturnal sleep and subjective scores on visual analog scale for sleepiness were collected from 18 healthy and 17 CFS female study participants aged 25 - 55. Age did not differ between the groups. A short-term fractal scaling exponent (α_1) of heart rate dynamics, analyzed by the detrended fluctuation analysis (DFA) method, was assessed during wake after sleep onset, non-rapid eye movement (non-REM) sleep (Stages 1, 2, and 3 sleep), rapid eye movement (REM) sleep, and arousal. CFS patients were stratified into those who reported more or less sleepiness after a night's sleep (a.m. sleepier or a.m. less sleepy, respectively).
Results: Patients in the a.m. sleepier group showed significantly ($p < 0.05$) lower RRI during Stages 1 and REM sleep and higher fractal scaling index α_1 during Stages 1, 2, and 3 sleep than healthy controls, although standard polysomnographic measures did not differ between the groups. The fractal scaling index α_1 during Stages 1, 2, and 3 sleep was significantly ($p < 0.05$) higher than that during awake periods after sleep onset for healthy controls and patients in the a.m. less sleepy group, but did not differ between sleep stages for patients in the a.m. sleepier group. For patients, changes in self-reported sleepiness after the night in the sleep lab correlated positively with the fractal scaling index α_1 during Stages 1, 2, and 3 sleep ($p < 0.05$).
Conclusion: These results suggest that HRV dynamics or autonomic nervous system activity during non-REM sleep might be associated with disrupted sleep in patients with CFS.

0934

THE COMBINED IMPACT OF POOR SLEEP CHARACTERISTICS ON BLOOD PRESSURE

Peach H, Gaultney JF
Health Psychology, University of North Carolina at Charlotte, Charlotte, NC, USA

Introduction: Poor sleep has a severe impact on cardiovascular health. Shortened and extensive sleep durations, as well as difficulties initiating sleep (DIS), have been independently associated with risks for both hypertension and diabetes. However, the combined impact of DIS and sleep duration is unclear. Considering the cardiovascular implications of hypertension and diabetes, understanding the effects of sleep characteristics on chronic disease development is vital. The present study investigated the interaction of sleep duration and sleep patterns on risk for hypertension and diabetes.
Methods: The present study investigated archival data collected via the National Longitudinal Study of Adolescent Health, Wave IV (2008) of the study (N= 3096). Sleep and health risks were assessed during a General Health questionnaire provided during in-home interviews.
Results: A direct linear regression model containing six independent variables (age, sex, BMI [Block 1], sleep duration during the week, DIS, DMS [Block 2], duration x DIS and duration x DMS interactions [Block 3]) was statistically significant, $\chi 2$ (2, N=3096) =15.449, $p < .000$), R2 = .19. A significant interaction of duration and DIS produced simple slopes that indicated people who do not have DIS show little association between BP and sleep duration. Among those with DIS, those getting the most sleep (>9-hrs) had higher BP.
Conclusion: Participants who experienced DIS and slept more than 9-hrs appear to have the greatest risk for elevated BP. The combination of DIS and long sleep suggests these individuals are spending more time in bed. This may be due to comorbid illness (e.g., 5% of this group had been diagnosed with diabetes relative to 2.5% of those getting less sleep), or greater time in bed may translate into less exercise that would lower BP. This finding highlights the importance of understanding the full scope of sleep characteristics in relation to the study, prevention, and treatment of hypertension.

0935

IS DIFFICULTY SLEEPING ASSOCIATED WITH HEALTH OUTCOMES IN PULMONARY ARTERIAL HYPERTENSION?

Matura L[1,3], McDonough A[2,3], Carroll D[3]
[1]School of Nursing, University of Pennsylvania, Philadelphia, PA, USA, [2]Department of Nursing, University of Massachusetts, Lowell, MA, USA, [3]Munn Center for Nursing Research, Massachusetts General Hospital, Boston, MA, USA

Introduction: There are limited data examining sleep disturbance in pulmonary arterial hypertension (PAH). The aim of this study was to determine the associations between difficulty sleeping and health outcomes [symptoms, health status, health-related quality of life (HRQL) and psychological distress] in PAH.
Methods: This was a cross-sectional design. A convenience sample included 191 adults with PAH. Participants completed a socio-demographic and clinical data form, investigator developed symptom scale (PAH Symptom Scale), Medical Outcomes Survey Short Form 36 (SF-36), US Cambridge Pulmonary Hypertension Outcome Review (US CAMPHOR) and Profile of Moods States (POMS). Descriptive statistics described the sample. T test and chi square determined differences between continuous and categorical variables. Univariate analysis determined variables associated with difficulty sleeping to include in multiple regression analysis.
Results: Mean age for the group was 53 years, the majority were women (85%). One hundred twenty six (66%) reported difficulty sleeping versus 65 (34%) reporting no difficulty sleeping. The two groups did not differ on socio-demographics. They differed on functional class (FC) (p=.004) and oxygen use (p=.002). Those with difficulty sleeping had worse symptoms for shortness of breath (SOB) on exertion (p<.001), fatigue (p<.001), palpitations (p=.003), dizziness (p=.029), cough (p=.029), chest pain (p<.001) and SOB lying down (p=.04). Those with difficulty sleeping had worse health status (SF-36) (p<.001), HRQL (US CAMHPOR) (p<.001), and psychological distress (POMS) (p<.001). In multiple regression analysis, difficulty sleeping was significantly associated with fatigue (POMS) (.201, 95% CI=.066-.336), swelling (.350, 95% CI=.193-.506), appetite (.287, 95% CI=.100-.474), dizziness (.221, 95% CI=.019-.423), Raynaud's symptoms (PAH Symptom Scale) (.152, 95% CI=.007-.296) and energy (SF-36) (.034, 95% CI=.005-.063).The model explained 51% of the variance (p=.037).
Conclusion: Difficulty sleeping was associated with symptoms and those reporting difficulty sleeping had worse health outcomes. More investigation is needed to determine the nature of sleep disorders and effective interventions in PAH.
Support (If Any): This study was partially funded by a Bouve College of Health Sciences, Northeastern University intramural grant and Sigma Theta Tau International Gamma Epsilon grant.

0936

DAYTIME SLEEPINESS AND RISK FOR MYOCARDIAL INFARCTION AND STROKE IN WOMAN

Gangwisch JE[1], Rexrode K[2,3], Forman J[2,4,5], Malaspina D[6], Feskanich D[2]

[1]Department of Psychiatry, Division of Cognitive Neuroscience, Columbia University, College of Physicians and Surgeons, New York, NY, USA, [2]Channing Laboratory, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA, [3]Preventive Medicine Division, Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [4]Renal Division, Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [5]Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA, [6]Department of Psychiatry, New York University Langone Medical Center, New York, NY, USA

Introduction: The association between daytime sleepiness and myocardial infarction and stroke has been hypothesized to imply that daytime somnolence could be a prodromal symptom or precursor for vascular events, suggesting the need for further diagnostic testing or the initiation of cardiovascular risk reduction. We explored an alternative hypothesis, whereby daytime sleepiness could be a manifestation of short sleep duration, disturbed sleep, and circadian disruption, conditions associated with metabolic abnormalities that are risk factors for heart attack and stroke.

Methods: Analyses were conducted among 82,560 women ages 37-54 in the Nurses' Health Study II with follow-up from 2001-2007. Daytime sleepiness was assessed with a single question in 2001. Data on covariates were collected at 2001 and updated biennially. Multivariate Cox regression was used to explore the relationship between reported daytime sleepiness and the incidence of cardiovascular disease (CVD) (either myocardial infarction or stroke, n = 334) controlling for demographic and lifestyle factors. Subsequent models adjusted for variables indicative of metabolism (BMI, diabetes, hypercholesterolemia, and hypertension) and sleep (sleep duration, snoring, shift work, self perception of sleep adequacy).

Results: Report of daytime sleepiness almost every day, compared to rarely/never, was associated with an elevated risk for CVD (HR = 1.84, 95% CI 1.27-2.67) after controlling for demographic and lifestyle factors. Controlling for the metabolic variables appreciably attenuated the association, but it remained significant (HR = 1.53 95% CI 1.05 - 2.24). The inclusion of the sleep variables further attenuated the association (HR = 1.27 95% CI 0.84 - 1.91).

Conclusion: Daytime sleepiness was associated with increased risk for CVD in this cohort of relatively young women. Results were subsequently attenuated with adjustment for metabolic abnormalities and sleep, lending support to a model whereby short sleep duration, disturbed sleep, and circadian disruption simultaneously contribute toward daytime sleepiness, metabolic abnormalities, and cardiovascular disease.

Support (If Any): Financial support for this study was provided by National Institutes of Health grants HL091443 from the National Heart, Lung, and Blood Institute and CA50385 from the National Cancer Institute.

0937

AUTONOMIC CARDIOVASCULAR REGULATION DURING SLEEP IN BRUGADA SYNDROME: THE IMPLICATIONS OF COMORBID SLEEP DISORDERED BREATHING

Tobaldini E[1], Brugada J[2], Begona B[2], Molina I[2], Montserrat J[3], Kara T[4,5], Leinveber P[5], Porta A[6], Montano N[1], Somers VK[4]

[1]Department of Clinical Sciences, L.Sacco Hospital,, University of Milan, Milan, Italy, [2]Cardiology Department, Thorax Institute, Hospital Clínic, Barcelona, Spain, [3]Pneumology Department, Hospital Clínic, Barcelona, Spain, [4]Division of Cardiovascular Diseases, Department of Internal Medicine, Mayo Clinic and Foundation, Rochester, MN, USA, [5]ICRC-Department of Cardiovascular Diseases, St. Anne's University Hospital Brno, Brno, Czech Republic, [6]Department Of Techonologies for Health, Galeazzi Orthopedic Institute, University of Milan, Milan, Italy

Introduction: Brugada syndrome is a pathological condition characterized by specific electrocardiographic and arrhythmic patterns, and is associated with ventricular tachyarrhythmias and sudden cardiac death. These events seem to be more frequent during the night, when vagal cardiac modulation is likely to be increased. Interestingly, recent evidence showed that Brugada patients are more likely to have sleep disordered breathing (SDB) when compared to controls. However, the effects of SDB on autonomic regulation during sleep in Brugada patients is not known.

Methods: We assessed autonomic control in 9 Brugada patients with SDB (BRU-SDB), 9 Brugada without SDB (BRU) and 8 healthy controls (CON) according to the different sleep stages (Wake, W, NREM 1, NREM 2, NREM 3 and REM). Autonomic regulation was assessed using spectral analysis of heart rate variability (HRV) and entropy-derived indices (regularity index, Ro, and Corrected Conditional Entropy, CCE). Spectral analysis identified two main rhythmical components: low frequency (LF), a marker of sympathetic modulation when expressed in normalized units, and high frequency (HF), a marker of vagal modulation. Regularity index (Ro) is derived by dividing Corrected Conditional Entropy by the Shannon entropy and values range from 1 (maximum regularity, lowest complexity) to 0 (lowest regularity, maximum complexity).

Results: BRU-SDB patients were characterized by a reduced total HRV compared to BRU and CON and a significantly decreased LF component, more evident during N2 and REM. During REM, in BRU-SDB an increased parasympathetic control was observed compared to BRU and CON. Entropy indices were similar in the three groups throughout the sleep stages.

Conclusion: These data suggest that the Brugada syndrome alone does not confer, per se, any alterations in autonomic control during wakefulness and sleep. However, the presence of comorbid SDB appears to play a key role in the derangement of autonomic cardiovascular regulation during sleep in Brugada patients.

0938

POOR SLEEP QUALITY CONTRIBUTES TO COGNITIVE IMPAIRMENT IN ADULTS WITH CHRONIC HEART FAILURE

Riegel B[1], Weaver T[2], Pressler SJ[3]

[1]School of Nursing, University of Pennsylvania, Philadelphia, PA, USA, [2]College of Nursing, University of Illinois, Chicago, IL, USA, [3]School of Nursing, University of Michigan, Ann Arbor, MI, USA

Introduction: Heart failure (HF) afflicts about 6M Americans and up to half have cognitive impairment (CI). Almost 60% of HF patients report having trouble sleeping and half report insomnia-related symptoms. Poor sleep quality is known to impair cognition but the contribution of poor sleep to the CI of HF has not been explored.

Methods: Adults with a confirmed diagnosis of chronic symptomatic HF were enrolled from 3 northeastern US sites after excluding individu-

als with dementia, recent drug/alcohol abuse, and nightshift workers. Baseline data obtained from 280 subjects were used to test the hypothesis that sleep quality (global Pittsburgh Sleep Quality Index [PSQI]) is a significant predictor of CI. A battery of 5 neuropsychological tests was used to judge CI. Only those with ≥2 abnormal tests were considered impaired. Demographic predictors included age, gender, education, and race. Clinical predictors included HF severity (NYHA functional class), depression (PHQ-9), number of comorbid illnesses (Charlson Index) and medications, hypertension, and systolic blood pressure—all factors thought to be associated with CI. Logistic regression with backward deletion was used to identify the best model of predictors of CI.

Results: Complete data were available on 272 HF patients (36% female, 37% non-white race, mean age 62±12.3 years). Higher age, non-white race, hypertension, NYHA class, and poor sleep quality explained 25.3% of the variance in CI ($p<0.001$). The likelihood of CI increased by 3% for each year increase in age ($p=0.02$). Non-white subjects were 2.2 times as likely to have CI compared to white subjects ($p=0.008$). Those with < high school education were 4 times as likely to have CI ($p<.004$). The likelihood of CI increased by 9.2% for each unit increase in the PSQI sleep score ($p=0.01$).

Conclusion: Sleep quality may be an important factor explaining CI in HF patients. Efforts to improve sleep quality may improve attention, memory, executive function, psychomotor speed, and global cognitive function in this large population of patients.

Support (If Any): This work was funded by a grant from the National Heart, Lung & Blood Institute (RO1 HL084394-01A1) and by the Philadelphia Veterans Affairs Medical Center, VISN 4 Mental Illness Research, Education, and Clinical Center (MIREC).

0939

BLOOD PRESSURE INCREASES WITH SLEEP DISORDERED BREATHING SEVERITY IN THE GENERAL POPULATION: THE HYPNOLAUS STUDY

Haba-Rubio J[1], Andries D[1], Tobback N[1], Vaucher J[2], Marques-Vidal P[2], Vollenweider P[2], Waeber G[2], Tafti M[1,3], Heinzer RC[1,4]

[1]Center for Investigation and Research in Sleep (CIRS), Lausanne University Hospital, Lausanne, Switzerland, [2]Internal Medicine, Lausanne University Hospital, Lausanne, Switzerland, [3]Center for Integrative Genomics (CIG), Lausanne University, Lausanne, Switzerland, [4]Pulmonary Department, Lausanne University Hospital, Lausanne, Switzerland

Introduction: Sleep disordered breathing (SDB) is recognized as a risk factor for high blood pressure. The aim of this study was to determine the association between systolic and diastolic blood pressures and SDB severity in a large unselected middle-aged European population.

Methods: 1066 subjects (47.8% women, 50.2±5.7 years old, BMI 25.3±4.1 kg/m2) participating in an ongoing population-based sleep cohort study (HypnoLaus, Lausanne, Switzerland) underwent complete polysomnographic recordings at home. SDB severity was assessed using the apnea-hypopnea index (AHI) defined according to the AASM 2007 criteria. All subjects had an extensive clinical workup including morning systolic and diastolic blood pressure measurements.

Results: Mean AHI was 6.4±10/h. Prevalence of SDB defined as an AHI > 5/h, >15/h and >30/h was 36.5%, 11.2% and 3.6% respectively. Mean Epworth sleepiness scale (ESS) score was 6.9±4.1. Mean neck circumference was 36.6±5.1 cm. There was a positive correlation between AHI and systolic blood pressure ($r=0.27$, $p<0.0001$) and between AHI and diastolic blood pressure ($r=0.25$, $p<0.0001$). Mean systolic blood pressure (mmHg) was 118.2±14.6 in the individuals with an AHI <5/h, 123.6±14.2 with an AHI between 5 and 14.9/h, 129.7±16.5 with an AHI between 15 and 29.9/h and 135.2±13.3 for and AHI ≥ 30/h ($p<0.0001$). Mean diastolic blood pressure (mmHg) was 76.1±9.9 for an AHI <5/h, 79.6±11.1 for an AHI between 5 and 14.9/h, 83.3±10.9 for an AHI between 15 and 29.9/h and 86.6±10.5 for and AHI ≥ 30/h ($p<0.0001$). These differences remained significant after adjustment for age, sex, BMI, waist and neck circumferences: $p=0.03$ (systolic pressure) and $p=0.04$ (diastolic pressure).

Conclusion: In HypnoLaus population-based study, there is a positive correlation between AHI and (systolic + diastolic) blood pressure. Diastolic and systolic blood pressures increase with increasing apnea-hypopnea index. These differences remain significant after adjustment for the main confounding factors.

0940

ASSOCIATIONS BETWEEN SLEEP DURATION AND HYPERCHOLESTEROLEMIA: ROLE OF RACE/ETHNICITY AND GENDER

Bagchi A[1], Pandey A[1,4], Nam D[1], Pandey A[4], Olafiranye O[3], Brown C[1], Jean-Louis G[1,2]

[1]Brooklyn Health Disparities Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [2]Sleep Disorder Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [3]Cardiology, SUNY Downstate Medical Center, Brooklyn, NY, USA, [4]Internal Medicine, A.P. Medical P.C., Brooklyn, NY, USA

Introduction: Evidence links aberrant sleep durations with elevated serum cholesterol levels. We hypothesized that race/ethnicity and gender play a key role in the association between sleep duration and hypercholesterolemia.

Methods: A total of 40,679 Americans (age range: 18-85 years) who participated in the 2008 - 2009 National Health Interview Survey (NHIS) provided data for the analysis. They were recruited using a nationally representative cross-sectional household interview survey, which uses a multistage area probability design. Respondents provided socio-demographic and anthropometric measures; data on physician-diagnosed chronic conditions were also obtained. They also rated their moods and indicated their habitual sleep duration. NHIS-provided weights adjusted for use of complex design.

Results: Of the sample, 85% reported their race/ethnicity as white and 15% as black. The average age was 45.3 + 17.3 years; 56% were female. Regression analysis showed that participants who reported long sleep duration (>8 hours) were more likely to have reported hypercholesterolemia than individuals reporting habitual sleep duration of 7 hours [OR = 1.28, 95% C.I: 1.28 -1.28, $p < 0.001$]. No significant associations were observed for short sleep. We observed significant association between sleep duration and presence of hypercholesterolemia among blacks, but not among whites. Blacks who reported short or long sleep duration had a greater risk of hypercholesterolemia [OR = 1.12, 95% C.I: 1.11 -1.13; OR = 1.13, 95% C.I: 1.12 -1.14; $p < 0.001$, respectively]. In a separate regression model, black females reporting short or long sleep had 11% and 10% greater risk of reporting hypercholesterolemia [OR = 1.11, 95% C.I: 1.10 -1.11; OR = 1.10, 95% C.I: 1.10 -1.10; $p < 0.001$, respectively].

Conclusion: Results showed that the risk of reporting hypercholesterolemia is higher among black short or long sleepers. Black females may be at greater risk than all other groups.

Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

0941

DOES FIBRINOGEN MEDIATE THE RELATIONSHIP BETWEEN LONG SLEEP DURATION AND CORONARY HEART DISEASE?

Hale L[1], Parente V[1], Dowd JB[2], Sands M[8,9], Berger JS[3], Curb JD[4], Song Y[5], Martin LW[6], Allison M[7]
[1]Preventive Medicine, Stony Brook University, Stony Brook, NY, USA, [2]Epidemiology and Biostatistics, Hunter College, CUNY, New York, NY, USA, [3]Medicine, New York University, New York, NY, USA, [4]Pacific Health Research Institute, Honolulu, HI, USA, [5]Preventive Medicine, Brigham and Women's Hospital, Boston, MA, USA, [6]Cardiovascular Institute, George Washington University, Washington, DC, DC, USA, [7]Preventive Medicine, University of California, San Diego, San Diego, CA, USA, [8]Epidemiology, Brown University, Providence, RI, USA, [9]Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Long sleep duration has been associated with increased cardiovascular disease and all-cause mortality. The physiological pathways through which these associations occur are not clear. Inflammation and coagulation have been hypothesized as possible mediating mechanisms. Fibrinogen, an acute-phase inflammatory protein that plays an important role in blood clotting, is associated with increased cardiovascular disease risk and long sleep duration, respectively. We aim to investigate whether circulating levels of fibrinogen mediate the relationship between sleep duration and coronary heart disease (CHD) in women.
Methods: We investigated longitudinal data from 3,942 postmenopausal women who are participants in the Women's Health Initiative. First performed logistic regression models to assess whether fibrinogen levels are associated with self-reported sleep duration and whether and to what extent fibrinogen modifies the associations of sleep duration with incident CHD, CVD mortality, and overall mortality.
Results: Our results show that high levels of fibrinogen (>325 mg/dl) are positively associated with long sleep duration (≥9 hours per night) (OR=1.61, 95%CI 1.52-2.24) and this association persists even after adjustment for age, education, income, ethnicity, BMI, exercise, alcohol, smoking history, elevated blood pressure, diabetes, and depression (adjusted OR=1.52, 95%CI 1.08-2.15). Fibrinogen is also a strong predictor of incident coronary heart disease and all-cause mortality (with adjusted ORs of 1.19 [95%CI 1.00-1.41] and 1.17 [95%CI 1.04-1.31], respectively). Adjustment for fibrinogen attenuates the association of long sleep and CHD by approximately 10% (OR without fibrinogen adjustment=2.04 [95% CI 1.01-4.13] , and OR with fibrinogen adjustment=1.94[95% CI 0.96-3.94]). A similar reduction in OR is observed with the outcome of mortality.
Conclusion: These results suggest that coagulation, as reflected by circulating levels of fibrinogen, may be a mechanism through which long sleep duration is associated with CHD and mortality.
Support (If Any): NHLBI WHI Contract No HHSN268201100001C and R01AG036838-02.

0942

RELATIONSHIP BETWEEN SLEEP DURATION AND CARDIO-ANKLE VASCULAR INDEX IN HEALTHY YOUNG ADULTS

Noda A, Miyata S
Chubu University, Kasugai, Japan

Introduction: Although short sleep duration is linked to an increased risk of hypertension and all-cause mortality, its effects on atherosclerosis are not well characterized. The cardio-ankle vascular index (CAVI) is a new index for assessing atherosclerosis. CAVI is essentially independent of blood pressure (BP), given the BP adjustments made based on the stiffness parameter. The purpose of this study was to assess the relationship between sleep duration and CAVI in healthy young adults.
Methods: Participants were 10 healthy young adults (mean age, 25.9±3.9 years). CAVI, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured by plethysmography (Fukuda Denshi, Tokyo, Japan). Maximum intima-media thickness (maxIMT) was measured by B-mode ultrasound (Toshiba Medical Co., Ltd., Japan). Heart rate variability (HRV) was used to evaluate autonomic activity. Power spectra were quantified at 0.04-0.15Hz (low frequency power; LF) and 0.15-0.40Hz (high frequency power; HF), and the HF component and LF/HF ratio were calculated. Salivary amylase levels were measured with an amylase monitor to quantitatively evaluate stress. On natural sleep nights, participants slept for 8 hours (i.e., sufficient sleep), while on controlled sleep nights, participants were allowed to sleep between 3:00AM and 7:00AM, with sleep duration limited to <4h (i.e., insufficient sleep).
Results: CAVI was significantly higher after insufficient sleep than after sufficient sleep. No significant differences were observed in SBP, DBP and maxIMT after insufficient and sufficient sleep. HF was significantly lower, while amylase and LF/HF ratio were significantly higher, after insufficient sleep than after sufficient sleep.
Conclusion: Short sleep duration was associated with increased CAVI. Our findings suggest that stress resulting from insufficient sleep elevates sympathetic activity, which may be related to the development of atherosclerosis.

0943

SLEEP DURATION AND RISK OF ATRIAL FIBRILLATION IN THE PHYSICIANS' HEALTH STUDY

Khawaja O[1,3], Sarwar A[5,6], Gaziano JM[1,2,3,4], Djousse L[1,2,3]
[1]MAVERIC, VA Boston Healthcare System, Boston, MA, USA, [2]GRECC, VA Boston Healthcare System, Boston, MA, USA, [3]Division of Aging, Brigham and Womens Hospita and Harvard Meidcal School, Boston, MA, USA, [4]Preventive Medicine, Brigham and Womens Hospita and Harvard Meidcal School, Boston, MA, USA, [5]Pulmonary, Critical Care, Sleep medicine, Lahey Clinic, Burlington, MA, USA, [6]Medicine, Tufts University School of Medicine, Boston, MA, USA

Introduction: Atrial fibrillation (AF) is a highly prevalent cardiac arrhythmia. While sleep quality and duration have been related to cardiovascular endpoints, little is known about the association between sleep duration and incident AF. Hence, we prospectively examined the association between sleep duration and incident AF in US male physicians.
Methods: Prospective study of 18,755 US male physicians. Self-reported sleep duration was ascertained during the 24 month annual follow-up questionnaire. Incident AF was ascertained through yearly follow-up questionnaires and validated on randomly selected 400 participants in a prior study. Cox regression was used to estimate relative risks of AF.
Results: The average age was 67.7 (+8.6) years. During a mean follow up of 6.9 (±2.1) years, 1,468 cases of AF occurred. The crude incidence rate was 9.6, 9.9, 14.4, and 17.29 cases/1000 person-years for people reporting average sleep duration of <6, 7, 8, and >9 hours respectively. Using 7 hours of sleep as the reference group, the multivariable adjusted hazard ratios (95% CI) for AF were 1.07 (0.93-1.22), 1.0 (ref), 1.15 (1.01-1.30), and 1.07 (0.89-1.30) from the lowest to the highest category of sleep duration respectively (p for trend 0.827). In a secondary analysis stratified by BMI, there was an increased risk of AF with longer sleep duration among individuals with BMI of 25+ kg/m2 but not in lean participants. The multivariable adjusted hazard ratios (95% CI) for AF were 1.09 (0.92-1.29), 1.0 (ref), 1.20 (1.03-1.41), and 1.30 (1.03-1.64) for those with BMI 25+ kg/m2 in comparison to 1.03 (0.82-1.31), 1.0 (ref), 1.05 (0.85-1.29), and 0.72 (0.50-1.03) for those with BMI <25 kg/m2, from the lowest to the highest category of sleep duration respectively.
Conclusion: Our data shows an increased risk of AF with longer sleep duration among US male physicians. Such an association was limited to overweight/obese people.

0944

LUNG TO FINGER CIRCULATION TIME IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA AND CONGESTIVE HEART FAILURE

Kwon Y[1,2,3], Kahn T[1,3], Iber C[1,3]
[1]Medicine (Pulmonary Critical Care), University of Minnesota, Minneapolis, MN, USA, [2]Medicine (Cardiovascular), University of Minnesota, Minneapolis, MN, USA, [3]Medicine, Hennepin County Medical Center, Minneapolis, MN, USA

Introduction: Lung to finger circulation time (LFCT) can be estimated from polysomnography (PSG) in the presence of an apneic event by using oxygen as an indicator and finger as a site of detection. The purpose of this study was to determine factors associated with prolonged LFCT in patients with obstructive sleep apnea (OSA).
Methods: In a retrospective manner, an average of 10 LFCT measurements per patient were made from PSG in 171 consecutive patients with a diagnosis of OSA that were divided into two groups: those with a clinical history of underlying CHF (n=42) and those without CHF (n=129). Mean values were compared between the two groups. We also examined associations of LFCT with various factors in each group using multiple linear regression.
Results: Mean LFCT of the OSA group with underlying CHF was significantly prolonged compared to the group without CHF. (Mean ± SD: 28 ± 9.4 sec vs. 17.3 ± 4.5 sec, p<0.0001) Among those with CHF, LFCT was significantly longer in patients with Cheyne Stokes Respiration (CSR, n=12) than those without (n=30). (33.3± 12.9 vs. 25.3± 6.6, p=0.01) In patients with OSA alone, male gender and the presence of hypertension (HTN) were significantly associated with LFCT after adjusting for other variables including BMI, AHI, age, diabetes and use of beta blocker (male vs. female: 18 ±4.6 vs. 15±3 p<0.0001; HTN vs. No HTN: 16.4 ± 4.0 vs. 18.7±4.9 p=0.006) In OSA patients with CHF, age and the presence of CSR were associated with prolonged LFCT.
Conclusion: Patients with OSA who have CHF have significantly prolonged LFCT compared to those without CHF. CSR is associated with longer LFCT in those with CHF. Future studies are necessary to further explore the clinical utility of LFCT performed during polysmnographic studies.

0945

HEART RATE ELEVATIONS FROM HOSPITAL SOUNDS DURING SLEEP

Gordhandas A[1], Buxton OM[2,3], Wang W[2,3], Carballeira A[4,5], Solet JM[2,6], Ellenbogen JM[1,2]
[1]Sleep Division, Department of Neurology, Massachusetts General Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [4]Cavanaugh Tocci Associates, Sudbury, MA, USA, [5]Berklee School of Music, Boston, MA, USA, [6]Department of Medicine- Masssachusetts General Hospiital, Cambridge Healh Alliance, Cambridge, MA, USA

Introduction: Noise in hospitals can have negative impacts on patient health and satisfaction with quality of care. We previously demonstrated that noises disrupt sleep by causing EEG arousals.We tested the hypothesis that sleep disruption by noise-induced arousals causes cardiovascular reactivity during sleep.
Methods: Hospital sound sources recognized as salient in the AIA Draft Interim Guideline on Sound and Vibration in Healthcare Facilities were recorded at Somerville Hospital. Twelve healthy, adult volunteers were monitored with polysomnography during one undisturbed baseline and two recorded-noise exposure nights at the MGH Sleep Laboratory. Fourteen sounds (e.g., IV pump alarm, telephone, helicopter, and human voices) were repeated, at rising five-decibel step exposures/epoch from 40 db(A) until arousal, or 70 db(A). EEG arousals met current AASM criteria. Instantaneous heart rate (HR) was assessed with ECG.
Results: Elevations in HR during evoked arousals varied by sleep stage (all p<0.05 adjusted for multiple comparisons), highest in REM sleep (median: 10.08 beats per minute [BPM] ± 3.84 BPM), followed by N3 (median: 4.32 BPM ± 1.90 BPM) and N2 (median: 3.48 BPM ± 2.60 BPM). Similar results were found on both noise-presentation nights (P=0.83), demonstrating a lack of short-term habituation for the ECG response. Sleep stage significantly predicted the duration of time from start of arousal to peak HR (P<0.0001). The fastest response (time from arousal onset to peak HR) occurred during REM (5.8 seconds ± 2.5 seconds, p<0.05, adjusted for multiple comparisons) followed by longer durations in N2 (8.2 seconds ± 4.1 seconds) and N3 (10.6 seconds ± 4.6 seconds).
Conclusion: Hospital noises cause sleep disruption, with contemporaneous elevations of heart rate that are most pronounced in REM sleep. These findings will spur further research into the impact of sleep related heart rate disturbances on patient health and recovery, including the relationship to hypertension and other clinically relevant cardiovascular outcomes.
Support (If Any): This study was funded by investigator-initiated grants (to JS) from the Academy of Architecture for Health, the Facilities Guidelines Institute, and The Center for Health Design. Sleep laboratory work was completed through the generosity of Massachusetts General Hospital.

0946

PREDICTING SELF-REPORTED CARDIOVASCULAR DISEASE FROM COMBINATIONS OF WORK DEMANDS AND SLEEP PROBLEMS - A PROSPECTIVE STUDY

Akerstedt T[1,4], Nordin M[3], Alfredsson L[2], Westerholm P[2], Kecklund G[1,4]
[1]Stress Research Institute, Stockholm University, Stockholm, Sweden, [2]Department of Environmental Medicine, Karolinska Institute, Stockholm, Sweden, [3]Department of Environmental Medicine, Umea Unversity, Umea, Sweden, [4]Department of Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden

Introduction: Each of high work demands and poor sleep is associated with increased risk of cardiovascular disease (CVD). However, very little is known about relation between CVD and combined high work demands and poor sleep (or about other combinations of demands and sleep). The present study aimed at providing such knowledge.
Methods: The data base use was the Swedish WOLF (work, occupation, lipids, fibrinogen) register, with 5000 individuals in two waves with 5 years in-between. CVD was defined as having reported at time 2 (but not at time 1) either: treatment for myocardial infarction, experience of chest pain with physical or mental effort (fading with rest), diagnos with vascular spasm in the heart, experience of a cerebrovascular accident (cerebral hemorrhage or clots in the brain), of high blood pressure? The predictors were combined to form the variables: low demands and good sleep (LG; OR = 1), High demands and good sleep (HG), low demands and poor sleep (LP), high demands and poor sleep (HP). Data were analyzed with logistic regression analysis. All analyses were controlled for age, gender, education, socio-economic status (SES), control at work, heavy work, marital status.
Results: The results showed the following Odds Ratios (OR) and 95% confidence intervals (Ci): LG =1 (0), HG = 0.82 (0.62-1.10), LP = 0.97 (0.70-1.35), HP =1.68 (1.12-2.50). Interaction analysis showed no effect of work demands only (0.82; 0.62-1.10) or of sleep only (0.97; 0.70-1.35), but for the interaction between the two (2.10; 1.21-3.84).
Conclusion: It is concluded that combined sleep problems and high work demands predict reports of CVD 5 years later.
Support (If Any): FAS - Stockholm Stress Center.

0947

ARTERIAL HYPERTENSION IS MAJOR DETERMINANT OF SEVERE CARDIOVASCULAR EVENTS IN A OSA POPULATION: A LONGITUDINAL STUDY

Cintra F, Mello-Fujita L, Tufik S, Poyares D
Psychobiology, Universidade Federal de São Paulo, São Paulo, Brazil

Introduction: OSA is a risk factor for a number of cardiovascular conditions including increased cardiovascular mortality. Predictors of cardiovascular death among OSA patients are still controversial. The aim of this study is to analyze the clinical, polysomnographic and ecocardiographic parameters related to major cardiovascular events in OSA patients in a longitudinal study.
Methods: Patients who underwent full polysomnography were consecutively selected from the Sleep Clinic of Universidade Federal de São Paulo (UNIFESP) database. Evaluations included: blood tests, physical examination, Epworth sleepiness scale (ESS), 12-lead ECG, symptom-limited maximum cardio respiratory exercise study (CPET) on a treadmill, and transthoracic echocardiogram. During the follow-up period the participants were submitted to questionnaires by telephone to identify the occurrence of major cardiovascular events defined as: all-cause mortality, stroke, nonfatal myocardial infarction (MI), stroke, angina, coronary revascularization, congestive heart failure, and peripheral arterial disease.
Results: A total of 225 OSA patients, 123 female gender, mean age: 54,25 ± 8,86 y and AHI: 26,62 ± 20,05 events/h were evaluated. Mean follow-up time was 35 ± 10 months. There were 23 major events during the follow-up period, with 6 deaths and 4 MI. Age and the presence of arterial hypertension were independently related to the occurrence of cardiovascular events. Neither polysomnographic nor laboratorial, echocardiographic parameters reached statistical significance.
Conclusion: Arterial hypertension and age, but not AHI are main predictors of major cardiovascular events in OSA patients.

0948

INFLUENCE OF SLEEP ON DYSPNEA, EMOTIONAL FUNCTION, AND PHYSICAL FUNCTION IN HEART FAILURE PATIENTS WITH CARDIAC RESYNCHRONIZATION THERAPY

Sherry D[1,3], Collins EG[2,3]
[1]Health Services Research, Dept of Veterans Affairs, Hines, IL, USA, [2]Rehabilitation, Dept of Veterans Affairs, Hines, IL, USA, [3]Biobehavioral Health, University of Illinois-Chicago, Chicago, IL, USA

Introduction: The study of sleep in heart failure patients is relevant to the promotion of health. However, the influence of sleep on dyspnea, emotional and physical function is not well described particularly in those treated with cardiac resynchronization therapy (CRT). These investigators hypothesized that there is a relationship of reported sleep on physical function, dyspnea, and emotional function in CRT patients.
Methods: In a prospective, one-group, pre-/post-CRT design, a convenience sample of 21 heart failure patients that underwent CRT implantation were recruited from an urban academic center and a suburban private practice. Measures (6-minute walk test, Daily Activity Questionnaire in Heart Failure, Chronic Heart Failure Questionnaire) were assessed pre-CRT and 3 months post-CRT.
Results: The sample consisted of 67% male patients with mean age = 61 +/- 14, and 57% were Caucasian. Self-reported sleep post-CRT was 8.2 hours +/- 2.6 hours per day. Those that slept less than 8 hours per day, reported 6.0 hours of sleep whereas those that slept at least 8 hours reported sleeping 9.9 hours per day. For those subjects that slept less than 8 hours per night, more dyspnea was reported and associated with more emotional dysfunction ($r = -0.83$, $p = .002$).
Conclusion: In this sample, there was a relationship of sleep with dyspnea and emotional function. Achieving the recommended amount of sleep may be a factor in minimizing symptoms of dyspnea and emotional dysfunction in heart failure patients. Further exploration with a larger sample is recommended to fully describe the relationships among sleep, heart failure symptoms, and physical function.
Support (If Any): This study was supported by the National Institutes of Nursing Research, Ruth L. Kirchstein National Research Service Award, #5F31NR009901.

0949

CORRELATION BETWEEN FATIGUE AND PSYCHOLOGICAL DISTRESS IN WOMEN WITH BREAST CANCER UNDERGOING CHEMOTHERAPY

Dandekar F[1], Rissling M[1,2], Faierman M[1], Liu L[1], Natarajan L[3,4], Palmer B[1,2], Parker BA[4], Ancoli-Israel S[1,2,4]
[1]Department of Psychiatry, University of California San Diego, La Jolla, CA, USA, [2]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, , San Diego, CA, USA, [3]Preventive and Family Medicine, UCSD, La Jolla, CA, USA, [4]Moores Cancer Center, UCSD, La Jolla, CA, USA

Introduction: Women with breast cancer undergoing chemotherapy often report fatigue and psychological distress as significant aspects of their symptom clusters. As part of a larger study on sleep in women with breast cancer, we examined the relationship between fatigue and psychological distress before and after chemotherapy.
Methods: 69 women (mean age=55.2±9.5 years) with newly diagnosed stage I-III breast cancer scheduled to receive ≥4 cycles of chemotherapy, were included in this analysis. Fatigue was assessed with the Multidimensional Fatigue Symptom Inventory-Short Form (MFSI-SF), and psychological distress was assessed with the Brief Symptoms Inventory (BSI) scale (Global Severity Index subscale, GSI). Data are presented from 2 time points: before the start of chemotherapy (baseline, BL) and at the end of cycle 4 chemotherapy (C4).
Results: More psychological distress (BSI_GSI) was significantly correlated with more fatigue (MFSI) at BL ($r=0.781$, $p=0.01$) and at C4 ($r=0.868$, $p= 0.01$). The change from BL-C4 in distress was significantly correlated with the change in fatigue ($r=0.664$, $p=0.01$). Linear regression showed that the change in BSI_GSI over the same time period was dependent on the change in total MFSI ($p<0.0001$).
Conclusion: Psychological distress and fatigue are associated with each other before and during chemotherapy in women with breast cancer. In addition, greater psychological distress is predicted by increased levels of fatigue. Studies are needed to examine whether treatment of fatigue will ameliorate psychological distress in this population.
Support (If Any): NCI CA112035, UL1RR031980 (CTRI), the UCSD Stein Institute for Research on Aging and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

0950

DEPRESSIVE SYMPTOMS AND SLEEP: A POPULATION-BASED POLYSOMNOGRAPHIC STUDY

Castro JP[1], Castro LS[1], Quarantini LC[2], Kauati A[1], Hoexter MQ[3], Santos-Silva R[1], Mello LE[4], Bittencourt LA[1], Tufik S[1]

[1]Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [2]Serviço de Psiquiatria - Hospital Universitário Professor Edgard Santos, Universidade Federal da Bahia, Salvador, Brazil, [3]Psiquiatria, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [4]Fisiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: The aim of this study was to estimate the prevalence of depressive symptoms in the adult population of Sao Paulo, Brazil and to investigate the association with sociodemographic factors, quality of life, sleep-related symptoms and polysomnographic sleep parameters.
Methods: This population-based survey used a probabilistic three-stage cluster sample of Sao Paulo inhabitants to represent the population according to gender, age (20-80 years), and socio-economic status. Participants were administered a wide range of questionnaires and submitted to full in-lab polysomnography. A score greater than 20 in the Beck Depression Inventory was used to define depressive symptoms.
Results: The prevalence of depressive symptoms was 10.9% (95%CI: 8.8%-13.4%). Estimates were slightly higher in women, tended to decrease in the elderly and were significantly higher among housewives, non-workers and subjects with lower education and income. A combination of sleep-related symptoms and impaired quality of life was 2.5 times more frequent among subjects with depressive symptoms. Co-morbid insomnia and anxiety were highly associated to depressive symptomatology. No alterations were observed in the polysomnographic parameters in either group. The occurrence of apnea-hypopnea index ≥5 was similar between subjects with and without depressive symptoms and highly frequent in both groups (32.2% versus 39.4%; p=0.22).
Conclusion: Although Obstructive Sleep Apnea Syndrome (OSAS) prevalence is high, the depressive symptoms were not associated with the apnea-hypopnea index but they were associated with low education, low income, severe comorbid symptomatology and impaired quality of life. In addition, the depressive symptoms were associated with other sleep disorders. In this way, these findings point to potential social and economic burdens associated with the co-occurrence of depressive symptomatology and multiple sleep diagnoses.
Support (If Any): FAPESP, CEPID, CNPq and AFIP.

0951

SLEEP DURATION AND THE ETIOLOGY OF DEPRESSIVE SYMPTOMS: EVIDENCE FOR A GENE-ENVIRONMENT INTERACTION

Watson NF[1,2,3,4], Harden P[5], Buchwald D[6,3], Vitiello MV[7,4], Pack A[8,9], Goldberg J[10,3,11]

[1]Neurology, University of Washington, Seattle, WA, USA, [2]University of Washington Medicine Sleep Center, University of Washington, Seattle, WA, USA, [3]University of Washington Twin Registry, University of Washington, Seattle, WA, USA, [4]Center for Research on the Management of Sleep Disturbances, University of Washington, Seattle, WA, USA, [5]Psychology, University of Texas, Austin, TX, USA, [6]Medicine, University of Washington, Seattle, WA, USA, [7]Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, USA, [8]Division of Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, PA, USA, [9]Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [10]Epidemiology, University of Washington, Seattle, WA, USA, [11]Vietnam Era Twin Registry, VA Epidemiologic and Research and Information Center, Seattle, WA, USA

Introduction: Depression and insomnia are tightly linked, but what effect does sleep duration have on depressive symptoms? We utilized behavioral genetic interaction models to assess if sleep duration modifies genetic and environmental influences on depressive symptoms in monozygotic (MZ) and dizygotic (DZ) twins from the University of Washington Twin Registry.
Methods: Participants were 1788 twins from 894 same-sex twin pairs (192 MZ male pairs, 81 DZ male pairs, 412 MZ female pairs, and 209 DZ female pairs). The mean age of participants was 36.1 years (SD = 15.3). Participants reported on their habitual sleep duration (M = 7.2 hours, SD = 1.2), and rated their depressive symptoms on 3 items from the Patient Health Questionnaire-9 (sum scores M = 1.8, SD = 1.9). Data were analyzed using behavioral genetic interaction models, which allowed the magnitude of additive genetic, shared environmental, and non-shared environmental influences on depressive symptoms to vary with sleep duration.
Results: The heritability of sleep duration was 34%, and longer sleep duration was associated with fewer depressive symptoms. This association was due to a non-shared environmental pathway. Specifically, within MZ twin pairs, the twin who reported longer sleep duration reported fewer depressive symptoms ($\beta = -0.17$; SE = 0.06; $P < 0.05$). There was also evidence for a significant gene-by-sleep duration interaction effect on depressive symptoms ($\beta = 0.65$; SE = 0.06; $P < 0.05$). Among individuals with normal sleep duration (8 hours/night), genetic influences on depressive symptoms were minimal (heritability [h2] = 4%). However, among individuals with low (< 7 hours) or high (> 9 hours) sleep duration substantial genetic influences on depressive symptoms were observed, particularly at sleep duration extremes (5 hours/night, h2 = 49%; 9.5 hours/night, h2 = 39%).
Conclusion: Genetic contributions to depressive symptoms increase when sleep duration is both shorter and longer than normal. This suggests that both short and long sleep provides a permissive environment for the expression of genetic factors related to depressive symptoms.
Support (If Any): This study was supported by grants K23HL083350, P30NR011400, and a University of Washington General Clinical Research Center Pilot Grant.

0952

SLEEP DURATION AND ALCOHOL CONSUMPTION: RESULTS FROM A NATIONALLY-REPRESENTATIVE SAMPLE

Chakravorty S[1,2,3], Jackson NJ[3], Gehrman P[2,3,1], Perlis ML[2], Grandner MA[3,2]

[1]Psychiatry, Philadelphia VAMC, Philadelphia, PA, USA, [2]Behavioral Sleep Medicine/Psychiatry, Perelman School of Medicine, Philadelphia, PA, USA, [3]Sleep Medicine/Internal Medicine, Perelman School of Medicine, Philadelphia, PA, USA

Introduction: Short sleep duration is associated with adverse cardiometabolic and psychiatric outcomes. Preliminary data on short sleep duration and the intensity of drinking have shown conflicting results. Our aim for this study was to clarify the relationship between sleep duration and alcohol use, including in covariates, using a nationally-representative sample.
Methods: Data from the 2007-2008 NHANES were used. The relationship between sleep duration and alcohol-related indices were assessed in 2919 adults (≥18yrs) without a history of street drug use. Sleep duration was assessed with regression models continuously (linear) and categorically (multinomial) as Short(≤6hrs) or Long(>8hrs) versus Normal(7-8hrs). Standard alcohol-related variables evaluated included quantity, frequency of drinking and "Heavy" drinking ("At-Risk"/binge drinking, defined by the NIAAA as >4 drinks/day for men and >3 drinks/day for women under age 65, and >1 drink/day for adults >65 years old) in the past 12 months. All analyses were adjusted for covariates including socio-demographic, socioeconomic, health risk-related factors, and insomnia symptoms.
Results: Mean alcohol consumption was 1.25±2.28 drinks/day, with 51% reporting consumption of 1-3 drinks/day, and 10% reporting heavy drinking. Significant predictors of continuous sleep duration were heavy

drinking (β±SE = 0.20±0.09), drinks/day (β±SE = 0.05±0.05), and heavy drinking days (β±SE = 0.06±0.02). Short sleep duration was significantly predicted by the following variables: heavy drinking (Relative Risk Ratio [RRR] =0.72), drinks/day (RRR=0.93), and heavy drinking days (RRR=0.84). The association between sleep duration and the drinking measures was found to vary with depression, anxiety, marital status and race/ethnicity. No relationships for long sleep duration were found.
Conclusion: Alcohol use especially heavy drinking was associated with short sleep duration. This suggests that following cessation of heavy alcohol use, patients in recovery may expect an increase in the amount of time they are able to sleep. These unique findings have implications in the individualized management of sleep and alcohol use disorders.
Support (If Any): Funding Sources T32HL007713 (University of Pennsylvania), VISN-4 MIRECC Philadelphia VAMC.

0953

SLEEP AND SUICIDAL IDEATION AND/OR ATTEMPTS IN YOUNG CHILDREN: POOR SLEEP, HIGHER REM PERCENT SLEEP AND IMPULSIVITY ARE ASSOCIATED WITH INCREASED RISK OF SUICIDAL IDEATION AND/OR ATTEMPTS

Singareddy R[1], Vgontzas AN[1], Meyer R[2], Calhoun S[1], Fernandez-Mendoza J[1], Shaffer M[3], Bixler EO[1]
[1]Sleep Research & Treatment Center, Penn State College of Medicine, Hershey, PA, USA, [2]Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [3]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA

Introduction: Substantial literature in adults and adolescents documents significant association between sleep disturbances and suicidal ideation and/or attempts(SI/A). However, there is a paucity of studies exploring the association between sleep and SI/A in young children. We examined the association between subjective and objective sleep with SI/A and whether neurobehavioral factors explain the association between sleep disturbances and SI/A in young children.
Methods: A screening questionnaire was sent to parents of every student in 3 local school(K-5) districts(n=7,312) with a 78.5% response. Randomly selected children from this sample participated in Phase-II of the study, which consisted of comprehensive history, physical examination, several questionnaires, and 9-hour overnight polysomnogram. The presence of SI/A in the sample was defined as a parent report of "talks about harming or killing self" and/or "deliberately harms self or attempts suicide" in the past 2 months.
Results: Of the final sample of 693 children, 27 had SI/A and the rest did not (Non-SI/A). Children in the two groups did not differ in age, gender, percentile for BMI-for-age or socio economic status. Significantly more children in the SI/A group had difficulty initiating sleep, restless sleep, nightmares, and current behavioral or psychiatric disorders. Multiple logistic regression analysis showed that restless sleep was significantly associated with SI/A(OR=3.7;p=.016) independent of demographics and current behavioral or psychiatric disorders. Percent of REM sleep was significantly higher in those with SI/A, after adjusting for demographic and current behavioral or psychiatric disorders. Among the subjects with SI/A, those with versus without restless sleep had significantly higher impulsivity T-scores after adjusting for demographics and current behavioral or psychiatric disorders.
Conclusion: These data indicate significant independent association between sleep disturbances and suicidal ideation/attempts in young children with impulsivity as a possible mediating neurobehavioral factor. Higher REM percentage sleep may be a potential biomarker for increased risk of suicidal ideation/attempts in young children.
Support (If Any): National Institutes of Health (R01 HL63772, RR010732, RR016499) American Foundation for Suicide Prevention (YIG-0-10-180).

0954

COMPARING THE NEURAL CORRELATES OF REM SLEEP IN POSTTRAUMATIC STRESS DISORDER AND DEPRESSION

Ebdlahad S[1], Milgrom O[1], James JA[2], Price J[2], Nofzinger E[1], Germain A[1]
[1]Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA, [2]Radiology, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Posttraumatic stress disorder (PTSD) and major depressive disorder (MDD) are two stress-related disorders associated with rapid eye movement (REM) sleep disturbances. We used [18F]-fluorodeoxyglucose positron emission tomography (FDG PET) to compare changes in relative cerebral metabolic rate of glucose (CMRglc) from wakefulness to REM sleep in adults with MDD or PTSD.
Methods: Twelve adults with MDD (mean age 34.0 ± 7.2; 9 women) and 13 veterans with PTSD (mean age 29.5 ± 6.4; 3 women) completed FDG PET studies during wakefulness and REM sleep. Whole-brain interaction analyses were conducted using Statistical Parametric Mapping (SPM8) to compare between-group changes in relative CMRglc from wakefulness to REM sleep. Between-group, within-state post-hoc analyses were conducted to decompose significant interactions.
Results: No group differences were found on polysomnographic measures. Participants with PTSD showed greater increases in relative CMRglc from wakefulness to REM sleep compared to MDD participants in two clusters (3758 voxels, Z=3.64, uncorrected p=0.013; and 3654 voxels; Z=3.47; uncorrected p=0.015), which included the right and left basal ganglia, amygdala, hippocampus, uncus, insula, parahippocampal gyrus, left fusiform and superior temporal gyri, and right anterior cingulate cortex, inferior temporal gyrus, and ventrolateral and orbital prefrontal cortex. However, post-hoc analyses revealed that MDD was associated with significantly greater relative CMRglc during both wakefulness and REM sleep compared to PTSD in these limbic and paralimbic regions.
Conclusion: Our findings suggest that PTSD is associated with greater increases in rCMRglc in limbic and paralimbic cortical regions from wakefulness to REM sleep, whereas MDD is associated with state-independent hypermetabolism in these areas. These preliminary findings suggest that observed REM sleep disturbances in PTSD and MDD may result from different neurobiological processes, and that treatment targets aiming to normalize REM sleep may differ between these two stress-related psychiatric disorders.
Support (If Any): This study was supported by the National Institute of Health (MH083035: Germain; MH061566: Nofzinger; ULRR024153: Reis) and the US Department of Defense Congressionally Directed Medical Research Program (PT073961; Germain).

0955

HIGH RESOLUTION DETECTION OF POLYSOMNOGRAPHY BASED PHASIC EVENTS OF REM SLEEP IN POSTTRAUMATIC STRESS DISORDER

Moore HE[1,2], Woodward SH[3], Mignot E[2]
[1]Electrical Engineering, Stanford University, Stanford, CA, USA, [2]Center for Sleep Science and Medicine, Stanford University, Stanford, CA, USA, [3]National Center for PTSD, Veteran Affairs Hospital, Menlo Park, CA, USA

Introduction: Sleep disturbances are a core component of post-traumatic stress disorder (PTSD); a unique anxiety disorder that develops when a person is unable or fails to recover from the stress induced by a specific traumatic event. Common symptoms of PTSD, such as nightmares, insomnia, and hyper-vigilance or hyper-arousal can aggravate and impose sleep problems, which may in turn perpetuate PTSD. Nocturnal polysomnography based-sleep studies involving PTSD have historically focused either on global power spectral analysis of the EEG or on sleep architecture changes. Our hypothesis is that an automated,

high-resolution analysis of ocular activity during REM sleep will reveal physiological characteristics unique to patients diagnosed with PTSD.
Methods: Sleep studies of 542 nocturnal polysomnographs from 64 Vietnam era combat veterans diagnosed with PTSD and 40 controls was investigated for phasic activity during REM. Three automated eye-movement detection algorithms were selected; two methods use relative thresholds, and one uses an absolute threshold for eye movement detections. The entire cohort of sleep studies was processed for phasic eye-movement activity during REM and compared with corresponding PTSD symptom severity diagnostics.
Results: Preliminary results show an increase in the average number (+24%,,+26%) and mean duration of eye movements (+26%, +36%) during REM between patients with PTSD versus controls when using relative threshold based detectors. A decrease in these measurements was found when absolute thresh holding was applied: eye movement count (-19%); duration (-10%). Increased REM activity was seen in both PTSD and controls over multiple sleep studies.
Conclusion: Phasic eye-movement activity during REM sleep differs in patients with PTSD versus. Phasic activity during sleep can provide useful insight into confounding difficulties of sleep problems and PTSD, however its insight is biased on the underlying methodology of the automated detector being used.
Support (If Any): HEM is supported through a Veteran Affair's continuing education scholarship (GI Bill).

0956

NEURAL CORRELATES OF NIGHTMARES IN COMBAT-EXPOSED MILITARY VETERANS WITH PTSD: AN FDG-PET STUDY

Milgrom O[1], James JA[2], Price J[2], Nofzinger E[1], Germain A[1]
[1]Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA, [2]Radiology, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Nightmares are the hallmark symptom of post-traumatic stress disorder (PTSD) and are considered to reflect dysregulation of the fear circuitry during REM sleep. In this study, we used [18F]-fluorodeoxyglucose positron emission tomography (18F-FDG PET) to assess the neural correlates of nightmares in combat-exposed military veterans with PTSD during REM sleep. We hypothesized that nightmare frequency (NF) would be positively correlated with relative regional cerebral metabolic rate of glucose (rCMRglc) in the amygdala and negatively correlated with relative rCMRglc in the medial prefrontal cortex.
Methods: Thirteen 18-45 year-old combat-exposed military veterans (3 women) who met diagnostic criteria for current PTSD completed a series of psychiatric and sleep assessments, including the Nightmare Frequency Questionnaire. All completed 18F-FDG PET studies during REM sleep. Region of interest (ROI) analyses were conducted using Statistical Parametric Mapping (SPM8) to assess the relationships between past-month estimates of nightmare frequency (NF) and relative rCMRglc during REM sleep in the amygdala and medial prefrontal cortex. The significance threshold was set at uncorrected $p < 0.05$.
Results: Mean NF was 6.28 per month (SD 7.36). ROI analyses revealed significant negative correlation between NF and relative rCMRglc during REM sleep bilaterally in regions of the mPFC (2,942 contiguous voxels; $Z = 4.48$, $p < 0.05$). No significant correlation was observed in the amygdala.
Conclusion: Consistent with our hypothesis, increased NF estimates were correlated with reduced relative rCMRglc in the medial prefrontal cortex during REM sleep in military veterans with PTSD. The expected positive correlation between NF and relative rCMRglc during REM sleep in the amygdala was not detected. These findings provide preliminary but partial support for the hypothesis that dysregulation of the fear circuitry contribute to nightmares in PTSD. Investigating the impacts of nightmare treatments on brain metabolism during REM sleep may further clarify the neural underpinnings of PTSD-related nightmares.
Support (If Any): This study was supported by the National Institute of Health (MH083035; Germain; ULRR-024153; Reis) and the US Department of Defense Congressionally Directed Medical Research Program (PT073961; Germain).

0957

THE EFFECTS OF PROLONGED EXPOSURE ON INSOMNIA AND NIGHTMARES IN PTSD

Drummond SP[1,2,4], Nappi CM[1,2], Salamat J[3], Straus LD[4,3], Anderson D[5,3]
[1]Psychology, VA San Diego Healthcare System, San Diego, CA, USA, [2]Psychiatry, University of California San Diego, San Diego, CA, USA, [3]Research, VA San Diego Healthcare System, San Diego, CA, USA, [4]Psychology, Joint Doctoral Program In Clinical Psychology, San Diego, CA, USA, [5]InterdisciplinaryScience, San Diego State University, San Diego, CA, USA

Introduction: Sleep difficulties (insomnia) and distressing dreams (nightmares) are ubiquitous in Posttraumatic Stress Disorders (PTSD). Recent studies examining the effects of treatments aimed specifically at these sleep disorders have found mixed results. No study has systematically examined whether evidence-based interventions for PTSD can effectively treat the sleep symptoms so common in the disorder.
Methods: Nineteen OEF/OIF Veterans (age=35.9±10.0years, 15M) participating in a clinical trial for PTSD completed a full protocol of Prolonged Exposure (PE), the gold-standard cognitive-behavioral treatment for PTSD (mean sessions=X, 2sessions/week). Starting at baseline (BL) prior to treatment and throughout PE, subjects completed daily sleep diaries and weekly self-report measures on sleep. At BL and post- PE (PPE), subjects wore an actigraph for 1 week. The Clinician Administered PTSD Scale (CAPS) was also administered at BL and PPE. Changes in diary (weekly averages) and self-report measures were examined with a repeated-measures ANOVA examining scores at BL, session5, session9, and PPE. Changes in actigraphy measures pre-post PE were assessed with paired samples t-test. Significance was assessed at $p<.05$.
Results: Subjects showed significant improvement in overall PTSD symptoms on the CAPS. ISI (BL=19.0±3.4, PPE=16.1±5.2) and PSQI (BL=15.2±2.8, PPE=12.2±2.5) also showed significant improvement. Diary data showed improvements in SL (BL=50.3±39min, PPE=26.1±15.9min), SE (BL=73.8±11.2%, PPE=84.6±8.2%), and nightmare frequency (BL6.6±4.1/week, PPE=3.8±4.5/wk), but not WASO (BL=71.0±47min, PPE=42.4±41.8min) or TST (BL=330.5±81.7min, PPE=362.6±87.4min). No actigraphy measure of sleep showed significant improvements following PE.
Conclusion: In these Veterans with PTSD, PE produced improvements in many self-report measures of sleep, despite no explicit focus on sleep in PE. However, every measure except SL remained in the clinical range, and actigraphy-defined objective sleep did not improve. These data suggest sleep remains clinically disrupted even following otherwise successful PE. Given mixed findings for sleep-focused treatments in PTSD as well, an approach addressing both daytime and nighttime symptoms may provide the best overall outcomes.
Support (If Any): National Institute for Nursing Research (1RC-1NR011728) VA San Diego Center for Excellence in Stress and Mental Health.

0958

SLEEP-RELATED BELIEFS AND PRACTICES IN DEPRESSED VERSUS NON-DEPRESSED ADULTS

Vergara A[1], Jackson NJ[1], Patel NP[2], Grandner MA[1]
[1]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Respiratory Specialists and Department of Medicine, Reading Hospital and Medical Center, Reading, PA, USA

Introduction: Depression has been linked to a number of maladaptive sleep behaviors. Further characterization of the habitual sleep-related

beliefs and practices among depressed adults may identify novel therapeutic targets.
Methods: The Sleep Practices and Attitudes Questionnaire (SPAQ) and Patient Health Questionnaire-9 (PHQ-9) were administered to n=124 adults in an online survey. The SPAQ contains 16 subscales: 1-SleepDuration, 2-SleepDebt, 3-SleepQuality, 4-Sleepiness/Tiredness, 5-CopingWithSleepiness, 6-CopingWithAcuteInsomnia, 7-CopingWithChronicInsomnia, 8-ActivitiesInBed, 9-SleepEnvironment, 10-Knowledge, 11-ImportanceOfSleep, 12-ImpactOnSleep, 13-ImpactOfSleep, 14-Self-Efficacy, 15-SleepAndHealth, and 16-SocialNorms. The PHQ-9 is a standard screening tool for depression. For the purposes of this analysis, individuals with a PHQ-9 score <6 (n=34,no depression) were compared to those >14 (n=36,moderate-severe depression). Wilcoxon Rank-Sum tests compared groups at the subscale and item levels. P-values were attenuated using the Holm-Bonferonni method to control Type-I error.
Results: At the subscale level, nominal differences (unadjusted $p<0.05$) between groups were found for the following subscales: 2-SleepDebt ($p=0.025$), 3-SleepQuality ($p=0.001$), 4-Sleepiness/Tiredness ($p=0.003$), 8-ActivitiesInBed ($p=0.0001$), 12-ImpactOnSleep ($p=0.0001$), and 14-SelfEfficacy ($p=0.045$). After adjustment, effects for subscales 3, 4, 8, and 12 remained. Within these subscales, at the item level, significant differences (p-values adjusted) were found such that depressed individuals reported more difficulty sleeping ($p<0.01$) and lower overall sleep quality ($p<0.01$); more morning tiredness ($p<0.01$) and feeling less refreshed in the morning ($p<0.01$); more worrying ($p<0.01$) and arguing ($p<0.05$) in bed; and greater impact on sleep from depression ($p<0.01$) and stress ($p<0.01$).
Conclusion: Overall, those with depression report more sleep disturbance and daytime impairment, consistent with previous findings, and relatively few differences in sleep-related practices and beliefs. Most prominently, stress and mood have a disproportionate impact on sleep. Future studies with larger, more generalizable samples may better elucidate the nature of differences in sleep-related practices and beliefs associated with depression.
Support (If Any): This work was supported by T32HL007713 and a pilot grant from the University of Pennsylvania CTSA(UL1RR024134). Also, we wish to thank the Centers for Disease Control and Prevention for collecting these data and making them available and the NHANES participants for providing data.

0959

I'M DEPRESSED AND I CAN'T SLEEP: THE RELATIONSHIP BETWEEN OBJECTIVE SLEEP PARAMETERS AND SUBJECTIVE SLEEP QUALITY IN DEPRESSED AND NONDEPRESSED COLLEGE-AGED ADULTS

Lillis TA[1], Hamilton N[1], Bowlin S[1], Pressman M[1], Karlson C[2], Stevens N[3], Olson C[1]
[1]Psychology, University of Kansas, Lawrence, KS, USA, [2]Psychology, University of Missippi Medical Center, Jackson, MS, USA, [3]Psychology, Behavioral Sciences, Rush University Medical Center, Chicago, IL, USA

Introduction: Although many people with depression report experiencing sleep problems, several studies of middle-aged adults have reported that depression may be more related to subjective rather than objective sleep parameters. The current study sought to extend this literature by evaluating sleep in a sample of college-aged adults and address two goals: 1) Test the hypothesis that in college-aged adults, depressed individuals would differ from nondepressed individuals in subjective (sleep diaries) but not objective sleep (actigraphy) and 2) Explore group differences between objective sleep parameters and perceived sleep quality.
Methods: A single night of actigraphy and sleep diary data were collected from 27 college-aged adults who had never met DSM-IV criteria for Major Depressive Disorder (MDD) (M Age=19.93 yrs, SD=2.66; 44.4% female) and 23 college-aged adults (M Age=19.52 yrs, SD=2.23; 65.2% female) who currently met DSM-IV criteria for MDD (diagnosed with SCID). Subjective sleep quality was measured by participants' morning rating of feeling "Refreshed," "Somewhat Refreshed," or "Fatigued" (1-3: higher numbers indicate lower sleep subjective sleep quality). Objective sleep parameter data [Time in Bed (TIB), Total Sleep Time (TST), Sleep Efficiency (SE), Sleep Onset Latency (SOL), Wake After Sleep Onset (WASO), number of Arousals] were gathered using actigraphy (Mini-Meter Actiwatch: 5 minute SOL, Low Arousal Threshold).
Results: MANOVA (controlling for age, gender, antidepressant use) indicated no between-group differences across objective sleep parameters (TIB, TST, SOL, WASO, SE, arousals: all p's >.05). However, depressed participants reported significantly worse sleep quality than nondepressed participants ($F=15.23$, $p<.01$). Zero order correlations showed that for depressed participants, higher sleep quality was correlated with longer TIB ($r= -.775$, $p<.01$), longer sleep duration ($r= -.578$, $p<.01$), more WASO ($r= -.490$, $p<.01$) and more arousals ($r= -.500$, $p<.01$) . However, for non-depressed participants, the only correlate of sleep quality was lower SE ($r=.509$, $p<.01$).
Conclusion: These results have treatment related implications, suggesting that depressed individuals may compensate for more arousals by remaining in bed longer and that their perception of sleep quality is driven by the opportunity for sleep. It may be that depressed participants are more sensitive to the effects sleep loss as it pertains to the loss of a sufficient window of time in which sleep could occur.

0960

CHRONIC SLEEP RESTRICTION: IMPACT ON DEPRESSIVE SYMPTOMS IN COLLEGE STUDENTS

Carter P[1], Schnyer DM[2], Trujillo L[2]
[1]School of Nursing, The University of Texas at Austin, Austin, TX, USA, [2]School of Psychology, The University of Texas at Austin, Austin, TX, USA

Introduction: Approximately 63% of college students do not get enough sleep. Chronic sleep restriction adversely affects school performance and mood regulation. This project followed college students over a full semester term and collected a combination of self-report and actigraph data in an attempt to describe the relationships between sleep and depressive symptoms and to observe changes over time.
Methods: We enrolled 28 students over Spring and Fall 2010. We placed actigraphs on the student's non-dominant wrist. Throughout the semester students kept a sleep log recording lights out, last time out of bed, naps, actigraph removal and reason. At semester mid-point actigraph data was downloaded, battery replaced, and reinitialized, and placed back on the student's wrist. PSQI and CESD reports were collected three times over the semester.
Results: Students were primarily Female (60 %) and an average age of 19.8 years (sd=2.5). CESD scores increased over time from 11.9 (sd=8) to13.6 (sd=11) and 15.3 (sd=11) by the end of the term. Interestingly, self reported sleep quality improved over time. Reported average PSQI scores were 8.08 (sd=2.9), 6.8 (sd=2.8), and 7.5 (sd=2.4) over the term. Quantitative sleep scores tell a different story. Students weeknight total sleep time averaged 410 minutes (sd=64) and 404 minutes (sd=61) for the first and second half of the semester. However, 50% of students reported weeknight sleep averages of <400 minutes. CESD scores were significantly correlated with self-reported daytime dysfunction ($r=0.48$; $p=0.01$) and total sleep time <400 minutes ($r=-0.769$; $p=0.01$).
Conclusion: College students are chronically sleep deprived due to self and environmentally imposed sleep restriction. This chronic sleep restriction is related to increased depressive symptoms; however, this relationship may be missed if only self report sleep measures are used. Students need to be taught to maximize their sleep opportunities to stave off negative emotional, physical, and academic consequences.

0961

REDUCED ACTIVITY DUE TO FATIGUE AND RUMINATION ABOUT FATIGUE MEDIATE THE RELATIONSHIP BETWEEN COMORBID INSOMNIA AND DEPRESSION

Zalai D[1], Harris AL[1], Shapiro CM[2,3], Carney CE[1]
[1]Psychology, Ryerson University, Toronto, ON, Canada, [2]Toronto Western Hospital, University Health Network, Toronto, ON, Canada, [3]Psychiatry, University of Toronto, Toronto, ON, Canada

Introduction: The reciprocal relationship between insomnia and depression is poorly understood. These conditions share substantial overlap; including sleep, cognitive, mood and fatigue complaints. Although we have successful treatments for both depression and insomnia, fatigue is a frequent residual complaint. Understanding how fatigue plays a role in the relationship between depression and insomnia may provide much needed answers to etiologic and treatment-refinement questions. This study examined whether fatigue, reducing activities due to fatigue, or ruminating about fatigue mediate the relationship between insomnia and depression.
Methods: Sixty-six participants (69 %female; M age = 41.5 SD = 11.8; range = 20-62 years old) enrolled a combined depression and insomnia treatment NIH-funded (5R01MH076856-05) trial completed pretreatment the Insomnia Severity Index, the Beck Depression Inventory (BDI-II), the Multidimensional Fatigue Inventory and a measure of rumination about the daytime symptoms of insomnia. BDI-II items relating to insomnia, fatigue, or energy loss were removed from the total BDI-II score. Bootstrapping (confidence level: 95, 10,000 resamples) tested for fatigue-related mediators of the relation between insomnia and depression.
Results: Insomnia and mood severity was mediated by reduced activities due to fatigue (Bias corrected confidence interval - BCCI = .0412 to .7745; standard error -SE = 1803) and ruminating about fatigue symptoms (BCCI = .1622 to .9884; SE = .2081). There was no evidence of mediation for general fatigue (BCCI: -.1737 to .4273; SE = .1419).
Conclusion: The relation between insomnia symptoms and depression symptoms is not merely accounted for by feeling fatigued; instead, the relationship is accounted for by a tendency to reduce activity levels when feeling tired and a tendency to ruminate on the daytime symptoms of fatigue. The findings point to the possibility of improved outcomes for those with these highly comorbid conditions if activity levels and rumination became treatment targets.

0962

MENTAL HEALTH HISTORY AND INSOMNIA SEVERITY

Segal AG[1,2], Barilla HE[1], Gehrman P[1], Findley J[1], Jackson NJ[3], Grandner MA[3], Perlis ML[1]
[1]Department of Psychiatry, University of Pennslvania, Philadelphia, PA, USA, [2]Psychology, Drexel University, Philadelphia, PA, USA, [3]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: The present analysis evaluates, in a continuous manner, how much sleep continuity disturbance and illness severity can be expected when the subject has an existing psychiatric diagnoses.
Methods: Participants with and without insomnia completed an online screening questionnaire. Of n=2911 respondents, n=2689 provided complete data, with 59% reporting insomnia. Daytime impairment was assessed in a binary fashion. Sleep latency (SL) and wake after sleep onset (WASO) were assessed as minutes/night and problematic nights/week, with the product used as a measure of severity. SL and WASO severity was summed for overall insomnia severity. Time in bed (TIB) and total sleep time (TST) were determined by self-report and computation. History of depression (n=1074), bipolar-disorder (n=180), anxiety-disorder (n=672), obsessive-compulsive-disorder (n=98), schizophrenia (n=20) and dementia (n=47) were assessed by self-report. Linear regression, with mental health variables as predictors, were adjusted for age, sex, race/ethnicity, and education.
Results: Depression history was associated with: greater SL (7.1mins), greater insomnia severity (50.9mins/wk), daytime complaint (19.6%), less TIB (0.2hrs); lower computed (23.5min) and self-reported TST (14min). History of bipolar-disorder was associated with greater: greater SL (17mins), WASO (11mins), insomnia severity (194.5mins/wk), and daytime complaint (9.4%); less computed TST (42.4mins). History of anxiety was associated with: greater SL (10mins), insomnia severity (86.9mins/wk), daytime complaint (13.1%); lower TIB (0.3hrs), and computed and self-reported TST (33.5mins and 20mins, respectively). History of dementia was associated with: greater WASO (15.3mins); less TIB (0.5hrs), and computed and self-reported TST (57.1mins and 34.8mins, respectively). History of obsessive-compulsive-disorder and schizophrenia were not associated with any outcome. All reported effects were significant at the $p<.05$ level.
Conclusion: Overall, self-reported history of psychiatric illness was positively associated with insomnia severity, with differential effects for different diagnoses. Future studies should examine samples with better-characterized mental illness (e.g., validated measures), larger numbers for some groups (e.g., schizophrenia), and information regarding course (e.g., past/present).
Support (If Any): This work was supported by T32HL007713, 5R01AT003332, 5R01MH077900.

0963

DEPRESSION, ANXIETY, AND SLEEP PROBLEMS: THE MODERATING ROLE OF NARCISSISM

Haak E, Keller P, Coe J, Brown B, DeWall N
Psychology, University of Kentucky, Lexington, KY, USA

Introduction: Depression and anxiety are tied to sleep problems (Tsuno, Besset, & Richie, 2005). Understanding mediators and moderators of associations between mood disturbances and sleep is a critical step for research. One potential moderator is narcissism. Research suggests that difficult personality types (e.g., neurotic) or disorders (e.g., borderline) are linked to poor sleep in adulthood (Gray & Watson, 2002; Lindberg et al., 2003; Philipsen et al., 2005). However, there are no known studies of narcissism and sleep. We propose that the comorbidity of narcissism and mood disturbance will be most strongly associated with poor sleep.
Methods: Participants were 160 undergraduate couples (aged 18 to 24 years) participating for course credit. Participants' sleep was monitored via actigraphy for 7 nights. Average sleep minutes per night, sleep efficiency, physical activity during sleep, and sleep latency were derived. Participants completed trait measures of narcissism, fear of negative evaluation, and depression. Data were analyzed using multiple regression.
Results: Significant interactions with narcissism were found only for women. When narcissism was high, there was an association between depression and fewer sleep minutes, fear of negative evaluation and lower sleep efficiency, and fear of negative evaluation and greater sleep activity. Interestingly, when narcissism was lower, there was an association between fear of negative evaluation and lower sleep activity.
Conclusion: Results support the hypothesis that comorbidity between narcissism and mood disturbance is especially disruptive for sleep, but only for women. This may be due to the increased prevalence of depression and anxiety in women. Comorbid narcissism, depression or anxiety may represent a subgroup of narcissists known as "vulnerable" narcissists (Dickinson & Pincus, 2003). These persons have a strong desire to present a grandiose persona to others, but are plagued by doubts about their self-worth. The doubts may interfere with restful sleep through rumination or intrusive thoughts.

0964

CIRCADIAN MISALIGNMENT IN MAJOR DEPRESSION

Emens J[1], Powell L[2], Lewy A[1]
[1]Psychiatry, Oregon Health & Science Univ, Portland, OR, USA, [2]Clinical and Translational Research Center, Oregon Health & Science University, Portland, OR, USA

Introduction: The hypothalamic circadian pacemaker (biological clock) has been hypothesized to play a role in major depressive disorder (MDD) and we recently demonstrated that a misalignment between the timing of sleep and the clock correlates with symptom severity in patients with MDD: the more delayed the clock relative to sleep, the worse the symptoms (Emens et al., Psychiatry Research, 2009). We sought to replicate these results while addressing the potential confound of antidepressant medication.
Methods: Subjects (8 female, 4 male, 21-64 years old) who had MDD, scored 7 or greater on the 21-Item Hamilton Depression scale (HAM-D), were not actively suicidal, and in good general health were studied. Following a 2 or 4 week antidepressant medication washout subjects received (single blind) one week of placebo followed by 8 weeks of the SSRI antidepressant medication escitalopram (10 mg daily for 2 weeks, then 20 mg daily for 6 weeks). Sleep was assessed with sleep diaries and wrist actigraphy. Two assessments of circadian phase were made (end of the placebo and final treatment weeks): blood and/or saliva were collected every 30 minutes for 7 hours in dim light (<10 lux). Melatonin concentrations were measured by RIA (ALPCO) and the plasma or salivary dim light melatonin onsets (DLMOs) were assessed using a 10 or 3 pg/ml threshold, respectively. Circadian misalignment was defined as the time interval between the DLMO and average midsleep during the prior week (phase angle difference, PAD).
Results: Depression severity (HAM-D) showed a correlation with PAD on placebo ($r_s = 0.30$, $p = 0.18$) and escitalopram ($r_s = 0.43$, $p = 0.17$) very similar to the previous data set: the more phase-delayed, the more severe the symptoms with similar slopes (change in HAM-D score per hour change in PAD) on placebo (2.4 points/hour) and escitalopram (1.8 points/hour) when compared to the original data set (1.7 points/hour). There was a correlation between the change in PAD and change in HAM-D between the two assessments ($r_s = 0.70$, $p = 0.04$): greater reductions in depression severity were associated with greater phase advances (increases in PAD).
Conclusion: There may be a component of circadian misalignment that contributes to symptom severity in non-seasonal MDD. Correction of circadian misalignment in MDD with circadian resetting agents such as light or melatonin may improve symptoms in MDD.
Support (If Any): Investigator Initiated Trial from Forest Laboratories (to JSE) and UL1 RR024120 (to OHSU).

0965

SLEEP FRAGMENTATION IN MAJOR DEPRESSION: DETECTION AND QUANTIFICATION WITH AN ELECTROCARDIOGRAM-BASED SPECTROGRAM METHOD

Yang A[1,2], Peng C[3], Thomas RJ[4]
[1]Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan, [2]Center for Dynamical Biomarkers and Translational Medicine, National Central University, Chungli, Taiwan, [3]Margret and H. A. Rey Institute for Nonlinear Dynamics in Medicine, Beth Israel Deaconess Medical Center/Harvard Medical School, Boston, MA, USA, [4]Division of Pulmonary, Critical Care and Sleep, Beth Israel Deaconess Medical Center/Harvard Medical School, Boston, MA, USA

Introduction: Depressed patients often have difficulty maintaining sleep continuity, which may result in a perception of poor sleep quality and quantity. A new method to estimate sleep physiology, the electrocardiogram (ECG)-derived sleep spectrogram, is based on analysis of cardiopulmonary coupling (CPC) during sleep, and provides automated measures of sleep stability. This study evaluated the utility of this ECG-based sleep spectrogram approach to quantify the fragmentation of physiologic sleep state in patients with major depression.
Methods: 100 adult Chinese-Han depressed patients (50 unmedicated and 50 medicated with hypnotics) and 91 healthy control subjects participated in this study. Depressive symptoms were assessed by the Beck Depression Inventory (BDI) and the Hamilton Depression Rating Scale (HAM-D). Sleep was assessed by the Pittsburgh Sleep Quality Index (PSQI) and sleepiness by the Epworth Sleepiness Scales. Continuous ECG recordings were obtained during sleeping hours and analyzed using an ECG-derived spectrographic technique to derive a sleep fragmentation index.
Results: ECG-based sleep state transitions showed increased sleep fragmentation in unmedicated patients that was not fully restored by hypnotics in medicated patients. Sleep fragmentation index was correlated significantly to HAM-D ($r=0.41$), BDI scores ($r=0.30$), and insomnia component of BDI (item#16) ($r=0.40$). The receiver operating characteristic analysis indicated that the sleep fragmentation index had the highest area under curve (0.833) among other objective sleep indices to differentiate unmedicated depression from healthy controls, compared to 0.913 for PSQI.
Conclusion: Findings based on ECG-based sleep spectrograms suggest that depressed patient had increased sleep fragmentation and decreased sleep continuity, compared to control group. ECG-based sleep spectrograms may provide a simple, cost-efficient point-of-care method to evaluate sleep continuity in patients with major depressive disorder.

0966

IMPAIRED VISUOMOTOR LEARNING IN MAJOR DEPRESSIVE DISORDER: A HIGH-DENSITY EEG INVESTIGATION

Plante DT[1], Landsness EC[1], Goldstein MR[1], Sanchez J[1], Wanger TJ[1], Guokas JJ[1], Ghilardi MF[2], Tononi G[1], Benca R[1]
[1]Psychiatry, Univ of Wisconsin, Madison, WI, USA, [2]Physiology and Pharmacology, City University of New York Medical School, New York, NY, USA

Introduction: Sleep plays an important role in off-line memory consolidation in a variety of learning paradigms. Previous studies using a visuomotor rotation-learning task have demonstrated a local increase in slow wave activity (SWA) in the right parietal cortex, which correlates with post-sleep performance enhancement. Major depressive disorder (MDD) is associated with alterations in SWA, as well as decrements in memory consolidation during sleep. This study sought to utilize a motor adaptation task to examine sleep-dependent procedural memory consolidation in MDD compared to healthy controls.
Methods: After an adaptation night, 19 unipolar, unmedicated MDD subjects and 21 healthy control subjects underwent two separate sessions, where sleep was recorded with high-density EEG. Before and after sleep, subjects performed one of two well-characterized motor tasks, a motor control (MC) and a visuomotor adaptation (MA) task. In both, subjects reached for targets that randomly appeared on a computer screen. In MA, subjects adapted their movements to 60° visual rotation in incremental steps of 10°. SWA (1-4.5 Hz, normalized to the power in all channels) during sleep was determined using spectral analysis. Learning rate and post-sleep improvement were computed for all subjects and Pearson's correlations between right parietal SWA values and retention of learning were performed.
Results: In the evening before sleep, MDD had lower learning rates on MA compared to controls (14.5±4.4% vs. 19.3±4.3%; $p<0.05$). Post-sleep improvement was lower in MDD than in controls (6.88±4.2% vs.12.8±3.2%, $p<0.05$). Increases in all night right parietal SWA from MC to MA nights correlated with post-sleep retention index in controls ($r=0.62$, $p<0.05$). However, there was no similar correlation between sleep SWA and post-sleep retention observed in MDD subjects.

Conclusion: We found that in a visuomotor adaptation task, subjects with MDD have a lower rate of learning and post-sleep retention of learning compared to controls. Further research is warranted to determine whether decrements in visuomotor learning occur in other forms of affective illness.
Support (If Any): This research was funded by the National Institute of Mental Health (5P20MH077967 to GT and RB, and F30MH082601 to EL).

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NEUROCOGNITIVE PERFORMANCE IN ADULTS WITH MAJOR DEPRESSIVE DISORDER AFTER REPEATED PARTIAL SLEEP DEPRIVATION

Arnedt J, Swanson L, Bertram H, Mooney A, Dopp R, Hoffmann RF, Armitage R
Psychiatry, Univ Michigan, Ann Arbor, MI, USA

Introduction: Repeated partial sleep deprivation reliably induces performance impairments, but studies are restricted to healthy controls. We compared neurocognitive performance in adults with depression randomized to two weeks of 6 or 8 hours time in bed (TIB) while starting antidepressant therapy.
Methods: Forty-one adults meeting DSM-IV criteria for major depressive disorder (25.6 ± 6.8 years of age, 26 women, baseline HAMD-17 score 20.2 ± 2.5) received 8 weeks of fluoxetine 20-40 mg and were randomized to 6 or 8 hours TIB for the first two weeks. Subjects in the 6-hour TIB condition delayed bedtime (early partial sleep deprivation, n=12) or advanced rise time (late partial sleep deprivation, n=14) by 2 hours. Subjects underwent in-lab polysomnography followed by neurocognitive testing at baseline, after one and 14 nights on the assigned TIB schedule, and after the first recovery night (8 hours TIB). Tests included the psychomotor vigilance test (PVT), Digit Symbol Substitution Task (DSST), and Serial Addition and Subtraction Task (SAST).
Results: Repeated-measures ANOVA indicated that DSST throughput performance was better and SAST completion times were faster after one night of 6-hours TIB, but performance deteriorated slightly on both tasks after 14 nights (ps<.05). PVT lapses increased for both TIB conditions after 14 nights (4.1 ± 6.3) compared to baseline (1.9 ± 3.4) and the first night (2.4 ± 3.3, p<.05). PVT reaction time increased more for women than men after 14 nights of 6-hours TIB (p<.05). PVT performance after recovery sleep improved in women, but remained stable or deteriorated slightly in men (p<.05).
Conclusion: Neurocognitive performance in adults with depression was worse on select outcomes after 14 nights of 6 hours compared to 8 hours TIB while beginning antidepressant therapy, but improved with recovery sleep. Performance impairment with sleep deprivation was greater in women and improved more than that seen in men.
Support (If Any): NIH R01 MH077690 (JT Arnedt) Acknowledgements: Neurobehavioral/cognitive tests programmed by Pulsar Informatics Inc. (Philadelphia PA).

0968

A THEORETICAL MODEL FOR UNDERSTANDING HOW INSOMNIA IS A RISK FACTOR FOR SUICIDAL IDEATION

Derreberry T, McDonough A, Batson N, Webster M, Joshi I, Farris S, Garza G, Boggs N, Ahmed M, McCall W
Dept Psychiatry and Behavioral Medicine, Wake Forest University Health Sciences, Winston-Salem, NC, USA

Introduction: Insomnia is a risk factor for suicide, however, a model to explain the link between the intensity of insomnia and suicidal ideation has yet to be developed. We postulate that the insomnia-suicide link is related to the well-described framework of hopelessness-suicide. Interestingly, hopelessness is a key dysfunctional cognition in dysfunctional beliefs about sleep. The primary aim of this study was to explore whether suicidal ideation in depressed insomniacs is related to dysfunctional beliefs and attitudes about sleep.
Methods: Adult patients with depressive disorders in various stages of care were assessed once each in a cross-sectional assessment with the PHQ-9, Insomnia Severity Index (ISI), Dysfunctional Beliefs and Attitudes about Sleep (DBAS), the Scale for Suicide Ideation (SSI) and Beck Hopelessness Scale (BHS). Patients with psychotic disorders, primary sleep disorders, or substance abuse were excluded.
Results: The sample includes 15 inpatients and 22 outpatients (mean age 55.6 ± 2.3, 78% women). The majority of our subjects (78%) were currently taking sedative-hypnotic drugs. The mean PHQ-9 score among our sample was 13.9 ± 1.24, with a SSI mean score of 4.8 ± 1.47. There was no correlation between BHS and DBAS (r=0.048 p=0.79). As we hypothesized, there was a positive correlation between the SSI and DBAS (r=0.49 p=0.0035). Multivariate analysis was overall significant (F=8.65, df=5, p= 0.0011) with independent contributions to the model of SSI made by DBAS (p=0.0034) and BHS (p=0.0172). When age and gender were included the model remained significant (F=4.29, df=4, p=0.0078).
Conclusion: This data supports the theory that dysfunctional beliefs and attitudes about sleep could be a mediating variable explaining the link between insomnia and suicide.

0969

META-ANALYSIS OF SLEEP DISTURBANCE AND SUICIDAL THOUGHTS AND BEHAVIORS

Pigeon WR[1,2,3], Pinquart M[4], Conner K[1,3]
[1]Center of Excellence for Suicide Prevention, Canandaigua VA Medical Center, Canandaigua, NY, USA, [2]Center for Integrated Healthcare, Syracuse VA Medical Center, Syracuse, NY, USA, [3]Department of Psychiatry, University of Rochester, Rochester, NY, USA, [4]Department of Psychology, Philipps University, Marburg, Germany

Introduction: The potential association of various sleep disturbances to suicidal thoughts and behaviours is the subject of several reviews and increasing clinical interest. The current meta-analysis was conducted to estimate the size of the association generally as well as between more specific relationships.
Methods: The electronic databases PubMed and OVID for years 1966-2011 were searched to identify candidate studies; the search was supplemented by cross-referencing from identified articles and reviews. Original studies reporting both insomnia and suicide outcomes were identified with 37 of 88 (42%) studies comprising 147,280 subjects selected for inclusion. Data were extracted by multiple independent observers and verified by a study author. The meta-anlysis was performed using random-effects models. The size of associations was calculated for all types of sleep disturbances and suicide outcomes combined and for more specific categories including nightmares, insomnia, and insomnia subtypes and suicidal ideation, suicide attempts, and suicide. Moderator effects were evaluated.
Results: Overall, sleep disturbance was significantly associated with an increased relative risk for suicidal ideation, suicide attempt, and suicide ranging from 1.92 (95% CI= 1.41-2.60) to a relative risk of 2.93 (95% CI= 2.50-3.42) in adjusted studies. Associations were smaller, but remained highly significant among unadjusted studies. Depression did not moderate the association between sleep and suicide variables.
Conclusion: This meta-analysis supports an association between sleep disturbance and suicidal thoughts and behaviors. Associations in general, and specific sleep disturbances including nightmares and insomnia, appear to represent a risk factor for suicidal thoughts and behaviour. This proposition is further bolstered by the result that depression did not show risk moderation.

0970

INSOMNIA, NIGHTMARES, AND SLEEP VARIABILITY AS PREDICTORS OF ACUTE SUICIDALITY IN A HIGH RISK YOUNG ADULT SAMPLE

Bernert RA[1], Joiner TE[2]
[1]School of Medicine, Department of Psychiatry & Behavioral Sciences, Stanford University, Palo Alto, CA, USA, [2]Department of Psychology, Florida State University, Tallahassee, FL, USA

Introduction: Suicide represents a global disease burden, accounting for 1 million deaths annually. Past reports suggest that insomnia, nightmares, and irregular sleep schedules present elevated risk for suicidal behaviors. However, a study has yet to compare the relative influence of specific sleep indices in the longitudinal prediction of acute suicidality.
Methods: Participants (71% female) included 49 undergraduates (aged 19-23), prescreened for active suicidality and a high risk for suicide. Subjects were assessed at baseline (T1) and one week (T2) using the Insomnia Severity Index (ISI), Disturbing Dreams and Nightmare Severity Index (DDNSI), Beck Scale for Suicide (BSS), and Beck Depression Inventory (BDI). Actigraphy for the same assessment period (T1-T2) was used to provide an objectively-measured index of sleep variabiity (SV; standard deviation of sleep onsets/offsets, summed).
Results: Mean statistics revealed clinically significant insomnia (57% with ISI scores > 14) and nightmares (36% with DDNSI scores > 10), and highly variable sleep timing (3h SV for onsets, 2.8h for offsets) among participants. Descriptive statistics revealed significant intercorrelations between SV and ISI (r=.35, p=.02), SV and DDNSI (r=.29, p=.04), but not between ISI and DDNSI (r=.24, p=.08). Hierarchical linear regressions, controlling for T1 BSS and BDI, indicated that all sleep variables individually predicted residual symptom increases in BSS at T2: ISI (P<.03, β=.24), DDNSI (P<.02,β=.20), and SV (P<.01, β=.34); however, comparing all indices of sleep within a single model, only SV predicted residual symptom increases in BSS at T2, as a non-significant trend (P=.055, β=.20).
Conclusion: Suicide is a preventable public health problem for which efficacious interventions remain scarce. Objective and subjective sleep problems appear common and interrelated as predictors of acute suicidal risk. Results suggest that stabilizing the sleep/wake schedule in insomnia and nightmare treatments may be clinically important as a future target in the study and prevention of suicide.
Support (If Any): This work was supported in part by NIH NRSA Postdoctoral Fellowship T32 MH019938-16; and NIH NRSA 1 F31 MH080470-02.

0971

INSOMNIA SYMPTOM CHANGES IN ADULTS WITH MAJOR DEPRESSIVE DISORDER TREATED WITH FLUOXETINE AND REPEATED PARTIAL SLEEP DEPRIVATION

Swanson L, Bertram H, Mooney A, Dopp R, Armitage R, Hoffmann RF, Arnedt J
Psychiatry, Univ Michigan, Ann Arbor, MI, USA

Introduction: Insomnia is commonly comorbid with major depressive disorder (MDD). We investigated insomnia symptoms in adults with MDD while starting fluoxetine. Participants were randomized to 14 nights of 6 hours time in bed (repeated partial sleep deprivation; rPSD) or 8 hours time in bed (no sleep deprivation; NSD).
Methods: Thirty-three adults meeting DSM-IV criteria for MDD (25±6 years old, 22 women, baseline HAMD score 20±6) participated. They received 8 weeks of open-label fluoxetine and were randomized rPSD or NSD for the first 14 nights, after which they resumed their preferred sleep schedule for the remaining six weeks. Participants completed the Insomnia Severity Index (ISI) at baseline and weeks 2, 4, and 8 of fluoxetine. Participants were classified by ISI score as follows: <8, no insomnia; 8-14, mild insomnia; >14, moderate to severe insomnia.
Results: Repeated measures ANOVA indicated that ISI scores increased during rPSD (9.2±6.6 to 11±5), but declined to 6.8±5.2 by week 8. By contrast, scores for NSD participants steadily declined from baseline (9.3±3.7) through week 8 (4.6±3.9); (F(3,29)=3.54, p=.027). Among those participants assigned to the rPSD group, there was a significant visit by baseline insomnia status interaction (F(6,34)=4.02, p=.004). Participants with no baseline insomnia reported an increase in insomnia symptoms with rPSD (4.2±2.1 to 9.4±4.5), whereas insomnia symptoms remained stable with in participants with mild insomnia at baseline (11.2±2.4 to 10.2±4.6). A reduction in insomnia symptoms with rPSD was evident in those with moderate to severe insomnia at baseline (20±3 to 16.5±3.9).
Conclusion: Sleep deprivation plus antidepressant therapy may worsen self-reported sleep for individuals with no pre-treatment insomnia, but may improve sleep quality for those with moderate to severe insomnia symptoms at baseline. We are continuing to explore how sleep changes relate to antidepressant treatment response.
Support (If Any): NIH R01 MH077690 (JT Arnedt).

0972

FLUOXETINE EFFECTS ON QUANTITATIVE EEG IN MEN AND WOMEN WITH MAJOR DEPRESSIVE DISORDER

Arnedt J, Swanson L, Bertram H, Mooney A, Dopp R, Hoffmann RF, Armitage R
Psychiatry, Univ Michigan, Ann Arbor, MI, USA

Introduction: Fluoxetine adversely affects objectively measured sleep in individuals with major depressive disorder (MDD), but no study has evaluated whether fluoxetine produces sex differences in quantitative EEG measures. We evaluated quantitative EEG with polysomnography in men and women with MDD before and after 8 weeks of antidepressant therapy.
Methods: Twenty-eight adults meeting DSM-IV criteria for MDD (24.0 ± 4.5 years of age, 13 women, baseline HAMD-17 score 20.0 ± 2.4) received 8 weeks of open-label fluoxetine 20-40 mg. Following an 8-hour at-home sleep schedule and screening, subjects underwent in-lab polysomnography before and after medication. Power spectral analyses were conducted on all 30-second artifact-free epochs and averaged across NREM and REM periods into 5 EEG frequency bands: delta (.5-3.9 Hz), theta (4-7.9 Hz), alpha (8-11.9 Hz), sigma (12-15.9 Hz), and beta (16-30 Hz). We examined sex differences in raw and relative power (frequency power/total power) separately in NREM and REM sleep using repeated measures ANOVA.
Results: Overall, women had higher total alpha and delta power in REM, while men had higher relative beta power in REM. After 8 weeks of fluoxetine, relative alpha power increased in REM in men (15.1% to 16.1%) but decreased slightly in women (16.3% to 15.9%, p<.06). No sex main effects or interactions were found for EEG frequencies in NREM sleep. Compared to baseline, NREM total (p<.01) and relative (p<.001) sigma power were higher, total theta power was lower (p<.004), whereas total (p<.007) and relative (p<.001) delta power were reduced after medication. By contrast, relative sigma power was elevated during REM after medication.
Conclusion: Eight weeks of fluoxetine increased high frequency EEG and decreased low frequency EEG, particularly during NREM sleep. Sex differences in fluoxetine effects were evident only for alpha power. We are exploring how these sleep changes relate to disease characteristics and treatment response.
Support (If Any): NIH R01 MH077690 (JT Arnedt).

0973

AN ELECTROCARDIOGRAM-BASED METHOD TO DETERMINE THE EFFECT OF BUPROPION ON SLEEP QUALITY IN PATIENTS WITH MAJOR DEPRESSION

Schramm P[1], Rao U[2], Poland RE[2]
[1]Clinical, AWP, Freiburg, Germany, [2]Psychiatry, Meharry Medical College, Nashville, TN, USA

Introduction: Depression as an independent risk factor for cardiovascular disease. Bupropion is an atypical antidepressant influencing both central and autonomic systems. The objective of this study was to determine if the effect of bupropion was measurable by polysomnography and cardiopulmonary coupling sleep variables.
Methods: The polysomnograms of 19 subjects with major depression were summarized and analyzed from a consecutive 2-night-2 session protocol. REM latency is defined as the time in minutes from sleep stage N2 having a minimum of three minutes duration followed by seven minutes of continuous N2 or deeper sleep to the first 3 minutes of stage REM. Two groups based on REM latency decrease (n=8) and increase (n=11) were identified. Baseline and bupropion night polysomnogram electrocardiograms were analyzed using cardiopulmonary coupling analysis. This technique uses heart rate variability and electrocardiogram's R-wave amplitude fluctuations associated with respiration to generate frequency maps. The algorithm categorizes sleep as "stable" (high frequency coupling, HFC, 0.1-0.4 Hz) and "unstable" (low frequency coupling, LFC, 0.1-0.01 Hz) independent of standard sleep stages. Wake and REM sleep exhibit very low frequency (VLFC, 0.0039 - 0.01 Hz) coupling.
Results: No significant differences were found among the polysomnogram variables between groups. On placebo night, the decrease REM latency group showed a statistical trend (p=0.073) for lower VLFC. Under bupropion conditions, the decrease REM latency group had significantly lower VLFC and higher HFC that approached statistical significance (p = 0.076). The groups showed a differential HFC response to bupropion. Moderate to strong correlations were found between polysomnogram and cardiopulmonary coupling variables under placebo conditions.
Conclusion: Cardiopulmonary coupling analysis detected changes in sleep quality following an acute administration of bupropion compared to polysomnogram measures. The operator-independent, automated measure of sleep physiology could have clinical utility in identifying major depressives likely to respond to antidepressant therapy.

0974

SLEEP RELATED BREATHING DISORDERS IN A SAMPLE OF PATIENTS WITH TREATMENT RESISTANT DEPRESSION REFERRED FOR ELECTROCONVULSIVE THERAPY

Fitzgerald CT[1], Hiett E[2], Buysse DJ[1], Altintas N[1], Aikman G[2]
[1]Pulmonary, University of Pittsburgh Medical Center, Little Rock, AR, USA, [2]Psychiatry, University of Arkansas for Medical Sciences, Little Rock, AR, USA

Introduction: Symptoms of Sleep Related Breathing Disorders (SRBDs) often overlap with symptoms of depression. Without extensive exploration of a patient's history it is possible that a SRBD could be diagnosed as Treatment Resistant Depression (TRD) and referred for Electroconvulsive Therapy (ECT). To date no study has reported on the prevalence of SRBD within this population.
Methods: Retrospective chart review of patients referred for ECT for TRD from January 1, 2008 to December 31, 2010 was undertaken (N=118, 23 females, 95 males, 91 white, 25 black, 2 other) at a Veteran's Hospital in Little Rock, Arkansas. Charts were searched for the words "apnea," "OSA," and "CPAP." Context was evaluated placing patients into categories of those without SRBDs, those suspected of SRBDs, or those with a known SRBD. Additional data regarding the patient's health status was collected. Logistic regression models were used to report on a variety of outcomes and odds ratios are presented.
Results: Average age was 54.5 ± 12. Average BMI was 30.3 ± 7.3. 36% had either a diagnosis of SRBD or were suspected of having a SRBD. Those with SRBD were more likely to have hypertension (9.4 CI 3-29.5), a BMI ≥30 (5.4 CI 2.2-13.5), and hyperlipidemia (4.2 CI 1.6-11.4). No significant odds ratios were found between SRBD and diabetes mellitus (2.2 CI .8-5.6), complaints of pain (2.4 CI .9-5.9) or headache (1.5 CI .6-3.8) in this study.
Conclusion: A diagnosis of SRBD should be considered in patients referred for ECT for TRD. BMI ≥30, presence of high blood pressure, and hyperlipidemia should all increase the suspicion for SRBD within this population. Important questions to address are whether patients with SRBD benefit from ECT, if they are at higher risk of complications from such procedures, and if optimization of SRBD treatment negates the need for ECT in this setting.

0975

DEPRESSION IN JAPANESE PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

Hori R, Sasanabe R, Maekubo A, Watanabe Y, Tokunaga Y, Mukai M, Shiomi T
Sleep Disorders Center, Aichi Medical University Hospital, Nagakute, Japan

Introduction: Psychological factors such as depression are well-known for affecting the onset and course of various physical diseases. Although some reports show patients with obstructive sleep apnea syndrome (OSAS) have atypical depression, there is discussion about the relationship between OSAS and depression that are closely related to cardiovascular diseases.
Methods: The subjects were consisted of 1376 male and 243 female patients, who were diagnosed with OSAS at our Sleep Disorders Center in Japan. To clarify relationship between OSAS and the complication of depression, and causes of the complication of depression, we conducted semi-structured interviews by using Hamilton Depression Rating Scale (HAM-D) before polysomnography.
Results: The incidences of complication of depression (on treatments of depression or with HAM-D score≧16) in OSAS patients were as follows: 6.8% of men and 11.9% of women. In male OSAS patients, HAM-D score related to Epworth sleepiness score (r=0.069, p=0.01), lowest SpO_2 (r=0.055, p<0.05), arousal index (r=-0.063, p<0.05), proportions of Stage (N1+N2) (r=0.075, p<0.01) and stage R (r=-0.076, p<0.01). In female OSAS patients, HAM-D score related to age (r=-0.127, p<0.05) and body mass index (BMI, r=0.151, p=0.02). There is no correlation between HAM-D score and AHI in both sexes. Stepwise multiple regression analysis was performed to estimate the magnitude of the association among the indices of sleeping condition (age, BMI, AHI, lowest SpO_2, arousal Index, the proportions of stage N3 and stage R) as independent variables and HAM-D score as a dependent variable. It showed that %REM (F=7.2, p<0.01) and arousal index (F=11.0, p<0.01) in male OSAS patients and BMI (F=5.25, p<0.05) in female OSAS patients were independent variables related to HAM-D score.
Conclusion: The complications of depression was more related to %REM and arousal index than to AHI in men, and was most related to BMI in women in Japanese OSAS patients.

0976

DOES SLEEPING TOO LITTLE MAKE YOU FEEL TOO MUCH? AN INVESTIGATION OF SLEEP DURATION AND EMOTION REACTIVITY IN INTER-EPISODE BIPOLAR DISORDER AND HEALTHY ADULTS

Soehner AM[1], Gruber J[2], Gershon A[3], Talbot LS[4], Eidelman P[5], Hairston IS[6], Harvey AG[1]

[1]Psychology, University of California, Berkeley, Berkeley, CA, USA, [2]Psychology, Yale, New Haven, CT, USA, [3]Psychiatry, Stanford, Palo Alto, CA, USA, [4]Psychiatry, University of California, San Francisco and San Francisco VA Medical Center, San Francisco, CA, USA, [5]San Francisco Bay Center for Cognitive Therapy, Oakland, CA, USA, [6]Psychiatry, University of Michigan, Ann Arbor, MI, USA

Introduction: Research in healthy adults has demonstrated that sleep loss is associated with heightened emotion reactivity. This relationship may be particularly important for individuals with bipolar disorder, a severe psychiatric disorder associated with both heightened emotion reactivity and sleep disturbance. The aim of the present study was to investigate whether shorter sleep duration predicts heightened emotion reactivity to standardized emotional stimuli in inter-episode bipolar disorder relative to healthy adults.

Methods: Participants included 27 adults with inter-episode bipolar disorder (BD) and 34 healthy adult controls (CTL). First, participants completed a sleep diary in the week preceding a laboratory visit; from which sleep duration (total sleep time, TST) was calculated. Second, participants viewed emotionally evocative (happy, sad) films in a laboratory. Self-reported positive (happy) and negative (sad) emotion reactivity to the films was calculated using a residualized change score. Hierarchical linear regressions tested whether diagnostic status moderated the effect of TST on subsequent emotion reactivity to the film stimuli.

Results: BD and CTL did not significantly differ in demographic characteristics, average TST, positive reactivity to the happy film or negative reactivity to the sad film. Shortened TST predicted heightened positive reactivity to the happy film (β=-0.301, $p<.05$) and heightened negative reactivity to the sad film (β=-0.358, $p<.01$). Across emotionally evocative films, diagnostic status did not moderate the relationship between TST and emotion reactivity.

Conclusion: Shortened TST in the prior week predicted heightened positive emotion reactivity to the happy stimuli and heightened negative emotion reactivity to the sad stimuli. Interestingly, diagnostic status did not moderate the relationship between TST and emotion reactivity. The present study indicates that shortened weekly TST intensifies emotion reactivity for both BD and CTL in emotionally evocative contexts.

Support (If Any): This project was supported by National Institute of Mental Health Grant R34MH080958 awarded to Allison G. Harvey and National Institute of Mental Health Grant T32MH089919-01A1 awarded to Adriane Soehner.

0977

TRAIT EMOTIONAL INTENSITY AND LABILITY ARE ASSOCIATED WITH SLEEP PROBLEMS IN INTER-EPISODE BIPOLAR I DISORDER

Soehner AM[1], Kanady JC[1], Lee J[1], Kaplan KA[1], Hein K[1], Li D[2], Harvey AG[1]

[1]Psychology, University of California, Berkeley, Berkeley, CA, USA, [2]Psychiatry, University of California, San Francisco, San Francisco, CA, USA

Introduction: It has been proposed that a bidirectional and mutually reinforcing relationship exists between disturbed sleep and mood. This relationship is particularly salient for individuals with bipolar disorder, who experience heightened emotional responding and high rates of sleep disturbance even between acute mood episodes. The aim of the present study was to investigate whether greater trait intensity and lability of inter-episode emotional reactions were associated with exacerbated sleep disturbance in inter-episode bipolar patients.

Methods: Forty-three adults with inter-episode bipolar I disorder and comorbid insomnia participated in the study. They kept one week of sleep diary and completed a questionnaire battery assessing two domains of trait inter-episode affective functioning: intensity of emotional responses (Affect Intensity Measure; AIM) and lability of emotional responses (Affective Lability Scale Short Form; ALS). From the sleep diary, the weekly average and variability of sleep characteristics were calculated. Spearman nonparametric inter-correlation analyses were conducted.

Results: Greater AIM positive affectivity (or serenity) was associated with more continuous sleep, specifically lower average wake after sleep onset (WASO; rho=-.399,p=.01) and higher weekly sleep efficiency (SE; rho=.330,p=.035). Higher AIM negative affect intensity was associated with a delayed sleep phase, or later average bedtimes (rho=.342, p=.029) and rise-times (rho=.374, p=.016). Participants scoring higher on the ALS depression-elation subscale tended to have more variable WASO duration (rho=.313, p=.049) and more a more variable number of nighttime awakenings (rho=.379, p=.016). Elevated scores on the ALS anger/irritability subscale correlated with more variable sleep onset latency (rho=.370, p=.019) and more variable SE (rho=.343, p=.03).

Conclusion: Certain trait affective characteristics were associated with sleep patterns in inter-episode bipolar participants. Better understanding how to regulate intense negative emotional reactions, promote low arousal positive affect, and stabilize emotional lability may be important pathways toward improving sleep in bipolar disorder. Conversely, chronic sleep disturbance could be maintaining these trait-like patterns in emotional responding between episodes for bipolar patients.

Support (If Any): This project was supported by National Institute of Mental Health Grant R34MH080958 awarded to Allison G. Harvey and National Institute of Mental Health Grant T32MH089919-01A1 awarded to Adriane Soehner.

0978

COMPARISON OF OBJECTIVE AND SUBJECTIVE ASSESSMENTS OF TOTAL SLEEP TIME IN BIPOLAR PATIENTS

Gonzalez R[1], Gibbs T[1], Tohen M[1], Suppes T[2]

[1]Psychiatry, University of Texas Health Science Center San Antonio, San Antonio, TX, USA, [2]Psychiatry, Stanford University School of Medicine, Palo Alto, CA, USA

Introduction: Sleep disturbance is believed to be a core feature of bipolar disorder (BD). To date there are a limited number of studies that compare subjective and objective measures of sleep in populations of subjects with mood disorders. The current study evaluated the relationship between subjective and objective measurements of sleep variables in a BD I population.

Methods: Thirty-nine BD subjects (type I) participated in this study. YMRS and IDS-30-C assessed the severity of manic and depressive symptoms , respectively. Subjects wore the actigraph device on their non-dominant wrist and maintained a sleep diary for seven consecutive days. Actigraphy data was sampled in 60s epochs. Total sleep time (TST) was calculated via the UCSD sleep algorithm. Differences between subjective and objective measures of sleep were calculated by the objective time measured minus the subjective time reported.

Results: Objective and subjective measures of TST were significantly correlated ($r = 0.5151$, $p = 0.0008$). Secondary analysis revealed that the overall mood state impact on discrepancy was $p = 0.04$. The severity of manic symptoms did not correlate with this discrepancy ($t = 0.03$, $p = 0.98$). The severity of depressive symptoms did correlate to this discrepancy ($t = 2.65$, $p = 0.01$).

Conclusion: The results of the current study support the notion that there is consistency in the estimation of total sleep time as measured objectively via actigraphy and subjectively via sleep diaries in BD patients.

We did note that mood symptomotology may impact the accuracy of TST reported. Sleep factors are common elements in the description and assessment of BD. The outcome of this study warrants further examination of the reliability of subjective assessment of sleep factors amongst a BD population in a clinical setting and should take mood symptoms into account.

Support (If Any): NARSAD Young Investigator Award; NIH #MH089868.

0979

THE RELATIONSHIP BETWEEN INSOMNIA AND COGNITIVE DYSFUNCTION IN BIPOLAR DISORDER

Kanady JC[1], Soehner AM[1], Lee J[1], Hein K[1], Tessier J[1], Li D[2], Harvey AG[1]

[1]Psychology, UC Berkeley, Berkeley, CA, USA, [2]Psychiatry, University of California, San Francisco, San Francisco, CA, USA

Introduction: Inter-episode bipolar disorder is characterized by cognitive dysfunction. This study aims to begin the process of determining if insomnia, also prevalent in inter-episode bipolar disorder, contributes to cognitive dysfunction in bipolar disorder.

Methods: Two groups of individuals diagnosed with bipolar disorder I, who were currently inter-episode were examined: the low sleep efficiency group (SE<85%: N=16, age=40.3±10.6, 11F, average SE=72.3%±10.2) and the high sleep efficiency group (SE≥85%: N=16, age=34.1±12.6, 11F, average SE=90.4%±3.4). Sleep efficiency was used as a composite insomnia index because it incorporates all complaints associated with insomnia (SOL, WASO, EMA), and a sleep efficiency of below 85% is a standard cutoff for disturbed sleep. Average sleep efficiency scores were calculated from sleep diaries completed the week prior to cognitive testing. Cognitive functioning was assessed using the n-back task. In previous research, deficits in n-back performance have been demonstrated separately for insomnia and inter-episode bipolar patients. Accuracy scores (#Hits - #False Positives) for the 0, 1, 2 and 3 back conditions were scored. Independent-samples t-tests examined differences in n-back load performance between the two groups.

Results: Relative to the high sleep efficiency group, the low sleep efficiency group performed significantly worse on the 0-back ($F=6.7$, $p=0.02$) and 1-back ($F=6.8$, $p=0.01$) conditions; they had significantly fewer hits and greater number of false positives. There were no significant differences in performance on the 2-back or 3-back conditions.

Conclusion: Compared to individuals with bipolar disorder and high sleep efficiency, individuals with bipolar disorder and low sleep efficiency performed significantly worse on tasks with low cognitive demands and that primarily assess attention. Our current interest is to examine the possibility that treating sleep disturbance may improve cognitive dysfunction in bipolar disorder.

Support (If Any): This project was supported by National Institute of Mental Health Grant R34MH080958 awarded to Allison G. Harvey and the National Science Foundation Graduate Research Fellowship awarded to Jennifer C. Kanady.

0980

SLEEP DISTURBANCE ACROSS THE LIFE COURSE IN BIPOLAR DISORDER

Kanady JC[1], Soehner AM[1], Lee J[1], Hein K[1], Li D[2], Harvey AG[1]

[1]Psychology, University of California, Berkeley, Berkeley, CA, USA, [2]Psychiatry, University of California, San Francisco, San Francisco, CA, USA

Introduction: Sleep disturbance is a prevalent and clinically significant feature of bipolar disorder. However, there are aspects of sleep and bipolar disorder that have been minimally characterized. This study aims to fill several of the key gaps in the literature by examining the course of sleep disturbance across bipolar disorder and the relationship between lifetime sleep disturbance and markers of illness severity.

Methods: Forty-nine euthymic bipolar I individuals (36.9±10.7yrs, 31F) were administered the NIMH-Life-Chart-Retrospective. The life chart is a validated and often utilized measure for recording retrospective aspects of bipolar disorder. The life chart was modified to include an assessment of comorbid sleep disturbance; including insomnia, hypersomnia, reduced sleep need, delayed sleep phase, and irregular sleep patterns. Correlations examined the relationship between the accumulation of lifetime and inter-episode sleep disturbance and markers of illness severity. Markers of illness severity included the number and severity of mood episodes, number of hospitalizations and current mood symptoms.

Results: Across the course of the disorder, manic months were primarily characterized by reduced sleep need (68%±37) and insomnia (25%±35), depressive months by insomnia (44%±43) and hypersomnia (44%±42), mixed months by insomnia (50%±49) and reduced sleep need (37%±45), and inter-episode months were primarily characterized by insomnia (60%±35). The accumulation of sleep disturbance significantly correlated with every marker of illness severity ($p\leq0.01$) except current manic symptoms and number of hospitalizations. The accumulation of inter-episode delayed sleep phase ($R=0.61$, $p\leq0.01$) and irregular sleep patterns ($R=0.50$, $p\leq0.01$) was the strongest correlate of number of mood episodes.

Conclusion: Sleep disturbance is a prevalent and problematic symptom across the lifespan in bipolar disorder. There is variation in the types of sleep disturbance experienced; however these disturbances are all modifiable. Current sleep treatments should be adapted for safe and effective use in bipolar disorder given the strong correlation between sleep disturbance and markers of illness severity.

Support (If Any): This project was supported by National Institute of Mental Health Grant R34MH080958 awarded to Allison G. Harvey and the National Science Foundation Graduate Research Fellowship awarded to Jennifer C. Kanady.

0981

THE ROLE OF SLEEP IN RESILIENCY AND MALADAPTIVE COGNITIVE-EMOTIONAL RESPONSE STYLES

Dolsen M[1], Cheng P[1], Casement M[1], Kim H[1], Goldschmied JR[1], Hoffmann RF[2], Armitage R[2], Deldin PJ[1]

[1]Psychology, University of Michigan, Ann Arbor, MI, USA, [2]Psychiatry, University of Michigan, Ann Arbor, MI, USA

Introduction: Resiliency allows individuals to adaptively respond to stressful life circumstances. Studies investigating brooding and maladaptive perfectionism have shown that these response styles reduce features of resiliency. Research has also demonstrated that resiliency is negatively affected by poor sleep quality, however, no studies have examined how sleep may account for the negative relationships between resiliency and maladaptive response styles. This study aims to first establish a relationship between resiliency and brooding and maladaptive perfectionism, and then investigate how sleep influences these relationships.

Methods: 17 individuals were recruited from the community, including college students and the general public. Half of the participants recruited experienced a varying degree of depression. Participants completed questionnaires measuring cognitive-emotional functioning and slept in the lab while different sleep measures were recorded. Participants also completed a number of self-report measures including the Ego-Resilience Scale (ER89), the Multidimensional Perfectionism Scale (MPS), the Performance Perfectionism Scale (PPS), and the Ruminative Response Scale (RRS).

Results: Bivariate correlations suggest a negative relationship between resiliency and maladaptive aspects of perfectionism ($r = -.62$, $p = .002$) and resiliency and brooding ($r = -.60$, $p = .003$). Partial correlations indicate that these relationships become non-significant after accounting for sleep efficiency (maladaptive perfectionism: $r = -.37$, n.s.; brooding: $r = -.484$, n.s.). A positive relationship was observed between resiliency and

adaptive perfectionism; however, this relationship remained significant after controlling for sleep efficiency (r = .50, p = .046).
Conclusion: Results indicate that sleep quality plays an important role in the relationship between resiliency and maladaptive aspects of perfectionism and brooding. Particularly, sleep efficiency seems most important for relationships involving maladaptive response styles, but less important for adaptive factors such as positive perfectionism. These findings may have potential implications for future research that focuses on how sleep is related to adaptive and maladaptive cognitive-emotional response styles.

0982

THE RELATIONSHIP BETWEEN SLEEP QUALITY, DAYTIME FUNCTIONING, AND PSYCHOPATHOLOGY

Thomas J[1], Lichstein KL[1], Taylor DJ[2], Riedel BW[3], Bush AJ[4]
[1]Psychology, University of Alabama, Tuscaloosa, AL, USA, [2]Psychology, University of North Texas, Denton, TX, USA, [3]University of Memphis, Memphis, TN, USA, [4]University of Tennessee, Memphis, Memphis, TN, USA

Introduction: Research supports a correlation between sleep quality, daytime functioning, and psychopathology. However, the exact nature of these relationships is unclear. The purpose of this study was to create a model of the relationship between the constructs of sleep quality, daytime functioning, and psychopathology through a variety of indicators.
Methods: Subjective questionnaires from an archival database were analyzed for 756 participants. Structural Equation Modeling was used to determine the relationship between three latent constructs and their indicators, as well as the predictive relationship between the latent constructs. Indicators of psychopathology included the Beck Depression Inventory, Second Edition and the State-Trait Anxiety Inventory, Trait Scale Form Y. Indicators of sleep quality included a number of subjective variables obtained from sleep diaries (i.e., sleep quality rating, sleep-onset latency, and wake after sleep onset). Lastly, indicators of daytime functioning included the Insomnia Impact Scale, Fatigue Severity Scale, and Epworth Sleepiness Scale.
Results: Good model fit was achieved with these latent constructs and their indicators. Latent regression indicated that sleep quality and psychopathology significantly predict daytime functioning, and that psychopathology is a stronger predictor of daytime functioning than sleep quality. Moderation and mediation analyses will be conducted.
Conclusion: Our model suggests that there is a significant relationship between sleep quality, daytime functioning, and psychopathology. Although these latent constructs are associated, psychopathology may be a stronger predictor of daytime functioning than sleep quality. Therefore, psychopathology should be assessed in patients with sleep and daytime functioning complaints, as treatment aimed at psychopathology may have a significant impact on daytime functioning.
Support (If Any): Research supported by National Institute on Aging grants AG12136 and AG14738.

0983

ANTI-NMDA RECEPTOR ANTIBODY POSITIVE SUBJECTS WITH VARIOUS PSYCHIATRIC AND SLEEP SYMPTOMS

Tsutsui K[1], Kanbayashi T[1], Tanaka K[2], Ito W[1], Boku S[3], Sagawa Y[4], Tokunaga J[1], Sato M[4], Shimizu T[1], Nishino S[4]
[1]Department of Neuropsychiatry, Akita University, Akita, Japan, [2]Department of Neurology, Kanazawa Medical University, Kanazawa, Japan, [3]Department of Neuropsychiatry, Hokkaido University, Sapporo, Japan, [4]Sleep and Circadian Neurobiology Laboratory, Stanford University, Palo Alto, CA, USA

Introduction: Recently, causative roles of encephalitis (EN) in major psychiatric features have been emphasized. These symptoms are often in young females with ovarian teratomas with good responses to tumor surgery and immunotherapy, and with autoantibodies to the NMDA receptor (NMDAR).
Methods: We have experienced 10 these patients (pts) with various psychiatric and sleep symptoms. These pts exhibited 3 distinct clinical pictures, and we believe that the report of our cases will bring further discussions on the autoimmune-mediated atypical psychosis.
Results: The first 3 cases had typical clinical pictures of anti-NMDAR EN, beginning with psychiatric symptoms, and then seizures and disturbances of consciousness occurring. In order to examine the specificity of the anti-NMDAR Ab involvements, we also examined the Ab in other psychotic pts with hypersomnia. Narcolepsy (NA) with severe psychosis was included, because auto-Ab (Ma2, AQP4) mediated mechanisms are suspected in some secondary NA cases.We found that 3 narcolepsy pts (among 5), who had severe psychotic symptoms, were positive for the Ab. These cases were hypocretin deficient, but no significant neurological signs were noted. They were under stimulant medications, and their symptoms were unchanged when the stimulants were withdrawn. Antipsychotics and modified electro-convulsion treatment (ECT) were required to manage the psychotic symptoms. In addition, we also found 4 Ab positive pts with schizophrenia or schizo-affective disorders among 51 pts examined. The neurological symptoms were mild in these cases, and mECT was effective for 3 cases.
Conclusion: Our results showed a high incidence of anti-NMDAR Ab positivity in a broader range of psychiatric disorders, including sleep and schizophrenia pts. Although the causative relationship between anti-NMDAR Ab positivity and psychiatric symptoms in these pts are not known, they exhibit unique demographic and clinical characteristics: Eight are female, and ovarian tumors are associated with 2 pts. Most of their symptoms are resistant to the pharmacological treatments, but responded relatively well to mECT.

0984

ORIGINAL RESEARCH: TREATING SLEEP DISORDERS HAS POSITIVE OUTCOMES IN PSYCHIATRIC ILLNESSES

Vyas UK
Sleep Disorders Center, Mayo Clinic Health System, Mankato, MN, USA

Introduction: Sleep is an essential physiological need; it is critical for our physical, mental and emotional well-being. Sleep is also important for optimal cognitive functioning and sleep disruption results in functional impairment. Psychiatric and sleep disorders are common and often co-morbid. Author hypothesized that treatment of sleep disorders improves outcomes in psychiatric illnesses.
Methods: Charts reviewed from October to December 2007 at VAMC, Milwaukee. Outcomes in patients with co-morbid psychiatric disorders were recorded at 6, 12 and 24 months after initiation of sleep disorder treatment. These patients received a baseline psychiatric status score of 0. Change in status at each subsequent time point was scored as: +2 (marked improvement), +1 (mild improvement), 0 (no change), -1 (mild worsening), or -2 (marked worsening). Change in average score for psychiatric disorders was compared individually at each time point to baseline using the signed rank test. Compliance was compared to sleep disorder treatment between patients with and without psychiatric disorders using Fisher's exact test. Difference in score changes at each time point to baseline was compared for a specific psychiatric disorder using Wilcoxon test.
Results: 127 charts reviewed, 54 patients (46.2%) had co-existing psychiatric and sleep disorder diagnoses. Psychiatric status progressively improved compared to baseline (Change in average score by +0.45, +0.56, and +0.79 at 6, 12, and 24 months, respectively, p<0.0001). There was no difference in provider documented compliance rate to sleep disorder treatment between patients with and without psychiatric disorders, (Fisher's p value 0.1031, 0.2290 and 0.2248 respectively). Wilcoxon test was used to find if there were significant differences in score change at each time point based on the presence of a specific psychiatric disorder.

Author found this was not statistically significant. This may be due to small number (N) for a specific psychiatric disorder; since most subjects had various co-existing psychiatric disorders. All statistical analysis was performed in SAS (Cary, NC).
Conclusion: Treatment of co-morbid sleep disorders was associated with significant improvement in psychiatric disorders. Psychiatric disorders did not affect compliance with sleep disorder treatment. No significant improvement observed for specific psychiatric disorder. There is a strong need for prospective studies with more subjects.

0985

DIAGNOSTIC SPECIFICITY OF SLEEP-DEPENDENT MEMORY IMPAIRMENTS IN PSYCHIATRIC INPATIENTS

Shinn AK[1,4], Masters G[1], Pfaff D[1], Cohen BM[1,4], Manoach D[2,4], Ongur D[1,4], Stickgold R[3,4]
[1]Psychiatry, McLean Hospital, Belmont, MA, USA, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital Charlestown Navy Yard, Charlestown, MA, USA, [3]Psychiatry, Beth Israel Deaconess Medical Center, Boston, MA, USA, [4]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Our group previously showed that patients with schizophrenia fail to demonstrate normal sleep-dependent improvement in procedural learning. In this study, we investigated whether this finding is specific to schizophrenia or reflects a more general characteristic of psychiatric inpatients on antipsychotic medications.
Methods: We studied men and women, ages 18-65 years, admitted to McLean Hospital and meeting the DSM-IV-TR diagnoses of schizophrenia or schizoaffective disorder, depressed type (SZ, n=21) and bipolar disorder (BP, n=26). Patients were on stable doses of antipsychotic medications. We excluded patients with sleep disorders other than insomnia, significant medical or neurological conditions, or acute substance intoxication or withdrawal. We administered a 12-min computerized finger tapping motor sequence task (MST) on two consecutive days approximately 24 hours apart. In each MST session, patients pressed four numeric keys on a keypad with the fingers of their left hand, repeating a five element tapping sequence (e.g., 4-1-3-2-4) "as quickly and as accurately as possible." Each session consisted of twelve 30s trials separated by 30s rest periods. Each 30s trial was scored for the number of completed sequences. Our primary outcome measure was overnight improvement, as measured by the change in mean MST scores from the last three trials on day 1 to the first three trials on day 2.
Results: BP patients showed significant overnight MST improvement (14.7%, p=0.0002), while SZ patients did not (6.5%, p=0.183). While the SZ patients had higher antipsychotic doses than the BP group as measured by chlorpromazine (CPZ) equivalents (294 vs. 203 mg daily), the difference was not statistically significant (p=0.063) and CPZ equivalents did not correlate with overnight improvement in either group.
Conclusion: Reduced sleep-dependent memory consolidation is specific to SZ and does not appear to simply be a side effect of antipsychotic medications.

0986

THE EFFECTS OF ACUPUNTURE ON SLEEP QUALITY AND EMOTIONAL MEASURES AMONG PSYCHIATRIC WARD INPATIENTS

Haimov I[1], Reshef A[2], Bloch B[2], Vadas L[1], Kremer I[2]
[1]Department of Psychology, The Max Stern Academic College of Emek Yezreel, Emek Yezreel, Israel, [2]Psychiatric Department, Ha'emek Medical Center, Afula, Israel

Introduction: Insomnia is the most common psychiatric sleep disorder. A growing number of studies have demonstrated that acupuncture has a positive impact on sleep disorders. Yet to the best of our knowledge, no research has examined the impact of acupuncture on hospitalized psychiatric patients. The present study examined the effect of acupuncture on sleep quality and emotional measures among psychiatric ward inpatients.
Methods: Study participants included twenty patients (mean age 42.8± 11.9: 8 males, 12 females) hospitalized in the psychiatric ward and exhibiting acute symptoms of schizophrenia, schizoaffective disorder or affective mood disorders. Participants were randomized into three groups: acupuncture therapy, music therapy and no treatment. Acupuncture therapy comprised 16 acupuncture sessions (four times a week for the duration of four weeks) given by a qualified therapist, and music therapy comprised 16 40-minute sessions during which participants listened to relaxing music. During the entire study period, patient sleep was continuously monitored with a wrist actigraph. Furthermore, at the beginning (no-treatment), middle and end of the study, patients completed a broad spectrum of questionnaires assessing emotional measures.
Results: The analysis revealed a decrease in sleep latency ($F[2,16] = 4.1$, $P < .036$), level of activity during sleep ($F[2,16] = 7.8$, $P < .004$) and depression ($F[2,9] = 6.9$, $P < .015$) over the study period for all three groups. Additionally, the analysis revealed a significant interaction between type of treatment and state anxiety ($F[2,16] = 5$, $P < .045$), indicating greater improvement in anxiety level following acupuncture treatment compared to no treatment.
Conclusion: The results suggest that among psychiatric inpatients acupuncture doesn't have a positive impact on sleep quality and depression; however, acupuncture appears to have a beneficial impact on state anxiety. This exploratory study was limited by the small and heterogeneous sample. Further research is needed to investigate this issue.

0987

LATE ADOLESCENTS WITH AN EVENING CHRONOTYPE DISPLAY BEHAVIORAL AND PSYCHOLOGICAL DYSREGULATION, SLEEP DISTURBANCE, AND ALTERED REWARD-RELATED BRAIN FUNCTION

Hasler BP[1], Shaw D[2], Sitnick S[2], Forbes E[1,2]
[1]Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA, [2]Psychology, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Evening chronotypes not only differ from morning-types in their sleep and circadian timing, but also in their degree of behavioral and psychological dysregulation. Evening-types are particularly prone to problematic outcomes involving reward function, including higher levels of affective disturbance, sensation seeking, and substance involvement, as well as other risk-taking behaviors. The present analyses explored the neural mechanisms underlying these chronotype differences by comparing reward-related brain function in late adolescent morning- and evening-types.
Methods: Chronotype was determined via the Composite Scale of Morningness. Using a monetary reward fMRI paradigm, we compared the neural response to reward in 13 morning-types and 21 evening-types (all 20 y/o males). Region of interest (ROI) analyses focused on the medial prefrontal cortex (mPFC) and ventral striatum, both of which are implicated in reward function. Two-sample t-tests compared the chronotype groups in these ROIs during reward anticipation vs. baseline and win outcome vs. baseline, using a threshold of $p<0.01$ and a minimum extent of 10 contiguous voxels. All analyses adjusted for time of scan. Chronotype groups were also compared on psychiatric diagnoses, various substance-related measures, and sleep quality (using the Pittsburgh Sleep Quality Index (PSQI)).
Results: Consistent with prior studies, evening-types showed a tendency towards more mood and substance use disorders, greater alcohol and drug involvement, and greater sleep disturbance, although these differences were only statistically significant on the Alcohol Dependence Scale ($t=-2.60, p=0.016$) and PSQI ($t=-2.97, p=0.007$). Furthermore, evening-types showed reduced mPFC reactivity and enhanced striatal reactivity relative to morning-types during both the anticipation and receipt of rewards (all $p<0.005$).

Conclusion: This preliminary data indicates that oft-noted increases in reward-related problems among evening-types are accompanied by altered neural responses to reward that are consistent with reduced regulatory control and elevated reward reactivity. Future studies should examine potential explanatory mechanisms for reward dysfunction among evening-types, such as social jet lag.
Support (If Any): This work was supported by grants from the National Institute of Drug Abuse (R01 DA026222) and the National Heart Lung Blood Institute (T32 HL082610).

0988

SLEEP AND MOOD IN ADOLESCENTS WITH BORDERLINE PERSONALITY DISORDER

Huynh C[1,2,3,4], Guilé J[1,3], Breton J[1,3,4], Godbout R[2,3,4]
[1]Mood Disorders Clinic, Rivière-des-Prairies Hospital, Montréal, QC, Canada, [2]Sleep Laboratory and Clinic, Rivière-des-Prairies Hospital, Montréal, QC, Canada, [3]Department of Psychiatry, Université de Montréal, Montréal, QC, Canada, [4]Centre de recherche Fernand-Seguin, Rivière-des-Prairies Hospital, Montréal, QC, Canada

Introduction: Borderline Personality Disorder (BPD) is characterized by emotional reactivity and extreme mood changes. There are a few published studies of sleep in adults with a BPD but none in adolescents. The aim of this study was two-fold: to characterize sleep patterns in BPD adolescents and to determine whether these characteristics were associated with dimensional measures of mood.
Methods: Fifteen euthymic BPD adolescents (13-17 years old; 13 girls/2 boys) wore an actigraph for at least nine days, including two weekends. They also completed self-reported questionnaires assessing mood instability (Affective Lability Scales), depressive status (Beck Depression Inventory II), impulsivity (Eysenck's Impulsiveness Questionnaire) and hostility (Buss-Durkee Hostility Inventory) on the first day of actigraphy recording. We compared actigraphy data from school/work days and schedule-free days with Mann-Whitney U Tests. The correlation between clinical scales and actigraphy data was estimated with the Spearman rank correlation coefficient.
Results: BPD adolescents showed a poor sleep efficiency (77.1 ± 6.7 %) and low amounts of sleep during school/work days (464 minutes per night) compared to published norms (i.e., 85 % and 540-600 minutes per night, respectively). Higher physical aggressiveness, verbal aggressiveness, and impulsivity were associated with, respectively, poorer sleep efficiency (r = 0.55), less total sleep time (r = 0.52), and less time spent immobile (r = 0.52). Frequency of mood swings (depression/elation) was correlated with more wake time after sleep onset (r = 0.54).
Conclusion: These results suggest that euthymic BPD adolescents experience lower sleep quality and quantity than normal youths. Poor sleep measures are associated with aggressiveness, impulsivity, and affective lability.
Support (If Any): Fonds de la recherche en santé du Québec, Opération Enfant Soleil Foundation, Les petits trésors de l'hôpital Rivière-des-Prairies Foundation, André Dédé Fortin Foundation, and Pfizer Foundation.

0989

PEEKING INTO THE MINDS OF TROUBLED ADOLESCENTS: THE UTILITY OF POLYSOMNOGRAPHY SLEEP STUDIES IN AN INPATIENT PSYCHIATRIC UNIT

Shahid A[1,2], Khairandish A[2], Gladanac B[2], Shapiro CM[2,1]
[1]Youthdale Treatment Centres, Toronto, ON, Canada, [2]Youthdale Child and Adolescent Sleep Centre, Toronto, ON, Canada

Introduction: Sleep problems are common features of psychiatric disorders and part of the primary diagnostic criteria for many affective and behavioral disorders. Evidence suggests sleep disturbances may precede development of psychiatric disorders and the severity of psychopathology reflects the severity of sleep problems. Well established in adults, polysomnography (PSG) sleep studies in child and adolescent psychiatric populations, a particularly at risk group, has been more elusive requiring further investigation.
Methods: We performed retrospective chart reviews of PSG sleep studies and psychiatrist evaluations of 106 adolescents aged 7-16 admitted to an involuntary adolescent psychiatric inpatient facility.
Results: More than 95% of cases had moderate to severe sleep problems. Hyperarousal hallmarked this population, and the prevalence of sleep disturbances trend with the severity of psychopathological states. Inpatients with mulitple psychiatric disorders had greater frequencies of insomnia, decreased sleep efficiency, and arousals form SWS ($p<0.05$). Inpatient's with self-harm behavior more frequently had elevated sleep onset latency (SOL), reduced efficiency, reduced SWS ($p<0.05$), increased REM, and reduced REM latency compared to inpatients with dysthymia and/or depression.
Conclusion: This study attests to the clinical utility of PSG sleep studies in the management of adolescent psychiatric disorders as well as contributes to the growing body of evidence reputing the intimate connection between sleep problems and the development and/or perpetuation of psychopathology. Medications were not controlled for, however, analysis indicates that associations were notwithstanding the fact that most patients were taking cocktails that "should" alleviate their sleep symptoms, suggesting greater associations may prevail in unmedicated populations.

0990

ASSOCIATION OF SOCIAL DESIRABILITY WITH SLEEP MEASURES AMONG BLACKS

Mahmud S[1], Bhunia N[1], Pandey A[1], Ceide ME[1,2], Nunes J[1,3], Casimir GJ[1,2], Zizi F[1], Jean-Louis G[1]
[1]Brooklyn Health Disparities Center, Department of Medicine, SUNY downstate, Brooklyn, NY, USA, [2]Psychiatry, SUNY Downstate Medical Center, Brooklyn, NY, USA, [3]Sophie Davis School of Biomedical Education, City University of New York, New York, NY, USA

Introduction: Despite a higher prevalence of sleep disturbance among blacks, they are less likely to report sleep complaints than individuals from other racial/ethnic groups. In this study, we examined whether the likelihood of reporting sleep-related problems are associated with degree of social desirability.
Methods: Data was obtained from a larger study (MetSO) investigating effects of OSA treatment among patients with metabolic syndrome in the primary-care setting. A total of 60 patients participated in face-to-face interviews providing both subjective and clinical data. Trained staff recorded reports of insomnia complaints, namely difficulty initiating sleep, difficulty maintaining sleep, excessive daytime sleepiness, and daytime napping. Social Desirability was measured using the 33-item Marlowe-Crowne Social Desirability Scale. Patients provided informed consent under the supervision of the IRB at SUNY Downstate Medical Center. Analyses were performed using SPSS 19.0.
Results: The mean age was 60.9 ± 13.8 years; 75% were female. Of the sample, 92.3% were diagnosed with hypertension, 58.9% with diabetes, 77.8% with dyslipidemia, and 88.2% were overweight/obese. The mean Social Desirability Score was 20.45 ± 4.45. The mean total sleep time was 5.65 ± 1.6 hours; 48.3% reported daytime sleepiness, 40.0% had difficulty falling asleep, 45% had difficulty staying asleep, and 40.0% took naps during the day. Univariate analysis showed that individuals reporting daytime napping had low social desirability scores (21.83 ± 4.93 vs. 19.00 ± 4.08; $t(48) = -2.220$, $p=0.031$).
Conclusion: Our findings suggest that blacks reporting daytime napping are characterized by lower levels of social desirability. Inadequate statistical power might explain why other sleep measures did not show significant differences. A sample size of 200 individuals would be required to detect true differences in the population. Future studies should

examine whether other sleep factors would be affected by level of social desirability.

Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092).

0991

AUTONOMIC CORRELATES OF ADVERSE CHILDHOOD EVENTS IN MILITARY VETERANS WITH PTSD SYMPTOMS

McDowell A, O'Donnell C, Hall MH, Rode N, Germain A
Medicine, Univsersity of Pittsburgh, Pittsburgh, PA, USA

Introduction: Adverse childhood events (ACEs) have been linked to sleep disturbance disorders. However, little is known about the impact of ACEs on cardiac autonomic tone during sleep. Given the adverse effects of autonomic dysregulation on mental and physical health outcomes, we explored the relationships between self-reported ACEs and vagal tone during NREM (N2 and N3) and REM sleep in combat-exposed male veterans with post traumatic stress symptoms, as determined by the Clinician Administered PTSD Scale (CAPS).

Methods: The Trauma History Questionnaire (THQ) was used to determine the frequency of ACEs. Male military veterans slept in the laboratory, and heart rate was collected. HR variability (HRV) analyses were conducted and relative high frequency indexed vagal tone. Participants who reported no ACEs (THQ = 0; N = 43) were compared to those who reported 1 or more ACEs (n = 27). Mean age did not differ between groups (34.8+10.4 and 39.5+15.1 years, respectively).

Results: After adjusting for age and PTSD symptom severity, vagal tone during NREM sleep was higher in veterans with ACEs compared to those without ACEs ($F(1, 69)=4.95$, $p < 0.05$). No such relationship was observed during REM sleep.

Conclusion: ACEs were significantly associated with increased vagal tone during NREM sleep, beyond the effects of PTSD symptoms. These results appear counter-intuitive. However, it is plausible that ACEs during critical developmental periods may reset cardiac autonomic tone via a compensatory response. Longitudinal studies are needed to determine the course of autonomic changes relative to ACEs and adult psychopathology.

Support (If Any): This study was supported by the National Institute of Health (MH083035 & MH080696; Germain; ULRR-024153; Reis) and the US Department of Defense Congressionally Directed Medical Research Program (PR054093 & PT073961; Germain).

0992

ISOLATED SLEEP PARALYSIS (ISP) AND CHRONIC POSTTRAUMATIC STRESS DISORDER (PTSD): POSSIBLE MANIFESTATION OF AUTONOMIC NERVOUS SYSTEM (ANS) DYSREGULATION AND REGULATORY EFFECT OF SLEEP ON HIGH SYMPATHETIC TONE DURING WAKEFULNESS

Gupta MA
Psychiatry, University of Western Ontario, London, ON, Canada

Introduction: Most studies on ISP have used a cross-sectional or case-control design to study the prevalence and phenomenology of ISP, and report rates ranging from 2.2% to >50% among non-clinical and clinical samples. Higher rates of ISP have been reported in sexual abuse, depression, anxiety disorders eg., panic disorder and PTSD, dissociation and hypertension especially among African Americans. This naturalistic, prospective study, reports ISP-related findings among patients with chronic PTSD versus controls.

Methods: 20 consecutive patients [all female, mean(sd) age: 45.6 (6.2) years, 18 white] with chronic PTSD (DSMIV-TR) and 20 age and sex matched controls with DSMIV-TR diagnosis of Major Depressive Disorder or Bipolar II Disorder underwent a detailed sleep evaluation. The patients were followed up prospectively over a period of 1 to 7 years and clinically monitored for sleep-related complaints including ISP.

Results: 17(85%) of PTSD patients versus 1(5%)of controls reported a past or current history of ISP. All PTSD patients with ISP had a history of complex childhood trauma ie., histories of severe ongoing sexual and emotional abuse/or neglect. 30% of PTSD patients versus 0% of controls had fibromyalgia and/or chronic idiopathic urticaria, which can both be associated with ANS dysregulation. 2 out of 3 PTSD patients with no ISP had PTSD after a motor vehicle accident or assault at work during adulthood; there was no history of trauma among the controls. Over the course of treatment, there was high correlation between exacerbations of ISP and psychosocial stressors, which were not related to the original trauma, eg., examinations or stresses with finances. Clinically, a decrease in the frequency and intensity of sleep paralysis was noticed with mood stabilizers eg., lithium carbonate, lamotrigine and divalproex.

Conclusion: The results suggest that ISP may be a symptom of ANS instability and hyperreactivity which are core features of anxiety disorders such as PTSD and panic disorder. It is noteworthy that hyperreactivity of the ANS is also a factor in essential hypertension. It is possible that ISP is a reflection of a dysregulation in the fluctuations between sympathetic and parasympathetic influences during REM, paralleling the high autonomic dysregulation in PTSD during wakefulness. Alternately, ISP may be an indication of excessive parasympathetic tone during REM as the organism tries to compensate (or perhaps overcompensate) for the increased sympathetic tone during wakefulness.

0993

SLEEP DISTURBANCE AS A RISK FACTOR FOR SUICIDAL IDEATION IN VETERANS

Bishop TM[1,2], Pigeon WR[3], Possemato K[1], Bruder TM[1]
[1]Center for Integrated Healthcare, Syracuse VAMC, Syracuse, NY, USA, [2]Psychology, Syracuse University, Syracuse, NY, USA, [3]Center of Excellence for Suicide Prevention, Canandaigua VAMC, Canandaigua, NY, USA

Introduction: Suicide rates are elevated among Veterans. Both depression and alcohol misuse are recognized risk-factors for suicide and each is associated with sleep disturbance. Sleep disturbances, whether operationalized as general complaints, specific symptoms, or full diagnostic entities, are associated with suicidal thoughts and behaviors. Whether the sleep-suicide association is simply a proxy for the relationship of established suicide risk factors is the focus of this study in a Veteran sample.

Methods: Data were obtained from telephone-based assessments of 654 Veterans (95% male; mean age 57.1 [16.6]) conducted by the VA Behavioral Health Assessment Center. Sleep disturbance was measured using the PTSD Checklist sleep item, in which trouble falling or staying asleep during the past month is rated on a 1-5 scale. Suicidal ideation (SI) was defined as scoring moderate or greater on the Paykel Suicide Scale. Depression status was measured by the PHQ-9 and alcohol dependence by the AUDIT-C. The relationship of sleep disturbance to SI was assessed in a multiple regression analysis controlling for age, gender, alcohol dependence, and depression. Step 1 included the variables of age and gender. Step 2 consisted of sleep disturbance, alcohol dependence and depression.

Results: The regression analysis revealed that patient report of disrupted sleep is a significant predictor of moderate to severe suicidal ideation ($\beta=.112$, $p<.01$) when controlling for the influences of age, gender, current alcohol use disorder and depressive disorder.

Conclusion: The primary finding of this study is that poor sleep is independently associated with SI. The study is limited to Veterans, does not assess suicidal behaviors, and is cross-sectional. Nonetheless, the findings suggest that the relationship of sleep disturbance to SI is not solely due to its association with comorbid mental health disorders. Accordingly, this may warrant the inclusion of sleep disturbance as a risk criterion during patient safety assessment and as a possible treatment target in suicide prevention efforts.

0994

SUBJECTIVELY AND OBJECTIVELY MEASURED SLEEP WITH AND WITHOUT POSTTRAUMATIC STRESS DISORDER AND TRAUMA EXPOSURE

Kobayashi I[1], Huntley E[2,3], Lavela J[1], Mellman T[1]
[1]Psychiatry, Howard University, Washington, DC, USA, [2]Psychology, American University, Washington, DC, USA, [3]Institute for Human Adjustment, University Of Michigan, Ann Arbor, MI, USA

Introduction: Reports of sleep disturbances are common among individuals with posttraumatic stress disorder (PTSD). Polysomnographic (PSG) studies, however, have been inconsistent in documenting abnormalities leading some investigators to suggest "sleep state misperception" in PTSD. Our study objectives were to compare objectively and subjectively measured sleep parameters in the lab and at home in civilians with and without trauma exposure and PTSD.
Methods: 103 urban-residing African Americans with and without trauma exposure and PTSD who participated in a larger study completed lab PSG and home actigraphy. A sleep diary was completed in the morning after PSG and actigraphy recordings. Habitual sleep during the month prior to the participation was assessed using a sleep questionnaire. The Clinician Administered PTSD Scale was administered to assess participants' trauma exposure and PTSD status. We analyzed sleep parameters [total sleep time (TST), sleep onset latency (SOL), and wake after sleep onset (WASO)] using 2 (objective vs. subjective sleep measures) x 4 (Current PTSD vs. Lifetime PTSD vs. Trauma-positive without PTSD vs. Trauma-negative) mixed ANCOVAs with sleep measures as the repeated measure.
Results: Participants, regardless of trauma/PTSD status, underestimated WASO in the diary and questionnaire relative to actigraphy ($F = 81.3$, $p < .001$; $F = 13.4$, $p < .001$, respectively) and overestimated SOL in the diary relative to PSG ($F = 5.6$, $p < .05$). Among participants with current PTSD, TST diary estimates did not differ from the actigraphy measure in contrast to those without current PTSD who overestimated TST ($F = 3.3$, $p < .05$). No other group differences in subjective-objective sleep discrepancies were found.
Conclusion: Discrepancies between subjectively and objectively measured sleep parameters were not associated with trauma exposure or PTSD. This challenges prior assertions that individuals with PTSD overreport their sleep disturbances.
Support (If Any): This study was supported by NIMH grant 5K24MH001917-1, NHLBI grant 5R01HL087995-03, and NCRR grant 1UL1RR031975-01 to Thomas Mellman.

0995

SLEEP PERCEPTION IN COMORBID POSTTRAUMATIC STRESS DISORDER AND DEPRESSION; SLEEP DIARY VERSUS POLYSOMNOGRAPHY

Kelly M[1,2,3], Bootzin R[3,1], Parthasarathy S[2,4], Haynes P[5,1,3]
[1]Psychiatry, Univ of Arizona, Tucson, AZ, USA, [2]Research Service, Southern Arizona VA Healthcare System, Tucson, AZ, USA, [3]Psychology, Univ of Arizona, Tucson, AZ, USA, [4]Department of Medicine, University of Arizona, Tucson, AZ, USA, [5]Mental Health Care Line, Southern Arizona VA Healthcare System, Tucson, AZ, USA

Introduction: Objective and subjective sleep measurements in Posttraumatic Stress Disorder (PTSD) and Major Depressive Disorder (MDD) have mixed results. Studies show, compared to polysomnography, self-reports overestimate wake after sleep onset (WASO) and nocturnal motor activity in PTSD, while underestimating sleep efficiency (SE). Moreover, patients with MDD underestimate total sleep time. However, MDD and PTSD are highly comorbid, with MDD occurring in approximately 50-80% of individuals with PTSD. Therefore, examination of the congruence between sleep measures in this population is both warranted and clinically relevant.
Methods: Self-report sleep diaries were completed following a single-night of polysomnography (PSG) by 40 male military veteran participants (49 + 13 years [SD]) with a diagnosis of comorbid PTSD and MDD. Zero-order correlations were used to examine the relationship between sleep diary and PSG variables.
Results: Subjective versus objective sleep measures produced significant correlations on some sleep indices. In patients with PTSD and MDD subjective and objective measures of both total sleep time (TST; $r = .59$, $p < .01$) and WASO ($r = .44$, $p < .05$) were correlated. However, these patients misperceived sleep onset latency (SOL; $r = .04$, $p = .78$). Subjective sleep efficiency (SE), as calculated from sleep diary time in bed and TST, did not match objective SE ($r = .05$, $p = .76$).
Conclusion: Patients with PTSD and MDD correctly perceive how long they sleep, as well as how long they are awake in the middle of the night. However, these patients may misperceive how long it takes to fall asleep. These results are in opposition to previous studies of patients with either MDD or PTSD alone. Many PTSD studies do not control for comorbidity, therefore, uncontrolled depression may complicate our understanding of sleep in PTSD. Further research exploring the role of each disorder in sleep may inform our understanding of their interaction in this population.
Support (If Any): Department of Defense (Grant #W81XWH-08-2-0121).

0996

A COMPARISON OF THREE ANALYTIC SCORING METHODS OF ACTIGRAPHICALLY RECORDED SLEEP IN PTSD

Straus LD[1,2], Anderson D[1], Salamat J[1], Nappi CM[3,4], Drummond SP[2,3,4]
[1]Research Service, VA San Diego Healthcare System, San Diego, CA, USA, [2]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, San Diego, CA, USA, [3]Psychology Service, VA San Diego Healthcare System, San Diego, CA, USA, [4]Psychiatry, University of California San Diego, San Diego, CA, USA

Introduction: Actigraphy is a commonly used objective measurement of sleep/wake outside the lab. There is no consensus on the best method for scoring actigraphy, especially in populations with severe sleep disturbance, e.g., Posttraumatic Stress Disorder (PTSD). Here, we compare three different scoring methods in Veterans with PTSD.
Methods: 26 Veterans (age=35.6±10.1yrs,5F) with PTSD and comorbid insomnia wore actigraphs and kept sleep diaries for one week. Actigraphy was scored using three methods: 1) manufacturer default rest interval settings with automatic scoring (Automatic); 2) rest intervals set using Veterans' diary-reported bed/wake times (Diary-Only); 3) diary-reported times used as guidelines, though rest intervals could be extended up to 60min on either side to account for obvious sleep outside diary-reported (Diary+60). Time in bed (TIB), total sleep time (TST), Wake After Sleep Onset (WASO), and sleep efficiency (SE) were compared across methods.
Results: TIB, TST, and SE differed significantly among methods, though WASO did not. Automatic and Diary-Only produced equivalent TIB, while Diary+60 had longer TIB than both. Automatic estimated greater TST than Diary-Only and marginally greater TST than Diary+60 while Diary+60 estimated greater TST than Diary-Only. Automatic estimated higher SE than either Diary method, which were equivalent. In terms of clock times for the rest intervals, Automatic was phase-delayed vs Diary-Only for bed and wake time, and was phase-delayed vs Diary+60 for bedtime.
Conclusion: The three scoring methods yielded very different estimates of sleep in Veterans with PTSD. Relative to Automatic default settings, using Diary times to set rest intervals reduced TST and SE. Using modified Diary+60 rest intervals increased TIB and TST, and reduced SE. Importantly, rest interval clock times differed by 28-40min among the methods. Automatic misses SL, and thus over-estimates SE. These dis-

crepancies, especially lack of agreement on the rest interval times, suggest a more formal PSG-based validation study is needed in PTSD.

0997

QUANTITATIVE EEG ANALYSIS IN A TRAUMA-EXPOSED POPULATION WITH AND WITHOUT POST-TRAUMATIC STRESS DISORDER

Cowdin NP[1,2], Kobayashi I[2], Lavela J[2], Huntley E[2], Mellman T[2]
[1]Neuroscience, Georgetown University, Washington DC, DC, USA, [2]Psychiatry, Howard University, Washington DC, DC, USA

Introduction: Sleep disturbances are core features of PTSD and have been associated with poor clinical outcomes. Polysomnographic (PSG) studies have suggested abnormalities of REM sleep continuity and reduced slow wave sleep with PTSD. Spectral analysis of EEG signals from PSG offers a more precise quantitative measure of cortical activity during sleep. A recent study suggests that processing of negative emotions occurs during REM sleep and is indexed by theta (4-8 Hz) frequencies. The objective of this study is to compare specific spectral EEG frequencies during sleep between young adult participants with and without PTSD and trauma exposure.
Methods: Healthy young adult African Americans were screened for trauma exposure and PTSD. To date, 100 of the participants have received two consecutive nights of overnight PSG recordings the first of which screened for primary sleep disorders. Data acquisition included bilateral frontal, central and occipital leads. Night two recordings were scored for sleep stages and rapid eye movements. Following preprocessing for artifact removal, spectral analysis was performed on EEG frequency bands of interest including delta (0.5-4 Hz), theta, beta (16-32 Hz) and gamma (>32 Hz) frequencies. Overall EEG spectral power for these frequencies was computed across the night with further analysis for both non-rapid eye movement sleep (NREM) and rapid eye movement sleep (REM) periods.
Results: While analysis is still in progress we find significantly diminished relative delta band power with current PTSD as compared with trauma negative controls and resilient groups. Relationships between clinical indicators of pathology, including REM fragmentation, and the results of quantitative EEG outcomes will be examined. Analyses of REM frequencies previously associated with memory processing will also be reported.
Conclusion: Preliminary results support findings of reduced sleep depth in PTSD subjects as compared with resilient and trauma negative groups.

0998

RELATIONSHIP OF BINGE DRINKING TO SLEEP DISTURBANCE AMONG IRAQ AND AFGHANISTAN WAR VETERANS WITH PTSD

Campbell C[1], Pigeon WR[1,2,3], McKenzie S[1], Possemato K[1]
[1]Center for Integrated Healthcare, Syracuse VA Medical Center, Syracuse, NY, USA, [2]Sleep & Neurophysiology Research Lab, University of Rochester Medical Center, Rochester, NY, USA, [3]Center of Excellence for Suicide Prevention, Canandaigua VA Medical Center, Canandaigua, NY, USA

Introduction: Iraq and Afghanistan War Veterans face elevated rates of PTSD, alcohol use, and insomnia. Efforts to improve sleep (e.g., using alcohol as a sleep aid) may ultimately lead to further disruption. After acute alcohol use, occasional drinkers tend to fall asleep quickly, sleep soundly at first, but wake during the night, whereas regular alcohol use is associated with difficulty falling and staying asleep. We hypothesized that, in comparison to occasional binge-drinkers, regular binge-drinkers would have more severe overall insomnia. We also explored the differences for insomnia subtypes.
Methods: Participants were 72 Veterans with PTSD symptoms and problematic alcohol use. Measures included the Timeline Follow-Back (past 30 days), Insomnia Severity Index (ISI), and PTSD Checklist (PCL). Participants were classified as occasional binge-drinkers (< 4 binges; n=29) or regular binge-drinkers (≥ 4 binges; n=43), with high PTSD severity (PCL ≥ 50; n=41) or low PTSD severity (PCL < 50; n=31).
Results: Sleep disturbance was common (76% had ISI score ≥ 0). T-tests revealed that regular (vs. occasional) binge-drinkers had elevated total ISI scores [16.7(5.7) vs. 12.4(9.4); p<.05] and marginally more difficulty initiating asleep (p=.11), maintaining sleep (p=.055) and early morning awakenings (p=.10). There were no age or gender differences between binge groups, but regular bingers had more severe PTSD. In two-way ANOVAs, the inclusion of PTSD severity rendered all main effects of binge drinking on insomnia variables insignificant, whereas there were significant main effects of PTSD for all insomnia variables. The interaction effects were also significant for all insomnia outcomes, with a greater effect of PTSD severity on insomnia for occasional binge-drinkers than regular binge-drinkers.
Conclusion: Although limited to a one month time frame, the findings suggest that regular binge-drinking is associated with more severe insomnia in recent Veterans with PTSD symptoms. The findings are somewhat nuanced, however, as an interaction between PTSD severity and binge drinking is evident. Given the high prevalence of sleep disturbance, PTSD, and alcohol abuse among returning Veterans, additional analyses of how they are related seems warranted.

0999

SLEEP DISTURBANCE AND EMOTION DYSREGULATION AS PREDICTORS OF PTSD AND ALCOHOL DEPENDENCE SYMPTOM SEVERITY AMONG INDIVIDUALS AT A RESIDENTIAL SUBSTANCE USE TREATMENT CENTER

Fairholme C, Nosen EL, Nillni YI, Schumacher JA, Coffey SF
Psychiatry & Human Behavior, University of Mississippi Medical Center, Jackson, MS, USA

Introduction: Emotion dysregulation has been implicated as a maintaining factor for a range of psychiatric disorders, including PTSD (Tull et al., 2007) and alcohol dependence (Fox et al., 2008). Sleep disturbance has also been proposed as an etiologic and maintaining factor for psychopathology (Bryant et al., 2010; Harvey et al., 2011). It is not yet known how these variables might operate together to predict PTSD and alcohol dependence (AD) symptom severity.
Methods: Participants were 220 patients in residential substance abuse treatment, who had experienced a trauma and exceeded screening cutoffs for probable PTSD and alcohol use disorder. Measures included: emotion dysregulation (Difficulties with Emotion Regulation Scale; Gratz & Roemer, 2006), sleep disturbance (Insomnia Severity Index; Bastien et al., 2000), anxiety (Beck Anxiety Inventory; Beck et al., 1993), depression (Beck Depression Inventory-II; Beck & Steer, 1996), PTSD (Impact of Event Scale-Revised; Weiss & Marmar, 1996), and AD (Alcohol Dependence Scale; Skinner & Allen, 1982).
Results: Simultaneous multiple regression was conducted to evaluate whether the two predictors were associated with unique variance in each of the four outcome variables. Controlling for the interrelationships among the outcome variables, sleep disturbance was uniquely associated with anxiety (B=.27, p < .001), depression (B=.31, p < .001), PTSD (B=.30, p < .001), and AD (B=.16, p = .01) symptom severity. Similarly, emotion dysregulation was also uniquely associated with anxiety (B=.42, p < .001), depression (B=.46, p < .001), PTSD (B=.31, p < .001), and AD (B=.29, p < .001) symptom severity.
Conclusion: Sleep disturbance and emotion dysregulation appear to be common processes uniquely associated with symptom severity across a number of different domains. This relationship is not due exclusively to associations with state distress. Results suggest that both sleep disturbance and emotion dysregulation might be important treatment targets for individuals with PTSD and AD.

1000

THE RELATIONSHIP BETWEEN SLEEP AND MEMORY IN POST-TRAUMATIC STRESS DISORDER

Lipinska M, Thomas KG, Kaminer D, Gounder M, Timol R
University of Cape Town, Cape Town, South Africa

Introduction: Previous research has shown that in normal individuals sleep is critical to memory formation. Successful memory consolidation during sleep is contingent on slow-wave sleep (SWS), rapid eye movement (REM) sleep and the successful transition of stages across the night. In Post-Traumatic Stress Disorder (PTSD), both sleep and memory processes are disrupted, but no previous study has examined whether these two variables are inter-related. This study aimed to determine whether disrupted sleep is a mechanism underlying declarative memory deficits in PTSD - investigating whether memory consolidation during sleep is disrupted in PTSD diagnosed individuals in comparison with controls.
Methods: Participants were recruited to one of four groups - PTSD (n = 16), trauma-exposed non-PTSD (n = 15), depression (n = 15) and healthy controls (n = 14). After screening, participants attended the Vincent Pallotti Hospital sleep laboratory for one night. Participants completed declarative and procedural memory tasks before and after an 8 hour sleep period. Declarative memory performance was assessed using a story recall task. Procedural memory performance was measured using a finger tapping task. Sleep variables such as total sleep time, sleep latency, number of awakenings, and REM and SWS percentage were measured using sleep adapted EEG.
Results: Results were analysed using one-way ANOVA, for sleep and memory variables. PTSD participants retained significantly less information on a declarative memory task than healthy controls after sleep.
Conclusion: Overall results show some support for the disruption of memory consolidation during sleep in PTSD.
Support (If Any): A.W. Mellon Foundation.

1001

PRIOR SLEEP DEPRIVATION MAY BE ASSOCIATED WITH DISTORTED/DELUSIONAL MEMORIES OF THE TRAUMATIC EVENT IN MOTOR VEHICLE ACCIDENT (MVA) - RELATED POSTTRAUMATIC STRESS DISORDER (PTSD)

Gupta MA
Psychiatry, University of Western Ontario, London, ON, Canada

Introduction: Sleep deprivation (SD) is an important contributory factor for MVAs. Studies involving SD and PTSD, eg., among patients in intensive care units (ICU), report distorted and delusional PTSD-related memories involving the ICU experience. There are no reported studies on the possible effect of prior SD on traumatic memories in MVA-related PTSD.
Methods: 13 patients (10 male; age 21 to 48 years; all white), seen in the author's practice over a period of 18 years, developed PTSD (DSMIV-TR) after MVAs during the course of psychotherapy for unrelated psychiatric conditions (major depressive disorder, 7 cases; bipolar II disorder, 3 cases; bulimia nervosa, 3 cases). The MVAs resulted in primarily soft tissue injuries. Detailed histories were available on the patients both pre- and post- MVA.
Results: 6 out of 13 patients (5 male, 1 female) reported significant SD prior to their MVAs: 2 had delayed sleep phase syndrome with usual wake times of 1pm or later and on the day of the MVA had been woken up between 5am to 7am after 2 to 3 hours of sleep; 3 patients had taken on extra jobs and had slept for less than 3 hours for at least 2 nights prior to the MVA; one patient had been bingeing and purging most of the night and had not slept for 36 hours prior to the MVA. In contrast to the patients that did not report SD at the time of the MVA (n=7), the SD patients tended to incorporate aspects of recent psychosocial stressors that they had reported in psychotherapy prior to the MVA, into the narrative of their intrusive traumatic memories of the MVA, and their PTSD-related nightmares. For example 4 SD patients experiencing marital or work-related stresses pre- MVA developed persistent paranoid ideation that their spouse was cheating on them or their bosses were spying on them when they were off work because of the MVA. 2 SD patients who were dealing with conflicts within the family tended to place all blame for the MVA on their families. The SD group needed therapy for PTSD for a longer duration (>1 year) than the non-SD group (<6 months).
Conclusion: The preliminary findings suggest that acute SD at the time of an MVA may result in the incorporation of recent memories with high negative emotional valence into traumatic memories of the MVA-related PTSD. The findings support previous observations that sleep loss impairs the coding of emotional memories, with a tendency to encode words with negative connotations and overall deficit in encoding memory of words with positive or neutral content.

1002

A META-ANALYSIS OF IMAGERY REHEARSAL FOR POST-TRAUMA NIGHTMARES: EFFECTS ON NIGHTMARE FREQUENCY, SLEEP QUALITY, AND POSTTRAUMATIC STRESS

Casement M[1], Swanson L[2]
[1]Behavioral Sciences Division, National Center for Posttraumatic Stress Disorder, Boston, MA, USA, [2]Department of Psychiatry, University of Michigan, Ann Arbor, MI, USA

Introduction: This meta-analysis evaluates the efficacy of imagery rehearsal as a treatment for nightmares, general sleep disturbance, and symptoms of post-traumatic stress disorder (PTSD).
Methods: Bibliographic databases and cited references were searched to identify clinical trials of imagery rehearsal in individuals with post-trauma nightmares. Mean effect sizes were calculated for nightmare frequency, sleep quality, and PTSD symptoms. Mixed effects models were performed to evaluate the effects of imagery rehearsal combined with cognitive behavioral therapy for insomnia, and imagery rehearsal with exposure to original nightmare content, on treatment efficacy.
Results: Thirteen studies met inclusion criteria and reported sleep and post-traumatic stress outcomes in sufficient detail to calculate effect sizes. Results indicate that imagery rehearsal has large effects on nightmare frequency and PTSD symptoms, and moderate effects on sleep quality. These effects were sustained through 6 to 12 month follow-up. Furthermore, interventions that included both imagery rehearsal and cognitive behavioral therapy for insomnia resulted in greater treatment-related improvement in sleep quality than imagery rehearsal alone. Combined treatment did not improve outcomes for PTSD or nightmares. Notably, effect sizes were small in the single study that included an active-treatment control condition.
Conclusion: Imagery rehearsal improves sleep and reduces PTSD symptoms across a diverse range of samples and treatment protocols. Future research should identify necessary and sufficient components of interventions for trauma-related sleep disturbance and post-traumatic stress (e.g., exposure, cognitive reappraisal, circadian regulation).
Support (If Any): This research was supported by National Institute of Mental Health Institutional Training Grant T32MH019836.

1003

RESCRIPTING NIGHTMARES OF VETERANS WITH PTSD: RELATION TO TREATMENT OUTCOME

Harb GC[1], Cook JM[2,3], Thompson R[4], Ross RJ[1,5]
[1]Behavioral Health Service, Philadelphia VA Medical Center, Philadelphia, PA, USA, [2]Psychiatry, Yale School of Medicine, New Haven, CT, USA, [3]National Center for PTSD, West Haven, CT, USA, [4]Psychiatry, University of Illinois at Chicago, Chicago, IL, USA, [5]Psychiatry, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA, USA

Introduction: Recurrent nightmares are present in up to 70% of individuals with posttraumatic stress disorder (PTSD). Posttraumatic nightmares often replicate the trauma. Replicative nightmares are associated with greater sleep disturbance and other PTSD symptoms. Current treatments for PTSD may improve waking symptoms but not the nightmare disturbance. Imagery rehearsal (IR), a cognitive-behavioral treatment that focuses on nightmares specifically, involves identifying a target nightmare, rescripting a less distressing dream, and imaginally rehearsing the rescript. We aimed to characterize target nightmares and rescripted dreams in a Veteran population receiving IR and to investigate associations with treatment outcome.
Methods: Participants were 48 male Vietnam War Veterans with combat-related PTSD enrolled in a trial of IR, with nightmare frequency and overall sleep quality as primary outcomes. Participants chose a target nightmare and were helped by therapists to rescript it. Nightmares and dreams were coded for content, emotions, and themes according to a new rating tool. Bivariate and multivariate analyses examined the relationships among nightmares, rescripts, and treatment outcome.
Results: Veterans chose target nightmares that most often replicated a reported trauma (77%). The emotions helplessness (90%) and fear (85%) were most common, and fear of death was the most prevalent dominant theme. Revised dream scripts contained primarily positive emotions, but 17.5% included violence. Olfactory experiences in the target nightmare predicted smaller treatment effects. Violence in the revised script was related to a smaller reduction in nightmare frequency. Resolving or addressing the nightmare theme in the revised script predicted a greater improvement in overall sleep disturbance.
Conclusion: IR for individuals with severe, chronic PTSD and largely replicative nightmares may be most effective when the rescripted dream incorporates a resolution of the nightmare theme and excludes violent details.
Support (If Any): Department of Veterans Affairs Research and Development.

1004

A RANDOMIZED CONTROLLED TRIAL OF COGNITIVE BEHAVIORAL SOCIAL RHYTHM GROUP THERAPY (CBSRT) FOR MALE VETERANS WITH PTSD, MAJOR DEPRESSIVE DISORDER, AND SLEEP PROBLEMS

Haynes P[1,2], Kelly MR[1,2], Parthasarathy S[2,1], Bootzin R[1]
[1]University of Arizona, Tucson, AZ, USA, [2]Southern Arizona VA Health Care System, Tucson, AZ, USA

Introduction: This study employed a double blind randomized controlled design to compare group Cognitive Behavioral Social Rhythm Therapy (CBSRT) to Present Centered Group Therapy (PCGT) in 43 male Veterans with PTSD, Major Depressive Disorder, and difficulties with sleep. CBSRT is an integrative group psychotherapy targeting both sleep and psychiatric symptoms via change of daytime and nighttime behavioral patterns. PCGT is a well-established, interpersonal group therapy for PTSD that has previously been shown to have equal benefit as trauma-focused group therapy but with fewer patient drop-outs. To our knowledge, this is the first randomized controlled group therapy trial comparing a behavioral sleep treatment to a well-researched mental health treatment in Veterans with PTSD and comorbid depression.
Methods: Forty three male subjects (M age = 48.81 years, SD = 13.45 years) were assessed at baseline, 4 weeks, 8 weeks, post-treatment, 3 months and 6 months post-treatment. PTSD symptoms were assessed via the Clinician Assessment of PTSD Scale (CAPS), and depression symptoms were assessed via the Hamilton Rating Scale for Depression. Mixed modeling was employed to examine preliminary differences in trajectories across the course of therapy and at follow-up.
Results: Preliminary intent-to-treat analyses indicated that both therapies resulted in improvements in depression and clinically significant improvements in PTSD (> 10 point drop on CAPS) with no differences between conditions. CBSRT was associated with fewer therapy drop-outs ($\chi^2 = 2.75$, $p < .10$). Only 14% of the CBSRT group (n = 3) attended less than 75% sessions versus PCGT, where 36% of the sample attended less than 75% of sessions.
Conclusion: CBSRT appears to be equivalent to PCGT on psychiatric outcomes. This finding is similar to those from VA Cooperative Study 420 showing the equivalency of PCGT with trauma focused group therapy for PTSD. In the current trial, fewer participants appear to drop-out of CBSRT as compared to PCGT, suggesting that CBSRT may be a more acceptable group therapy than PCGT for Veterans with PTSD. Analysis of sleep outcomes is pending.
Support (If Any): Department of Defense (Grant #W81XWH-08-2-0121).

1005

MINDFULLNESS-BASED STRESS REDUCTION IMPROVES TOTAL SLEEP TIME IN VETERANS WITH PTSD

Mehta A[1], Wohlgemuth WK[2], Malphurs JE[3], Claude LB[3], Gonzalez C[2], David D[3]
[1]Medicine, University of Miami, Miami, FL, USA, [2]Psychology Service, Miami VA Medical Center, Miami, FL, USA, [3]Psychiatry Service, Miami VA Medical Center, Miami, FL, USA

Introduction: Sleep disturbances are often primary complaints of PTSD patients. Frequently, sleep disturbances do not respond to first-line treatments for PTSD. Mindfulness-Based Stress Reduction (MBSR) interventions have, in healthy people, significantly reduced stress, ruminative thinking and anxiety. In this study we examined the impact of MBSR, as an adjunct therapy, on the sleep of veterans with Post Traumatic Stress Disorder (PTSD).
Methods: We recruited newly diagnosed and untreated veterans with PTSD. All veterans were diagnosed by the PTSD Clinical Team (PCT). Seventy-nine participants were randomized into the study. Veterans were randomized to receive standard care (SC) only or SC plus MBSR. Intervention participants were provided with a take-home meditation module to use in between sessions. All participants completed an initial baseline assessment and 51 completed final assessments for PTSD as well as depression, pain, anxiety, stress and sleep. Veteran were assessed with the PTSD Check-List Military version (PCL-M), PHQ-9, Beck Anxiety Inventory (BAI), visual analogue scale for pain, and the PSQI.
Results: At baseline, no differences were found for depression, anxiety, pain or sleep. Both groups showed elevated levels of depression, anxiety, pain and poor sleep quality. Compared to baseline, both groups had reduced PTSD symptoms ($p<.08$), reduced depression symptoms ($p<.015$), and reduced perceived pain ($p<.001$). After controlling for age, baseline levels of PTSD, pain, depression, and length of time in treatment, a significant treatment x time effect was found for Total Sleep Time ($p=.039$). The meditation intervention improved total sleep time independent of age, level of PTSD pain or depression.
Conclusion: MBSR may be an additional therapeutic tool that is easy to use and implement in existing treatment models, potentially improving the sleep of veterans with PTSD.

1006

THE EFFECTS OF ESZOPICLONE ON SLEEP SPINDLES AND MEMORY CONSOLIDATION IN SCHIZOPHRENIA

Manoach D[1,2,5], Wamsley EJ[3,5], Shinn AK[4,5], Tucker MA[3,5], Ono KE[1,5], McKinley SK[3,5], Ely AV[3,5], Goff DC[1,5], Stickgold R[3,5]

[1]Psychiatry, MGH, Charlestown, MA, USA, [2]Martinos Center for biomedical imaging, MGH, Charlestown, MA, USA, [3]Psychiatry, BIDMC, Boston, MA, USA, [4]Psychotic Disorders Division, McLean Hosp, Belmont, MA, USA, [5]Psychiatry, Harvard Medical School, Boston, MA, USA

Introduction: Sleep spindles are thought to contribute to memory consolidation. In schizophrenia, there is a dramatic reduction of spindles that correlates with deficient sleep-dependent memory consolidation. Eszopiclone (Lunesta), a non-benzodiazepine hypnotic agent, acts on γ-aminobutyric acid (GABA)ergic neurons in the thalamic reticular nucleus where sleep spindles are generated. We tested the hypothesis that eszopiclone would increase spindles and thereby improve memory consolidation in schizophrenia.

Methods: In a double-blind design, 21 chronic, medicated schizophrenia outpatients were randomly assigned to receive either placebo (n=11) or 3 mg of eszopiclone (n=10) before bed. Patients completed baseline and treatment visits each consisting of two consecutive nights of polysomnography. On the second night of each visit participants were trained on the finger tapping Motor Sequence Task (MST) at bedtime and tested the following morning. We compared the effects of eszopiclone vs. placebo on stage 2 sleep spindles and overnight changes in MST performance.

Results: Eszopiclone increased the number and density of sleep spindles over baseline levels significantly more than placebo. Although MST performance was not significantly enhanced by eszopiclone compared with placebo, only the eszopiclone group showed significant overnight improvement during the treatment visit, and in the combined groups MST improvement correlated with spindle number and density on the learning night.

Conclusion: Eszopiclone significantly increased sleep spindles and sleep spindles predicted overnight improvement on the MST. This suggests that the spindle deficit in schizophrenia impairs sleep-dependent memory consolidation and can be reversed with eszopiclone. Given the more general role of sleep spindles in cognition, they are a promising novel target for the treatment of cognitive deficits in schizophrenia.

Support (If Any): Sepracor, Inc.; National Institutes of Health R01-MH48832 and T32-HL07901; National Center for Research Resources UL1-RR025758 and M01-RR-01066; Harvard Clinical and Translational Science Center.

1007

SHORTER PHASE ANGLES BETWEEN DIM LIGHT MELATONIN ONSET AND BEDTIME IN COLLEGE STUDENTS WHO REPORT OBSESSIVE-COMPULSIVE (OC) SYMPTOMS

Sharkey KM[1,2,4], Coles ME[3], Van Reen E[1,4], Roane BM[1,4], Gredvig-Ardito C[4], Carskadon MA[1,4]

[1]Warren Alpert Medical School of Brown University, Providence, RI, USA, [2]Rhode Island Hospital, Providence, RI, USA, [3]Department of Psychology, Binghamton University, Binghamton, NY, USA, [4]Sleep for Science Research Laboratory, EP Bradley Hospital, Providence, RI, USA

Introduction: Comorbid delayed sleep phase disorder has been observed in 17-42% of patients with obsessive-compulsive disorder (OCD). Patients with OCD and individuals who report OC symptoms have later bedtimes than controls. We explored bedtime, circadian phase, and phase angle between salivary dim light melatonin onset (DLMO) and bedtime in college students with and without OC symptoms.

Methods: Students completed online sleep diaries for their first 9 weeks at college. Salivary DLMO was measured in a subset of students 7 weeks after classes started. DLMO was estimated from radioimmunoassays (Alpco, Salem, NH) by linear interpolation using a 4 pg/ml threshold in 30-minute sampling intervals. Average reported bedtime was calculated for 7 days preceding saliva collection, and phase angle was calculated by subtracting DLMO time from bedtime. OC symptoms were reported on the Psychiatric Diagnostic Screening Questionnaire (PDSQ, Zimmerman, 2002), completed online during semester week 9. Students who endorsed at least one of 7 OC symptoms on the PDSQ were classified as OC+.

Results: 103 students (53 male, ages 17-21, mean±SD=18.6±0.6 years) completed DLMO, sleep diaries, and the PDSQ. Twenty-seven (14 male) were OC+ and 76 (39 male) were OC-. Neither DLMO phase (OC+ = 23:46±70 minutes, OC- = 23:17±93 minutes; t=-1.50, df=101, p=.14) nor bedtime (OC+ = 01:38±65 minutes, OC- = 01:56±60 minutes; t=1.27, df=101, p=.21) showed significant differences between OC groups. OC+ students had significantly shorter phase angles between DLMO and bedtime than OC- students (OC+ = 1.9±1.3 hrs, OC- = 2.6±1.5 hrs; t=2.46, df=101, p=.016).

Conclusion: OCD is a debilitating anxiety disorder with peak age of onset in adolescence and young adulthood. This life phase is associated with significant developmental changes in sleep and circadian rhythms, particularly at the transition from high school to college. In this non-clinical sample, first-semester college students who reported OC symptoms also reported going to bed at an earlier circadian phase than students without OC symptoms. These data indicate an association between circadian rhythms, sleep timing, and OC symptoms. Future analyses in a larger sample will examine whether sleep homeostasis interacts to affect expression of OC symptoms.

Support (If Any): MH079179 (MAC), MH086689 (KMS), and the Sleep Research Society Foundation Elliot D. Weitzman, M.D. Research Grant.

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ASSOCIATION BETWEEN MORNINGNESS-EVENINGNESS AND SEVERITY OF COMPULSIVE INTERNET USE: THE MODERATING ROLE OF GENDER AND PARENTING STYLE

Lin Y[1,2], Gau SS[1]

[1]Department of Psychiatry, National Taiwan University Hospital, Yun-Lin Branch, Douliu City, Yunlin County, Taiwan, [2]Psychiatry, National Taiwan University Hospital, Taipei, Taiwan

Introduction: Eveningness and internet addiction are the main concerns in adolescence and young adulthood. However, limited studies have investigated the association between morningness-eveningness and problematic internet use in university students. The moderating roles of co-occurring psychiatric symptoms, and perceived parenting style, family support were also explored.

Methods: The participants consisted of 2731 university incoming students (male: 52.4%) with a mean age, 19.4 years (SD=3.6) from a national university in Taiwan. Student participants completed the questionnaires included Morningness/Eveningness Scale (MES), Yale-Brown Obsessive Compulsive Scale modified for internet use, the Parental Bonding Instrument for parenting style, the Family APGAR for perceived family support, and the Adult Self Report Inventory-4 for psychopathology. The morning (n = 459), intermediate (n =1878), and evening (n = 394) groups were operationally defined by the MES t scores. Statistical methods included analysis of variance, chi-square test and multiple regression analysis.

Results: The evening group had shorter weekday sleep time and longer weekend sleep time, and was more likely to have compulsive internet use than the other two groups. The association of compulsive internet use with the evening type was greater in males than females. Both males and females with problematic compulsive internet use perceived significantly less affection/care, more overprotection from their mothers and less support from their families.

Conclusion: The finding that problematic internet use was associated with eveningness, maternal parenting style, and perceived family support in college freshmen implies that sleep schedule and parental/family work should be part of specific measures for prevention and intervention of problematic internet use.

1009

THE INFLUENCE OF EVOKED ANXIETY ON SLEEP PARAMETERS, SUBJECTIVE SCALES, AND HEART RATE VARIABILITY DURING SLEEP ONSET PERIOD

Narisawa H, Takahashi T
Psychology, Hosei University, Tokyo, Japan

Introduction: There has been a serious problem of the sleep study of producing deviation between subjective consciousness and objective findings, e.g., psychophysiological insomnia (PPI). Our purpose was to investigate the psychophysiological changes during sleep onset period (SOP) with using the 9 electroencephalogram (EEG) stages criteria and cardiac autonomic function.
Methods: Sixteen healthy student volunteers (13 females and 3males, mean age 22.5 years) participated and were randomly assigned into control or experimental group. Experimental group received the manipulation of speech anxiety before taking 30-minute nap, while control group did not. Rechtschaffen and Kales' criteria of sleep stages caused difficulties in examining the delicate changes in the SOP; therefore, we adopted other criteria for every 5-second epoch into the 9 EEG stages which was proposed for the SOP evaluation from stage W to stage 2 by Hori et al (1994) and Ogilvie (2001). We also focused on the autonomic nervous activity during the SOP. The cardiac autonomic function was quantitatively measured based on the R-R interval. Power spectrum analysis of the HRV was performed by complex demodulation method to obtain the high-frequency component (HF), and the low-frequency component (LF).
Results: Experimental group indicated higher anxiety assessment ($F(1, 14) = 7.03$, $p = .02$). The result showed EEG stage 8 ($F(1, 14) = 5.67$, $p = .03$) and 9 ($F(1, 14) = 5.97$, $p = .03$) were significantly longer latencies in experimental group. For HF in the experimental group, significant decreases at 23 and 30 minute after lights off during the nap were observed.
Conclusion: Delicate changes in the SOP could be explained in details by the combination of cardiac autonomic function and the 9 EEG stages criteria instead of Rechtschaffen and Kales' criteria.

1010

INSOMNIA AND ITS CORRELATES AMONG HEROIN USERS TREATED WITH METHADONE IN TAIWAN

Lin Y[1,2], Chen Y[1], Huang W[1], Chang L[1]
[1]Department of Psychiatry, National Taiwan University Hospital, Yun-Lin Branch, Douliu City, Yunlin County, Taiwan, [2]Psychiatry, National Taiwan University Hospital, Taipei, Taiwan

Introduction: Insomnia is one of most common symptoms among heroin users. It is not only related to chronic opioid use itself but also associated with opioid withdrawal symptoms, anxiety, depression and other psychopathologies. We designed the present study to investigate the characteristics of insomnia and its psychosocial determinants among heroin users treated with methadone.
Methods: A total of 65 heroin users treated in methadone clinic of outpatient department in National Taiwan University Hospital, Yun-Lin Branch, were recruited. They completed questionnaires including demographic data, questionnaires about heroine and methadone use, Opiate Treatment Index, Subjective Opiate Withdrawal Scale, State and Trait Anxiety Inventory (STAI), Beck Depression Inventory (BDI), Minimal Insomnia Symptom Scale (MISS), Tridimensional Personality Questionnaire (TPQ), EuroQuol, Family APGAR (Adaptation, Partnership, Growth, Affection, Resolve). They are further divided into two groups of similar sample size according to the cut-point of MISS total score, i.e. High MISS group (≧3)and Low MISS group(<3). We conducted independent t test to compare clinical features between the two groups, and used univariate correlation analysis and subsequent multivariate regression analysis to find out determinants of insomnia in this population.
Results: Of all 65 heroin users, 89.2% were male. Their mean age was 36.94 ± 7.1 years. 70.8% are unmarried and 95.4% are smokers. Both two groups were not different in gender, age, education, years of regular heroin use, methadone dosage. High MISS group has more heroin withdrawal symptoms, higher STAI scores, higher BDI score, and higher TPQ-harm avoidance score. In regression analysis, MISS total score is predicted by BDI total score and STAI-trait total score; difficulties in initiating sleep is predicted by STAI-trait total score and BDI total score; difficulties in maintaining sleep is predicted by BDI total score alone; not being refreshed is predicted by BDI total score and STAI-trait total score.
Conclusion: Our results suggested that depressive symptoms and trait anxiety were independent predictors of insomnia among heroin users treated with methadone. To improve insomnia in this population, clinicians should focus on depressive symptomatology and trait anxiety.

1011

PARENTAL PROBLEM DRINKING, MARITAL CONFLICT, AND CHILD SLEEP

Keller P[1], Gilbert L[1], Razor MB[1], Motley S[1], El-Sheikh M[2]
[1]Psychology, University of Kentucky, Lexington, KY, USA, [2]Human Development and Family Studies, Auburn University, Auburn, AL, USA

Introduction: Family stress predicts children's poor sleep (El-Sheikh, 2011). However, there are no known studies of parental problem drinking (PPD) and child sleep. 40% of children are exposed to PPD before age 18 (Grant, 2000), leading to risk for maladaptive outcomes (West & Prinz, 1987). It is therefore important to examine PPD associations with child sleep, including processes involved. We hypothesize that PPD will be associated with poor child sleep, and these associations will be mediated by marital aggression and child emotional insecurity.
Methods: 64 children (aged 6 - 12 years) and their parents participated. Child sleep was monitored via actigraphy for one week. Average sleep minutes per night, sleep efficiency, nighttime physical activity, and sleep latency were derived. Parents reported their symptoms of problem drinking (Alcohol Use Disorders Identification Test), maximum number of drinks per occasion, the frequency with which they drink in front of their children, and aggression in the marital relationship (Conflict Tactics Scale). Children reported on their pre-sleep arousal (Pre-Sleep Arousal Scale) and their emotional security in the marital realtionship (Security in the Interparental Subsystem Scale). Data were analyzed using structural equation modeling.
Results: Mother problem drinking (AUDIT) scores were associated with lower child sleep efficiency. Child witnessing father alcohol use was related to child longer sleep latency and fewer sleep minutes. The combination of high mother and father maximum drinking amount predicted fewer sleep minutes and greater emotional insecurity. Marital aggression mediated the association between child witnessing mother drinking and child sleep minutes.
Conclusion: Findings support PPD as disruptive of child sleep, with relations often being direct. PPD may be uniquely worrisome to children, above and beyond family problems it causes, especially at night (when PPD may be greatest). Also, poor sleep may help explain the emotional and behavioral problems in children exposed to PPD.
Support (If Any): This project was supported by NIH grant R21 HD 062833 awarded to the first author.

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TREATING INSOMNIA IN ALCOHOLIC MEN AND WOMEN: A RANDOMIZED CONTROLLED TRIAL OF GABAPENTIN VS. PLACEBO

Conroy DA, Arnedt J, Armitage R, Brower K
Psychiatry, Univ Michigan, Ann Arbor, MI, USA

Introduction: Insomnia is common, persistent, and associated with relapse in alcohol-dependent (AD) patients. Studies of differences in treatment response in alcoholic men and women are lacking. We explored insomnia treatment response to gabapentin in male and female alcoholics.
Methods: 40 participants (29 males and 11 females), 68% Caucasian, with a mean age of 35.8 (+/- 10.2) and DSM-IV alcohol dependence, who were abstinent for 3-12 weeks, were recruited from the community without regard to insomnia diagnosis. They kept an 11 p.m. to 6 a.m. sleep schedule for 1 week before baseline and were then randomized to either gabapentin 1200 mg or placebo at bedtime for 1 additional week while maintaining that sleep schedule. The Insomnia Severity Index (ISI) was administered at baseline and post-treatment. A baseline ISI score > 8 defined insomnia.
Results: Mean ISI scores were 6.8 (+/- 5.7) at baseline and 6.0 (+/- 4.5) post-treatment. Repeated-measures ANOVA showed a main effect of time, $F(1, 20)=13.5$, $p=.002$, but no medication effect on ISI scores. Interactions were found for time by insomnia, $F(1, 36)= 38$, $p<.005$, time by sex, $F(1,36)=7.4$, $p=.010$, and time by insomnia by sex ,$F(1,36)=31$, $p=.030$. Women with insomnia (n=6) showed the greatest improvement in ISI scores from 14.8 (+/- 3.4) to 6.3 (+/- 6.6), whereas men with insomnia changed slightly [10.8 (+ /-2.8) to 8.4 (+/- 5.1)]. Regression analysis showed that baseline insomnia (beta=-.68, $p<.005$) and sex (beta=-.32, $p=.009$) independently predicted ISI change scores, but medication did not.
Conclusion: One week of nightly gabapentin had no effect on ISI scores in AD participants. Baseline insomnia improved over time in women but persisted in men regardless of treatment condition. The study is limited by a small number of AD women.
Support (If Any): Funded by R01 AA016117 to KJB.

1013

SUBJECTIVE ASSESSMENT OF SLEEP IN ADULTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD) OF THE PREDOMINANTLY INATTENTIVE (ADHD-I) AND COMBINED (ADHD-C) SUBTYPES

Yoon R[1,3], Jain U[1,3], Shapiro CM[2,3]
[1]Centre for Addiction and Mental Health, Toronto, ON, Canada, [2]Toronto Western Hospital, Toronto, ON, Canada, [3]Institute of Medical Science, University of Toronto, Toronto, ON, Canada

Introduction: Sleep is important in ADHD because sleep disturbances and/or disorders can give rise to, or exacerbate the core symptoms of ADHD. While extensive research exists on sleep in children with ADHD, such is not the case with the adult ADHD population, where research on sleep is scarce and, thus, the relationship between sleep and adult ADHD is poorly understood.
Methods: The aims of this study were to investigate variables associated with sleep in adults with ADHD, and to assess whether any differences exist between subjects with ADHD of the predominantly inattentive (ADHD-I) and subjects with ADHD of the combined (ADHD-C) subtypes. To this end, we collected subjective data on daytime sleepiness, sleep quality, alertness, circadian preference, and fatigue in 125 subjects with ADHD (44 ADHD-I and 81 ADHD-C subjects) referred to the Centre for Addiction and Mental Health for diagnosis and treatment for ADHD.
Results: As a whole, approximately 90% of subjects with ADHD reported excessive daytime sleepiness and/or poor sleep quality, suggesting that an alarmingly high proportion of subjects with ADHD suffer from sleep disturbances. In line with this, subjects with ADHD also reported high levels of fatigue. When looking at differences between ADHD subtypes, we found that, while there are no differences with regards to daytime sleepiness, alertness, or daytime sleepiness; inattentive subtypes report poorer sleep quality and more fatigue than combined subtypes do. Hierarchical regression analyses revealed that the relationships between sleep quality and the experience of fatigue, sleepiness, and alertness differs between ADHD subtypes, such that in inattentive subtypes, fatigue is directly associated with sleep quality, while in the combined subtypes, fatigue is associated with sleepiness.
Conclusion: Altogether, these data indicate that the differences between ADHD subtypes are not limited to daytime function, but may extend to the realm of sleep and, thus, the interplay of variables associated with daytime function and sleep.

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ALERTNESS AND DRIVING PERFORMANCE IN ADULTS AFFECTED BY ATTENTION DEFICIT DISORDER / HYPERACTIVITY (ADHD)

Philip P[1], Bioulac S[1,2], Capelli A[1], Claret A[1], Gauduchau M[1], Sagaspe P[1], Taillard J[1], Reneric J[2], Bouvard M[2]
[1]USR3413 SANPSY Sleep, Attention and Neuropsychiatry, CNRS-University Victor Segalen, Bordeaux, France, [2]Pôle de psychiatrie de l'enfant et de l'adolescent, Centre Hospitalier Charles Perrens, Bordeaux, France

Introduction: Attention Deficit Disorder / Hyperactivity (ADHD) is a neurodevelopmental disorder characterized by a triad of symptoms involving hyperactivity, impulsivity and inattention. Several studies in children with ADHD showed a high prevalence of excessive daytime sleepiness. To our knowledge, no study has objectively assessed sleepiness in adults with ADHD. Moreover, it has been shown that adults with ADHD were at risk for driving accidents. The objectives of this study are to quantify objective sleepiness and its impact on driving performance in ADHD adult patients.
Methods: Nocturnal polysomnography was performed to identify potential sleep disorder. The next day patients were submitted to a Maintenance Wakefulness Test (MWT) at 10H, 12H, 14H, 16H to examine their level of daytime sleepiness. After a training of 15 minutes, a driving test of one hour was carried out at 17H on the simulator F2300R (INRETS / Ifsttar-Faros) to evaluate driving performance.
Results: 15 subjects with ADHD were included (age (mean ± SE) = 33.3 ± 2.6). They were divided into 2 groups according to their level of sleepiness at the MWT: the "sleepy" group consisted of eight subjects (mean sleep latency (SL) = 23.2 ± 1.3 minutes) and the "alert" group included 7 subjects (LE = 37 ± 1.1 minutes). These two groups differ significantly at the MWT ($F (1, 13) = 65.8$, $p <0.001$). The "sleepy" group exhibited more inappropriate line crossings (154.3 ± 84) that the "alert" group (56.3 ± 36.8) ($F (1, 13) = 8.1$, $p <0.05$). Performances over time decreased significantly in the "sleepy group" when they remained stable in the "alert group" ($F (2, 26) = 13.35$, $p <0.001$).
Conclusion: In our sample, half of the patients suffer of excessive daytime sleepiness, which deteriorates significantly their driving performance.

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PREDICTORS OF SHORT AND LONG SLEEP IN CHINESE ADULTS, GUANGZHOU BIOBANK COHORT STUDY, 2003-2008

Hosseini Araghi M[1], Jiang C[3], Taheri S[1], Lam T[2], Zhang W[3], Cheng K[4], Thomas G[1]

[1]School of Health and Population Sciences, University of Birmingham, Birmingham, United Kingdom, [2]Department of Community Medicine, School of Public Health, University of Hong Kong, Hong Kong, China, [3]Guangzhou, No. 12 Hospital, Guangzhou, China, [4]Public Health, Epidemiology, and Biostatistics, University of Birmingham, Birmingham, United Kingdom

Introduction: Short (< 7 h) and long sleep durations (≥ 9 h) have recently been linked with increased mortality. Whether this association is causal and what pathways explain this association are unknown. Little is known about the sleep patterns of Chinese adults. The present study examined the sleep habits of Chinese adults and identified socio-demographic and health-related factors associated with short and long sleep.
Methods: Cross-sectional analysis of baseline data from the Guangzhou Biobank Cohort Study. Participants (n=30,026) were aged ≥50years. We excluded patients with poor health self report, mental illnesses, cancer and heart disease complications. We entered total number of 22,833 participants into our analysis. Socio-demographic and health-related factors were entered into multinomial logistic regression models predicting self-reported sleep duration.
Results: Short and long sleep were reported by 13.2% and 8.6% of participants respectively. Short sleep was associated with manual working (odds ratio [OR] = 1.19, 95% confidence interval (CI): 1.08, 1.32) and low income level (OR = 1.38, 95% CI: 1.16, 1.65); long sleep was associated with obesity (waist circumference >80cm) (OR = 1.13, 95% CI: 1.03, 1.24) and napping (OR = 2.84, 95% CI: 2.53, 3.18).
Conclusion: This study has shown that short and long sleep duration is associated with socio-demographic and health-related factors. Sleep problems in elderly people requires assessment and this must be accompanied by the treatment of underlying disorders and monitoring of future health.

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EFFECTS OF ALCOHOL ON SLEEP IN A REAL-HOME ENVIRONMENT

Butt M[1], Moturu ST[2], Aharony N[2], Pentland A[2], Khayal I[1,2]

[1]Engineering Systems and Management, Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates, [2]MIT Media Lab, MIT, Cambridge, MA, USA

Introduction: Previous studies attempting to understand the effect of alcohol on sleep have utilized laboratory polysomnography (PSG) and have not been able to capture real-home environment experiments. In this study, sleep parameters were assessed using a headband sleep-monitoring device (ZEO Inc.) to determine how these parameters are affected in a 14-night in-home study.
Methods: Twenty healthy individuals (10 couples), following their normal routine, were asked to use the head-band for 14 nights. They were asked to complete a questionnaire each morning about activities performed in the two hours prior to sleeping. Sleep parameters (Time in Deep Sleep (TDS), Wake time during sleep (WTDS), Time in REM (TREM), and awakenings) were recorded each night.
Results: Across all patients, nights when alcohol was consumed showed significantly different sleep parameters from nights when no alcohol was consumed for (with-alcohol vs. without-alcohol, p-value) (TDS: 51min vs. 64min, p=0.0068); (WTDS: 37min vs. 19min, p=0.0093). Subjects that reported consuming any alcohol, relative to subjects who did not during the study period, showed significantly different sleep parameters, (TDS: 55min vs. 77min, p<0.0001); (WTDS: 26min vs. 11min, p=0.01); (awakenings: 4.56 vs. 2.58, p=0.0007). We found that base no-alcohol nights sleep parameters of subjects who had any alcohol vs. those that never did during this period showed significantly different values in (TDS: 57min vs. 77min, p<0.0001); (WTDS: 22min vs. 11min, p=0.052); (awakenings:4.48 vs. 2.5,p=0.0013); (TREM:111min vs. 97min,p=0.03). For subjects who consumed alcohol, 54% showed improvements in TDS scores while 46% showed a reduction. Those negatively affected had significantly more heated arguments (p<0.03), 2 hours before sleeping, than those positively affected.
Conclusion: In conclusion, deep sleep, wake time and awakenings are heavily influenced by alcohol intake in the 2 hours prior to sleeping. This study suggests that detailed sampling of an individual's daily pre-sleep routine in a real-home setting will aid in determining the effects of alcohol on the subject.
Support (If Any): This work was partially sponsored by Masdar Institute Fellowship, MIT/Masdar Collaborative Research Grant and by AFOSR under Award Number FA9550-10-1-0122.

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RACIAL/ETHNIC DIFFERENCES IN SLEEP DURATION AND QUALITY IN A POPULATION SAMPLE

Carnethon M[1], Knutson KL[2], Kim K[1], de Chavez PJ[1], Goldberger JJ[3], Ng J[3], Liu K[1], Zee P[3]

[1]Preventive Medicine, Northwestern University, Chicago, IL, USA, [2]Medicine, University of Chicago, Chicago, IL, USA, [3]Medicine, Northwestern University, Chicago, IL, USA

Introduction: Prior studies report shorter sleep duration and higher rates of sleep disordered breathing (SDB) among non-whites as compared with non-Hispanic whites. However, few population-based studies used objective measures of sleep duration and SDB and included more than one non-white racial/ethnic comparison group. We tested whether objectively-determined sleep duration and self-reported sleep quality varied among black, white, Hispanic and Asian adults.
Methods: Men and women aged 35-64 living in Chicago, IL were randomly sampled using commercially available telephone listings and invited to participate in the Chicago Area Sleep Study. Participants were eligible if they had a low probability of SDB based on the Berlin Questionnaire, underwent 1 night of screening using in-home apnea detection equipment (ApneaLinkTM) and had 7 days of wrist actigraphy to determine sleep duration (n=585). Self-reported sleep quality (Epworth Sleepiness Score [ESS] and Pittsburgh Sleep Quality Index [PSQI]), health behaviors and cardiovascular disease risk factors were assessed.
Results: After excluding participants with an AHI>15, 439 participants (116 white, 129 black, 102 Asian, 92 Hispanic) remained. Sleep duration was significantly (p<0.01) shorter in black (mean=407.6 min), Hispanic (mean=416.5 min) and Asian (mean=418.1 min) participants than white participants (mean=444.2 min). Daytime sleepiness was similar among black (mean=6.99), Hispanic (mean=6.68) and white (mean=6.09) participants, but ESS was significantly higher (p=0.02 vs. white) in Asians (mean=7.43). PSQI scores were significantly (p<0.01) higher in black (mean=7.02) as compared with white (mean=5.28) participants, but there were no differences in Chinese (mean=5.52) or Hispanics (mean=6.07) vs. whites. Following statistical adjustment for age, race, sex, education, BMI, hypertension and diabetes, patterns of sleep duration, ESS and PSQI by race remained.
Conclusion: White participants slept significantly longer than other racial/ethnic groups even after adjustment for correlates of sleep duration. Despite differences in sleep duration, self-reported sleep quality was worse only in blacks, and sleepiness was higher only in Asians.
Support (If Any): Support was provided by NIH 4 R01 HL092140-03.

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SLEEP CONTINUITY IS STATISTICALLY CORRELATED WITH OBJECTIVE SLEEP DURATION INDEPENDENT OF OTHER FACTORS

Kishi A[1,2], Natelson BH[2], Palombini LO[3], Santos-Silva R[3], Bittencourt LA[3], Tufik S[3], Ayappa I[1], Rapoport DM[1]

[1]Department of Medicine, New York University School of Medicine, New York, NY, USA, [2]Pain & Fatigue Study Center, Beth Israel Medical Center and Albert Einstein College of Medicine, New York, NY, USA, [3]Department of Psychobiology, Federal University of São Paulo, São Paulo, Brazil

Introduction: Sleep duration varies widely across individuals without sleep pathology. We investigated whether shorter sleep duration (TST) in normal subjects is associated with increased stability (reflecting an overall more "efficient" pattern of sleep) or the opposite, i.e., shorter sleep duration and less continuous sleep occur in the same individuals.
Methods: We analyzed sleep hypnogram data from 2 separate datasets of in-lab NPSGs: 1) 134 healthy controls (age: 37 ± 13 years, RDI<15 with no EDS, fatigue or other respiratory illness) from the São Paulo Epidemiology study, and 2) 51 treated OSA patients (47 ± 13 years, RDI<15, Epworth Sleepiness Scale [ESS] 10 ± 5) who were treated with CPAP for at least 2 months (compliance: 5 ± 2 hrs). In each dataset we separated subjects into 2 subgroups by objective sleep duration (TST): shorter than (SS) and longer than (LS) the median value in that group. We compared traditional sleep variables and a variable assessing sleep continuity (survival curves of sleep run duration) between SS and LS in each dataset. We also analyzed the correlation between TST and median duration of sleep runs.
Results: Age, sex and body mass index did not differ significantly between SS and LS groups in either dataset. ESS was low in the São Paolo group, and did not differ between SS and LS in the treated OSA patients. For both datasets, sleep efficiency was significantly lower in SS groups than in LS groups (P<0.01 for each dataset). For both datasets, pooled sleep run durations (continuity) were also significantly shorter in SS groups (i.e., less continuous) than in LS groups (P<0.01 for both datasets). There was a significant correlation between TST and median duration of sleep runs in each dataset (r=0.23, P<0.01 for controls and r=0.45, P<0.01 for treated OSA patients).
Conclusion: In both healthy control and treated OSA patient datasets, shorter sleep was associated with decreased sleep efficiency and less sleep continuity. While we cannot completely rule out that both our datasets had subjects with chronic sleep deprivation and rebound, our data are most consistent with either SS subjects needing less continuous sleep or with SS subjects having a more rapid resolution of sleep pressure early in the night than LS subjects. This coexistence of short sleep and lower continuity has implications for the definition of "sleep phenotypes" and for the analysis of patients with disorders of sleep that may affect these parameters.
Support (If Any): This work was supported in part by a grant to AK from the Foundation for Research in Sleep Disorders and the Georg Waechter Memorial Foundation.

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SLEEPINESS AND SLEEP HABITS IN COLLEGIATE ATHLETES

Mah CD[1], Mah KE[1,2], Dement WC[1]

[1]Psychiatry and Behavioral Sciences, Stanford University, Stanford, CA, USA, [2]Pediatrics - Cardiology, Stanford University, Stanford, CA, USA

Introduction: Traditional athletic training regimens generally do not consider the role of sleep in athletic performance. Minimal research has been conducted on the collegiate athlete population and few of these studies have utilized standardized sleep questionnaires. The goal of this study was to investigate the sleep patterns of an entire student-athlete population at a university. The study aimed to assess levels of daytime sleepiness and potential effects on functioning including athletic performance.
Methods: 217 healthy students (age 18-23) participating in a varsity sport at Stanford University have thus far completed a questionnaire inquiring about their sleep habits during the 2011 fall academic quarter. Enrollment is ongoing with the target of including all Stanford student-athletes. The sports surveyed so far include Men's and Women's Basketball, Golf, Gymnastics, Tennis, Volleyball; Women's Field Hockey, Soccer, Softball, Synchronized Swimming; and Men's Waterpolo. The questionnaire included the following standardized sleep assessments: Pittsburgh Sleep Quality Index (PSQI), Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10), and Epworth Sleepiness Scale (ESS). The questionnaire also included questions directed at the unique situation of athletes sleeping and training in a college environment and traveling for competition.
Results: The mean Epworth Sleepiness Score was 9.1 ± 3.7. The mean Functional Outcomes of Sleep Questionnaire-10 Total Score was 7.6 ± 2.2. The mean global Pittsburgh Sleep Quality Index score was 4.9 ± 2.5. Examples of additional questions include environmental factors that impact sleep and whether athletes are able to obtain their ideal amount of sleep before games to be at peak performance. 30% reported sleep was negatively impacted by a roommate. 50% reported 'often' or 'always' obtaining their subjective ideal amount of sleep before games.
Conclusion: Collegiate athletes at one university appear to experience mild to moderate levels of daytime sleepiness. Athletes' responses about their sleep patterns suggest that the college environment and scheduling constraints may contribute to daytime sleepiness and affect athletic performance.

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EFFECTS OF POLYPHASIC SLEEP ON A SINGLE-HANDED SAILOR PERFORMANCE, WITH AND WITHOUT BLUE LIGHT EXPOSURE AT NIGHT

Andries D[1], Beaud-Goetschmann V[2], Rossetti A[1,3], Lecciso G[1], Haba-Rubio J[1], Heinzer RC[1]

[1]Center for Investigation and Research in Sleep (CIRS), Lausanne University Hospital, Lausanne, Switzerland, [2]Department of Neuropsychology and Neurorehabilitation, Lausanne University Hospital, Lausanne, Switzerland, [3]Neurology Department, Lausanne University Hospital, Lausanne, Switzerland

Introduction: For safety reasons, single-handed sailors are compelled to fragment their sleep in repeated short naps (polyphasic sleep). The aims of this study were 1) to determine the effect of a 4-days polyphasic sleep on reflexes, cognitive performance and sleep patterns 2) to assess the effects of blue light exposure at night on these parameters.
Methods: A sailor training for a single-handed transatlantic race was subjected to a polyphasic sleep consisting in 30 minutes naps every 90 minutes (12 naps per 24 hours) for 4 days under polysomnographic control. The first and last 24 hours were recorded in the lab and the remaining 48 hours while sailing on the Geneva Lake. The sailor was then submitted to the same protocol while exposed to a blue light during the nightime periods of wakefulness. Neuropsychological tests were performed at the beginning and at the end of each 4-days period. Psychomotor vigilance tests (PVT) were performed before each nap.
Results: Mean sleep duration was 25.3±21.8 min/nap. Between the first and fourth day, no significant alteration in PVT mean reaction time was observed (322 ± 122 vs 311 ± 70 ms, p = 0.6). We did not find any negative effect on memory, executive functions, attention, logical reasoning or self-assessment tasks, nor on risk-benefit management. With the blue light exposure, EEG spectral analysis showed a decrease in relative delta power (80.4±0.4 vs 71.2±1.5% p< 0.001) and an increase in relative alpha power (3.59±1.1 vs 15.6±4.7% p< 0.001). We also observed a deterioration in PVT reaction time (302 vs 421 ms p< 0.001) and a higher number of lapses (5.1 vs 14.0 p< 0.001).

Conclusion: Polyphasic sleep for 4 days does not alter the reflexes or cognitive functions. The application of blue light during wakefulness at night may have a deleterious effect on sleep pattern and cognitive performance.

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SLEEPINESS AND ITS RELATIONSHIP TO STAGE 4 SLEEP

Goldschmied J[1,2], Cheng P[1,2], Arnedt J[2], Hoffmann RF[2], Armitage R[2], Deldin PJ[1,2]
[1]Psychology, University of Michigan, Ann Arbor, MI, USA, [2]Sleep and Chronophysiology Laboratory, University of Michigan, Ann Arbor, MI, USA

Introduction: The Epworth Sleepiness Scale (ESS) is known as a reliable and valid self-report measure of daytime sleepiness that is often used in samples of Sleep-Disordered Breathing patients. Studies have shown, however, that the ESS is not consistently associated with the hypothesized, more objective sleepiness parameters, such as measures of Sleep Apnea severity or the Multiple Sleep Latency Test (Chervin & Aldrich, 1999). This study aims to identify the objective sleep correlates of the ESS.
Methods: A sample of unmedicated participants were recruited for a larger study, and asked to adhere to a strict 11pm-6am schedule for five nights, later confirmed by actigraphy and sleep diary. Prior to the first of four overnight visits including polysomography in the sleep laboratory, the participants were administered a battery of questionnaires, including the Epworth Sleepiness Scale and Visual Analogue Scales of Sleepiness.
Results: Analyses revealed that the ESS was highly correlated with the sleep parameter measuring total minutes of Stage 4 in the first NREM period ($r=.48$, $p<.05$), but was not associated with minutes of Stage 3 in the first NREM period ($r=-.04$). A measure of stage 4 density, calculated as the number of epochs of stage 4 sleep divided by total epochs in the NREM period, yielded a parameter that was highly correlated with ESS ($r=.48$, $p<.05$). Additionally, ESS was correlated with a pre-sleep VAS of sleepiness ($r=.44$, $p<.05$), but VAS sleepiness was not significantly associated with any objective sleep parameters.
Conclusion: In the current sample, we found that the ESS was highly correlated with the total time spent in stage 4 and the density of Stages 4 sleep in the first NREM period, but not time spent in stage 3. These results suggest that the concentration of high amplitude delta, reflected in the minutes and density of Stage 4 sleep may index the degree of sleepiness on the Epworth Sleepiness Scale.

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PEDUNCOLOPONTINE TEGMENTUM REGULATES AROUSAL AND HEART RATE DURING SLEEP: RECORDINGS IN LIVING HUMANS

Testani E[1], Vollono C[1], Dittoni S[1], Losurdo A[1], Colicchio S[1], Gnoni V[1], Di Lazzaro V[1], Mazzone P[2], Della Marca G[1]
[1]Neurosciences, Catholic University, Rome, Italy, [2]Functional and Stereotactic Neurosurgery, CTO, ASL RMC, Rome, Italy

Introduction: The Peduncolopontine Tegmentum (PPTg) has been recently indicated as a new potential target for Deep Brain Stimulation (DBS) in Parkinson's Disease (PD), in particular for ameliorating postural abnormalities and gait disturbances. The aim of the study was to analyze sleep EEG activity from scalp electrodes and, simultaneously, from electrodes implanted in the PPTg in patients treated with deep brain stimulation for Parkinson's disease.
Methods: Twelve consecutive patients, 10 men and 2 women, mean age 61.1±6.9 (range: 48-67) received a total of 20 leads implantation in the PPTg (8 bilateral and 4 monolateral implantations). Attended polysomnographic recording were performed in all patients during hospitalization, in spontaneous sleep, from 11 pm to 6 am in the next morning. Montage included: scalp EEG electrodes, EOG, submental muscles EMG, EKG, and 4 contacts within the deep PPTg electrode. Sleep staging was performed according to the standard criteria. EEG analysis included visual sleep scoring, spectral analysis and measures of EEG coherence.
Results: PPTg recording during wake showed mixed frequency activity, with prevalence of high frequency rhythms (mean frequency in the whole sample: 18 Hz). Low-frequency rhythms (3-6 Hz) appeared at sleep onset and persisted during NREM sleep stages. Activation of the PPTg (increase in frequency and amplitude of the PPTg signal) was constantly associated with EEG arousals recorded from the scalp, and with the transition from NREM to REM sleep. Moreover, a close correlation was observed between increase of EEG frequencies on the PPTg leads and heart rate. No ponto-genicolo-occiptal (PGO) waves were detected.
Conclusion: This study provides evidence, in living humans, that pontine tegmentum is involved in the regulation of arousal from sleep and in the transition from NREM to REM. Moreover, PPTg seems to play a major role in the regulation of heart rate during sleep, and in autonomic arousal.

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THE BDNF GENE POLYMORPHISM PREDICTS INTER-INDIVIDUAL VARIATION IN SLEEP ELECTROENCEPHALOGRAM

Guindalini C, Mazzotti DR, Souza AA, Castro LS, D'Aurea C, Andersen ML, Poyares D, Santos-Silva R, Bittencourt LA, Tufik S
Psychobiology, Universidade Federal de São Paulo, São Paulo, Brazil

Introduction: Brain-derived neurotrophic factor (BDNF) is important in regulating synaptic plasticity and connectivity in the brain. Studies have suggested that BDNF may also participate in the homeostatic regulation of sleep. The objective of the present study was to investigate the influence of the BDNF gene Val66Met functional polymorphism on sleep and sleep electroencephalogram (EEG) parameters in a large population-based sample.
Methods: A total of 353 participating in the Sao Paulo Epidemiologic Sleep Study were eligible for the study. Subjects with PSG or questionnaires indication of sleep disorders, as well as individuals taking medication which could influence sleep were excluded from the analysis Sleep stages and events were scored according to standardized criteria. Spectral analysis was conducted using the Fast Fourier Transformation of the oscillatory signals for each sleep stage and for each EEG electrode.
Results: Individuals with the Val/Val genotype were compared to Met carriers (Val/Met and Met/Met genotypes). No significant differences were observed for the macrostructural sleep parameters among the two BDNF genotype groups. On the other hand, Met carriers showed lower spectral power of alpha bandwidth in Stages 1, 2 and 3+4 of non-REM sleep, as well as in REM sleep in both EEG leads, central and parietal-occipital. In addition, lower theta power in Stages 2 and 3+4 and higher delta power during Stage 2 in the central region were also observed in Met allele carriers.
Conclusion: The results presented for this population-based study confirms previously reported findings suggesting a role of the BDNF gene polymorphism on the modulation of EEG profile, and extends this hypothesis to individuals with different age ranges. Further investigation of this and other polymorphic variants in potential candidate genes will help the characterization of the molecular bases of sleep.
Support (If Any): This work was supported by grants from AFIP, FAPESP and CNPq.

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ADENOSINE DEAMINASE G22A FUNCTIONAL POLYMORPHISM AFFECTS SLEEP ELECTROENCEPHALOGRAM SPECTRAL POWER

Mazzotti DR[1], Guindalini C[1], Souza AA[1], Sato JR[2], Santos-Silva R[1], Bittencourt LA[1], Tufik S[1]

[1]Psychobiology, Universidade Federal de São Paulo, Sao Paulo, Brazil, [2]Centro de Matemática, Computação e Cognição, Universidade Federal do ABC, Santo André, Brazil

Introduction: Slow wave oscillations in electroencephalogram (EEG) during sleep may reflect both sleep need and intensity, which implies in a homeostatic regulation. Adenosine is strongly implicated in sleep homeostasis and a single nucleotide polymorphism in adenosine deaminase gene (ADA G22A) has been associated with deeper and more efficient sleep. The present study verified the association between sleep EEG spectral power and ADA G22A polymorphism in a subsample of the Epidemiologic Sleep Study (EPISONO) of Sao Paulo city, Brazil.

Methods: Eight-hundred individuals participating in the EPISONO were subjected to an extensive sleep survey followed by full-night polysomnography and ADA G22A genotyping. Spectral analysis of the EEG was carried out in all individuals using the Fast Fourier Transformation of the oscillatory signals for each EEG electrode. A subsample of 125 individuals matched according to ADA genotype in regard to age, sex, body mass index, caffeine intake status, presence of sleep disturbance and medication that might disturb sleep was included in the analysis. A weighted general linear model was used to verify the effect of the polymorphism on spectral power. Results are represented by weighted mean spectral power (μV2/Hz) ± standard deviation.

Results: When compared to GG genotype carriers (N=61), A allele carriers (N=64) showed higher spectral power of delta bandwidth in Stage 1 (17.75±2.56 vs. 14.87±2.47; $p<0.001$) and Stages 3+4 (25.02±2.66 vs. 20.83±1.73; $p<0.001$) and higher spectral power of theta bandwidth in Stage 2 (5.67±1.36 vs. 4.13±1.03; $p<0.001$) and REM sleep (4.18±1.10 vs. 3.56±1.08; $p=0.002$).

Conclusion: The present findings suggest that the sleep of individuals carrying the A allele might be more intense, as evidenced by higher sleep EEG spectral power. Therefore, this polymorphism may exert a more refined effect on sleep by modifying specific components of sleep EEG, being an important source of variation in response to sleep homeostasis in humans.

Support (If Any): This work was supported by grants from AFIP, FAPESP and CNPq.

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MATHEMATICAL MODELING THE RELATION BETWEEN FRACTAL AND SPECTRAL CHARACTERISTICS OF HEART RATE VARIABILITY AT WAKEFULNESS AND DIFFERENT SLEEP PHASES IN MALE WORKERS

Ting H[1,2], Lai C[3], Huang R[4], Hsiao Y[4], Chang S[1], Chung A[1], Lee S[5]

[1]Sleep Medicine Center, Chung Shan Medical University Hospital, Taichung, Taiwan, [2]Institute of Medicine, Chung Shan Medical University, Taichung, Taiwan, [3]Department of Applied Information Sciences, Chung Shan Medical University, Taichung, Taiwan, [4]Department of Medical Image and Radiological Sciences, Chung Shan Medical University, Taichung, Taiwan, [5]Department of Physical Therapy, Graduate Institute of Rehabilitation Science, China Medical University, Taichung, Taiwan

Introduction: Both fractal and spectral characteristics of heart rate variability at wakefulness and different sleep phases could provide useful information on the aging, gender and cardiovascular prognostic issues. We try to model the relationship between these two parameters.

Methods: 94 male sedentary workers (44.1+-7.7 yrs, 27.3+-3.4 kg/m2) without healthy complaints were recruited. From an overnight polysomnogram, all first breathing event-/ ectopic-free five-min EKG wavelets, in pre-sleep wakefulness, non-rapid eye movement (N-REM) stage 2 sleep, slow wave sleep, and first and last terms of REM sleeps, were processed by detrended fluctuation and fast Fouier transform power spectral analyses to get exponent slope alpha, and powers of high-(HF), low-(LF), and very low-(VLF) frequencies.

Results: Initially, that alpha =a0+a1HF+a2LF+a3VLF+e1 (e: error) was set as a basic modeling. To avoid skew distributions and to fit better, the spectral power values should have natural logarithm transformed. By logistic regression analysis, values of lnHF and lnVLF, but not lnLF had excellent correlation with alpha values in five aforementioned stages (R2=0.550-0.796). Therefore, the modeling would evolve to alpha=b0+b1 lnHF+b2 lnVLF+ e2; and furthermore alpha=c0+c1Stage +c2lnHF+c3nVLF+c12Stage*lnHF+c13Stage*+lnVLF+e3, when stages' effect assumed. Due to Stage, Stage*lnHF and Stage*lnVLF were not statistically significant and absolute values of constants of lnHF and lnVLF were almost identical (-0.149 and 0.151, respectively), this model could be aggregated and simplified moreover as: alpha=d0+d1ln(VLF/HF)+e4 (R2=0.754).

Conclusion: The fractal exponent slope alpha values are positively correlated with the values of ln(VLF/HF) constantly at wakefulness and sleep stages, which possibly helpful for better understanding the relationship between these two surrogates of regulating cardiac sympathovagal balance.

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HABITUAL INTAKE OF IRON AND FERRITIN ASSOCIATED WITH SLEEP SYMPTOMS: DATA FROM NHANES

Sobowale AS[1,2], Jackson NJ[1,2], Gerstner JR[1,2], Knutson KL[3], Grandner MA[1,2]

[1]Center for Sleep and Circadian Neurobiology, Division of Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [3]Medicine, University of Chicago, Chicago, IL, USA

Introduction: Abnormal levels of iron or ferritin may produce sleep disturbances in adults. However, previous nationally-representative studies have not examined relationships between habitual dietary intake of iron or ferritin and sleep symptoms.

Methods: Adult (18+) data from the 2007-2008 National Health and Nutrition Examination Survey (NHANES) were used (N=4875). Self-reported sleep symptoms (Trouble Falling Asleep, Frequent Awakenings, Unrestful Sleep, and Daytime Sleepiness) were assessed and dichotomized as those reporting a problem ≤15 days/month or >15 days/month. Dietary iron and ferritin were assessed using standard, validated procedures. Levels were assessed continuously or categorically (Low/Normal/High, based on guidelines). Logistic regression examined whether iron or ferritin was associated with sleep symptoms. Odds ratios are interpreted as the change in odds of sleep symptoms associated with a doubling in iron or ferritin (continuous) or relative to normal (categorical). Adjusted analyses included age, gender, race/ethnicity, income, education, exercise (minutes), BMI, total calories, number of foods in the diet, comparison to typical diet, and special diet.

Results: In bivariate analyses, higher ferritin was seen in those with difficulty falling asleep (65.2mg>50.6mg,$p=0.015$) and frequent awakenings (61.8mg>51.7mg,$p=0.038$) and lower iron was seen in those with daytime sleepiness (82.9mg<87.9mg,$p=0.002$), and those with unrestful sleep were more likely to have high iron levels (3.16%>1.72%,$p=0.032$). In adjusted analyses, the association between ferritin and likelihood of frequent awakenings remained significant (OR=1.24,$p<0.05$). Relationships between iron and daytime sleepiness (OR=0.82,$p<0.10$), and high iron and unrestful sleep (OR=1.68,$p<0.10$), were reduced to trends and the relationship between ferritin and frequent awakenings was nonsignificant.

Conclusion: Overall, few associations were found between habitual iron/ferritin intake and sleep symptoms, though some relationships were

found for difficulty falling asleep, unrestful sleep, and daytime sleepiness. As these represented habitual intake, future research is needed to understand whether changes in levels, are associated with sleep disturbance in the general population.

Support (If Any): This work was supported by T32HL007713 and a pilot grant from the University of Pennsylvania CTSA(UL1RR024134). Also, we wish to thank the Centers for Disease Control and Prevention for collecting these data and making them available and the NHANES participants for providing data.

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RELATIONSHIPS BETWEEN VISUAL CREATIVITY AND SLEEP STRUCTURE AND QUALITY AMONG VISUAL ARTS AND PSYCHOLOGY STUDENTS

Shochat T[1], Ram N[2], Green A[3], Tzischinsky O[4]
[1]Nursing, University of Haifa, Haifa, Israel, [2]Graduate School of Creative Arts Therapies, University of Haifa, Haifa, Israel, [3]Sleep and Fatigue Institute, Assuta Medical Center, Tel Aviv, Israel, [4]Psychology, Emek Yezreel College, Emek Yezreel, Israel

Introduction: Sleep processes have a crucial impact on waking functions including creativity. Conversely, there is no evidence to date that creativity may affect sleep. This study explores relationships between visual creativity and the structure and quality of sleep in visual arts students and psychology students. It was hypothesized that visual creativity and practice of visual arts may predispose to alterations in sleep structure and to poor sleep quality. Specifically, it was predicted that: 1) among all students, increased visual creativity is related to altered sleep structure and reduced sleep quality; 2) visual arts students exhibit altered sleep structure and reduced sleep quality compared to psychology students.
Methods: Fourteen visual arts and 16 psychology students participated in the study. Visual creativity was measured using the Torrance Tests of Creative Thinking (TTCT). Sleep was assessed by overnight polysomnography (PSG) and the self-report Pittsburgh Sleep Quality Index (PSQI). Relationships between measures of creativity and sleep for the entire sample were computed by Pearson correlations, and group comparisons of sleep measures were performed by MANOVA.
Results: Increased visual creativity was related to poor subjective sleep quality (r=0.37, p=0.045). In particular, visual elaboration was related to sleep disturbances (r=0.39, p=0.035), daytime dysfunction (r=0.39, p=0.033) and overall sleep quality (r=0.39, p=0.036). Significant relationships were not found between measures of creativity and stages of sleep. Compared to psychology students, visual arts students reported more sleep disturbances (p=0.006), more daytime dysfunction (p=0.050), tended to report poorer overall sleep quality (p=0.088) and tended to have shorter stage 3 sleep percentage (8.50±2.44 vs. 6.68±2.86, p=0.07).
Conclusion: This study suggests that visual creativity and the practice of visual arts may constitute predispositions for poor sleep quality among young adults. Future investigations may characterize specific cognitive, emotional and behavioral mechanisms underlying the creative process and the structure and quality of sleep.

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DIETARY NUTRIENTS ASSOCIATED WITH SLEEP SYMPTOMS IN THE AMERICAN POPULATION

Knutson KL[1], Jackson NJ[2], Gerstner JR[2], Grandner MA[2]
[1]Medicine, University of Chicago, Chicago, IL, USA, [2]Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Sleep disturbances are associated with weight gain and metabolic dysregulation. The role of diet has been largely unexplored. Our aim was to determine which dietary nutrients were associated with self-reported sleep symptoms in a nationally-representative sample.
Methods: Data from the 2007-2008 NHANES were used (N=4,552). Survey items assessed Difficulty Falling Asleep, Frequent Awakenings, Unrestful Sleep, and Daytime Sleepiness. Responses were dichotomized into symptoms 16-30 days/month and <16 days/month. Analyses were adjusted for total calories, number of foods, special diet, comparison to typical intake, exercise (minutes), measured BMI and sociodemographics. Population-weighted, logistic regression analyses, with backwards-stepwise selection (removal p>0.10, inclusion p<0.05), examined which individual log-transformed nutrients were associated with sleep symptoms. Odds ratios (ORs) are interpreted as the change in odds of sleep symptoms associated with a doubling of nutrient.
Results: Contributors of unique variance for Difficulty Falling Asleep included (in order): Selenium (OR=0.63), Beta-Cryptoxanthin (OR=0.91), Hexanoic Acid (OR=1.13), Hexadecanoic Acid (OR=1.18), Eicosatetraenoic Acid (OR=1.14), Octadecatetraenoic Acid (OR=0.85), Hexadecenoic Acid (OR=1.12), and Vitamin A-RAE (OR=0.86). Contributors of unique variance for Frequent Awakenings included: Vitamin K (OR= 1.20), Vitamin A-RAE (OR= 0.88), Lycopene (OR=0.97), Fiber (OR= 0.70), Caffeine (OR= 1.05), Hexanoic Acid (OR= 1.34), Butanoic Acid (OR= 0.76), Water (OR= 1.05), Tap Water (OR=0.96), and frequent use of salt (OR=1.33). Contributors of unique variance for Unrestful Sleep included Vitamin C (OR=0.84), Beta-Carotene (OR=1.10), Moisture (OR= 1.33), Water (OR= 0.97), Selenium (OR= 0.74), and Cholesterol (OR= 1.18). Contributors for Sleepiness included: Cholesterol (OR= 1.30), Choline (OR= 0.50), Fiber (OR= 0.69), Vitamin C (OR= 0.84), Potassium (OR= 1.59), and Lutein/Zeaxanthin (OR= 1.14).
Conclusion: We found several significant relationships between specific nutrients and sleep symptoms after adjustment for many confounders and intercorrelations among nutrients. These results may help elucidate novel pathways linking sleep symptoms with diet/metabolism, and identify specific nutrients that may regulate sleep.

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RELATIONSHIP BETWEEN SLEEP DURATION AND BODY MASS INDEX DEPENDS ON AGE

Schopfer E[1], Jackson NJ[1], Patel NP[2], Grandner MA[1]
[1]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Respiratory Specialists and Department of Medicine, Reading Hospital and Medical Center, Reading, PA, USA

Introduction: Many studies have demonstrated associations between habitual sleep duration and mortality, as well as other adverse health outcomes, including obesity. It is unclear, though, whether the relationship between sleep duration and obesity depends on age, and, if so, how.
Methods: Data from the 2007-2008 NHANES were used(N=5,607), including respondents aged 16+ with complete data. Sleep duration and age were assessed via self-report and body mass index(BMI) was assessed objectively. Sleep duration was evaluated continuously (log-transformed) and categorically: VeryShort(<5hrs), Short(5-6hrs), and Long(9+hrs) versus Normal(7-8hrs) sleep. BMI was also assessed continuously and categorically(Underweight/Obese/Normal). Linear and Multinomial regression models examined the effects of BMI (continuous or categorical) on sleep duration adjusting for age, sex, exercise(mins), and household poverty-income-ratio. Interaction terms explored whether effects of BMI varied by age. Multinomial models report Relative Risk Ratio (RRR) as the effect size.
Results: Overall, increasing BMI was associated with less sleep(B=0.98,p<0.0001), as was obesity(B=0.97,p<0.0001). Underweight was positively associated with sleep duration(B=1.05,p=0.014). Significant interactions were present for continuous(p=0.019) and categorical(p=0.013) BMI, such that the negative relationship attenuates with age. Regarding categorical sleep duration, increasing BMI was associated with VeryShort(RRR=1.24,p<0.0001) and Short(RR=1.15,p<0.0001) sleep, and decreasing BMI was associated with Long sleep(RRR=0.88,p=0.025); an interaction was present for Long sleep(p=0.039), such that in the young there is a negative relationship between BMI and long sleep, which changes direction in the old. Obesity was associated with increased likelihood of VeryShort(RRR=1.81,p=0.0002) and Short(RRR=1.27,p=0.003) sleep.

An interaction for VeryShort sleep was found(p=0.003), with positive relationships between age and VeryShort sleep attenuated in the obese.
Conclusion: Body mass was related to sleep duration, though this depended on age. Overall, the sleep-BMI relationship attenuated in older adults, and the relationship between BMI and long sleep changes direction in mid-life. These findings suggest important insights regarding the role of age in the sleep-obesity relationship.
Support (If Any): This work was supported by T32HL007713 and a pilot grant from the University of Pennsylvania CTSA(UL1RR024134). Also, we wish to thank the Centers for Disease Control and Prevention for collecting these data and making them available and the NHANES participants for providing data.

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INFLAMMATION IN MONOZYGOTIC TWINS DISCORDANT FOR HABITUAL SLEEP DURATION

Watson NF[1,2,3,4], Collins C[3], Buchwald D[5,3], Vitiello MV[6,4], Pack A[7,8], Noonan C[5,3], Dansie EJ[3], Goldberg J[9,3,10]
[1]Neurology, University of Washington, Seattle, WA, USA, [2]University of Washington Medicine Sleep Center, University of Washington, Seattle, WA, USA, [3]University of Washington Twin Registry, University of Washington, Seattle, WA, USA, [4]Center for Research on the Management of Sleep Disturbances, University of Washington, Seattle, WA, USA, [5]Medicine, University of Washington, Seattle, WA, USA, [6]Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, USA, [7]Division of Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, PA, USA, [8]Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [9]Epidemiology, University of Washington, Seattle, WA, USA, [10]Vietnam Era Twin Registry, VA Epidemiologic Research and Information Center, Seattle, WA, USA

Introduction: Short sleep is associated with the activation of pro-inflammatory cytokines and inflammatory states such as obesity. Co-twin study methodologies are advantageous as they account for familial (e.g., genetics and shared environmental) confounding, allowing assessment of subtle environmental effects, such as the effect of short habitual sleep duration on serum cytokine levels. Therefore, we sought to investigate cytokines in monozygotic twins discordant for actigraphy phenotyped habitual sleep duration.
Methods: Sixteen monozygotic twin pairs (81% female, mean age 40.3 [SD=17.2] years), selected by subjective habitual sleep duration discordance of at least one hour per 24 hours, were phenotyped for habitual objective sleep duration with two weeks of actigraphy. Fasting blood samples were obtained in the morning of the final day of actigraphic measurement and assayed with Luminex multi-analyte profiling beads. Within-pair 24 hour sleep duration discordance was the independent variable, within-pair cytokine difference the dependent variable. Analysis included linear regression with robust standard error estimates. Results are presented as Pearson's correlation coefficients.
Results: For the total twin sample, mean 24-hour sleep duration was 444.8 minutes (SD=53.6 minutes; range 325.4 - 553.2 minutes). Mean within-pair 24 hour sleep duration discordance was 72.2 minutes (SD=28.1; range 45.9 - 137.1 minutes). IL-1 alpha levels correlated with 24 hour within-pair sleep duration discordance (r=0.55; p=0.03), with correlative trends observed for sIL-6 receptor (r=0.47; p=0.07), IL-10 (r=0.41; p=0.11), IL-6 (r=0.38; p=0.15), and IL-1 receptor antagonist (r=0.37; p=0.16) levels. Sleep duration discordance did not correlate with other inflammatory measures including TNF-alpha, C-reactive protein, and VCAM1.
Conclusion: By accounting for familial (e.g., genetic and shared environmental) confounding and measuring real life habitual sleep duration, our study suggests a complicated interplay of pro and anti-inflammatory mediators in shorter sleeping twins in (what may be considered) immunologically "compensated" sleep deprivation due to the habitual, and not experimental, nature of the sleep duration phenotype.
Support (If Any): Support: This study was supported by grants K23HL083350, P30NR011400, and a University of Washington General Clinical Research Center Pilot Grant.

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CHILD SLEEP, PARENT SLEEP, AND FAMILY CONTEXT

Gilbert L[1], Keller P[1], Motley S[1], Coe J[1], El-Sheikh M[2]
[1]Psychology, University of Kentucky, Lexington, KY, USA, [2]Human Development and Family Studies, Auburn University, Auburn, AL, USA

Introduction: Research suggests that parent sleep parameters and child sleep parameters impact each other bidirectionally (Kelly & El-Sheikh, 2011). Research investigating the mechanisms underlying this association is less common. Family context has a significant role in child sleep outcomes (Erath & Tu, 2011). Parent-child attachment is one family context that may be important for child sleep. Mother-infant attachment bonds have been shown to predict child sleep parameters (Morrell & Steele, 2003). Little is known about the role of parent-child attachment in predicting parent sleep parameters. The current study examines the effects of child sleep on mother and father sleep as moderated by parent-child attachment in middle childhood.
Methods: 64 children (aged 6 - 12 years) had their sleep monitored via actigraphy for one week. Average sleep minutes per night and sleep latency were derived. Children reported on their subjective sleep quality and their attachment to mother and father. Parents reported their average sleep minutes per night, sleep latency, daytime sleepiness, and subjective sleep quality. Data were analyzed using multiple regression.
Results: Child sleep latency and mother-child attachment interacted in the prediction of father sleep minutes, $\beta = -.35$, $p = .05$. Child sleep minutes interacted with mother-child attachment in the prediction of mother sleep minutes, $\beta = -.28$, $p = .055$. Child sleep minutes was positively related to mother sleep minutes in the context of child attachment insecurity. When attachment security was high, mothers had longer sleep duration regardless of child sleep minutes.
Conclusion: Child sleep and attachment affected both mother and father sleep, demonstrating the importance of studying child-father relationships. Attachment interacted with sleep to affect parent sleep parameters, suggesting an important contextual factor for future research.
Support (If Any): This project was supported by NIH grant R21 HD 062833 awarded to the first author.

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GENDER DIFFERENCES IN SLEEP QUALITY AND PATTERNS AMONG UNIVERSITY STUDENTS IN LEBANON: POTENTIAL INFLUENCING FACTORS AND IMPLICATIONS ON ACADEMIC STATUS

Kabrita CS[1], Hajjar-Muca T[2]
[1]Sciences, Notre Dame University-Louaize, Zouk Mosbeh, Lebanon, [2]Mathematics and Statistics, Notre Dame University-Louaize, Zouk Mosbeh, Lebanon

Introduction: Sleep is part of a daily biological rhythm that is indispensable for survival and maintenance of optimal health. Sleep deprivation and irregularity are acquired habits that threaten the psychological, physiological, behavioral and cognitive well-being of university students. This study aimed at assessing gender differences in sleep quality and delineating potential influencing factors and their impact on academic output among university students in Lebanon.
Methods: 578 students, aged 17-25, from 6 randomly selected private and public universities, completed a self-filled questionnaire inquiring about socio-demographic, health-risk behaviors, and personal health conditions; and evaluating sleep quality (Pittsburgh Sleep Quality Index), and daytime sleepiness (Epworth Sleepiness Scale) using standard scales. T-test, Chi-square, ANOVA, and Fisher's Exact tests were used for the analysis.

Results: 49.2% of respondents were sophomores and 51% were females. The mean age was significantly higher for males than females (20.08 ± 1.63 vs. 19.72 ± 1.40). Significantly more males were employed (37.4% vs. 24.4%), overworked (39.4% vs. 13.55%), and of high household income (12.5% vs. 6.4%). Concerning habits, significantly a higher percentage of males smoked (51.8% vs. 33.2%), consumed alcohol (61.8% vs. 35.7%), and caffeine (85.0% vs. 90.7%) and were physically active (66.9% vs. 45.5%). While more females suffered from depression (75.4% vs. 71.7%), daytime sleepiness (93.2% vs. 89.2%), poor sleep (68.6% vs. 56.3%), prolonged sleep onset latency (22.0% vs. 14.7%, respectively; $p<0.05$) and sleep inadequacy (50.8% vs. 42.2%), more males exhibited irregular bedtime habits (58.8% vs. 42.3%) and low sleep efficiency (69.6% vs. 57.6%). Academically, more males had poor performance (50.0% vs. 36.9%, $p<0.05$) and faced difficulties (10.6% vs. 8.7%).
Conclusion: Differences in sleep quality and patterns exist among university students in Lebanon. This may be linked to differential influences of certain biological and lifestyle habits and can result in serious implications on academic performance and daytime alertness.
Support (If Any): Supported by the Lebanese CNRS, grant Ref. 268.

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SLEEP DISPARITY, RACE/ETHNICITY, AND SOCIOECONOMIC POSITION

Grandner MA[1], Rattanaumpawan P[1], Jackson NJ[1], Patel NP[2]
[1]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Respiratory Specialists and Department of Medicine, Reading Hospital and Medical Center, Reading, PA, USA

Introduction: Growing evidence implicates sleep loss as a major public health issue. Race/ethnicity and socioeconomics may play an important role. This study assessed whether sleep symptoms were increased amongst minorities and/or the socioeconomically disadvantaged.
Methods: The 2007-2008 NHANES were used(N=4,081). Demographics included age, sex, race/ethnicity, marital status, and immigration. Socioeconomics(SES) included poverty, education, private insurance, and food-insecurity. Sleep symptoms included sleep latency(SL) >30mins, difficulty falling asleep, sleep maintenance problems, early-morning awakenings, unrestful sleep, sleepiness, snorting/gasping, and snoring. Logistic regression evaluated relationships between each demographic/SES variable and each sleep symptom, adjusted for all other demographic/SES factors, health and medical morbidity, and mental health.
Results: SL>30mins was associated with being female and Black/African-American and having less education, no private insurance, and food-insecurity; SL>30min was less common in Mexico-born respondents. Increased difficulty falling asleep was associated with female sex and food-insecurity; decreased rates were seen in racial/ethnic minorities, Mexico-born, and <9th-grade respondents. Increased sleep maintenance problems found with older age, female sex, and food-insecurity; decreased problems were found in minorities, immigrants, and lower education levels. Early-morning awakenings were associated with female sex and food-insecurity; decreased problems were seen in Black/African-American and Mexico-born respondents. Increased sleepiness was seen in younger, female and divorced respondents; less sleepiness was seen in minority, Mexico-born, and <9th-grade respondents. Increased unrestful sleep was seen in younger, female, and food-insecure respondents; lower levels were seen in minority, Mexico-born, and lower education respondents. Increased snorting/gasping was seen in older, male, Other-Hispanic/Latino, and 9th-11th-grade respondents; decreased snorting/gasping was seen in widowed, never-married, and other non-US-born respondents. Increased snoring was seen in older, male, Other-Hispanic/Latino, less-educated, and food-insecure respondents; decreased snoring was seen in widowed, separated, and never married respondents.
Conclusion: Sleep symptoms were associated with demographics and SES, even after adjustment for many potential confounders. This represents the first comprehensive, nationally-representative survey of sleep disparities.
Support (If Any): This work was supported by T32HL007713 and a pilot grant from the University of Pennsylvania CTSA(UL1RR024134). Also, we wish to thank the Centers for Disease Control and Prevention for collecting these data and making them available and the NHANES participants for providing data.

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DOES THE ASSOCIATION BETWEEN SLEEP DURATION AND BMI IN US ADOLESCENTS VARY BY SES?

Hale L[1], Reither E[2], Krueger PM[3], Peppard PE[4]
[1]Preventive Medicine, Stony Brook University, Stony Brook, NY, USA, [2]Sociology, Utah State University, Logan, UT, USA, [3]Health and Behavioral Sciences, University of Colorado, Denver, CO, USA, [4]Population Health Sciences, University of Wisconsin, Madison, WI, USA

Introduction: Short sleep duration is associated with increased body mass index (BMI) among children and adolescents. Proposed mechanisms for this association include increased caloric intake and decreased energy expenditure among short sleepers. Both sociobehavioral factors (e.g., night snacking, sedentary media use) and physiological factors (e.g., alterations in hunger-regulating hormones) may play a role in the association. We investigate whether the associations between sleep duration and BMI vary by socioeconomic status (SES), hypothesizing that adolescents from lower SES families (possibly representing more obesogenic environments) are more susceptible to weight gain from short sleep.
Methods: We use "Wave 1" data from the National Longitudinal Study of Adolescent Health (Add Health, N=6,111 female and 6,424 male adolescents). OLS regression analyses measured the association between self-reported sleep duration (<7 hours "very short", 7-9 hours "short", and >9 hours "recommended") and age-adjusted BMI Z-scores. Analyses are stratified by sex and two measures of SES (mother's education, household income).
Results: Among adolescent males, both very short and short sleep durations are associated with higher BMI for the three lowest categories of mother's education and household income; at the highest levels of household income (>$75,000/yr) and maternal education level (college educated), short sleep is not statistically significantly associated with BMI. Among female adolescents, the only statistically significant association between short sleep and BMI occurs in households with the highest maternal education level.
Conclusion: These results suggest that for adolescent boys, high SES may mitigate the association of short sleep and elevated BMI; the opposite may be true for girls. This research has implications for understanding gender and socioenvironmental differences in the association between sleep and obesity.
Support (If Any): This work is supported by an NIDDK grant, R21DK089414.

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NEIGHBORHOOD DISORDER MODERATES THE ASSOCIATION BETWEEN SLEEP AND SOCIOECONOMIC STATUS

Jarrin DC, Aloi A, McGrath JJ
Psychology, Concordia University, Montreal, QC, Canada

Introduction: Low socioeconomic status (SES) may predispose individuals to increased exposure of environmental stressors in their neighborhood (e.g., more crime, noise, violence, and crowding), which negatively affect sleep and confer risk to health outcomes, especially among low SES individuals. The aim of the current study was to evalu-

ate whether neighborhood disorder moderated the association between SES and sleep.

Methods: Participants were part of the Healthy Heart Project and included 168 adults aged 30-65 years (*M*=45, *SD*=6.47). Individual-level SES was measured with reports of income, education, and months without income. Neighborhood-level SES was measured using Canadian Census dataset and included data such as unemployment rate, median income, and percent below poverty cut-off. Neighborhood disorder was objectively measured using data from the Canadian Census dataset and the Montreal Crime Index and included data on population density and percent of violent crimes. Subjective measures of neighborhood disorder were based on participant's perception of neighbourhood safety. Using the Epworth Sleepiness Scale and the Pittsburgh Sleep Quality Index, participants rated the degree to which they experienced feelings of drowsiness during the day and their overall sleep quality over the past month, respectively.

Results: Results show that individual-level SES (R^2=.11, p<.05) and subjective neighborhood disorder (R^2=.03, p<.05) are associated with poor sleep. When entered simultaneously, neighborhood disorder moderated the association between individual-level SES and poor sleep (R^2=.13, p<.05). Thus, irrespective of neighborhood disorder perception, individuals with lower indices of individual-level SES have poor sleep. However, among individuals with high indices of individual-level SES, only those who perceived more neighborhood disorder had poorer sleep compared to those who perceived less neighborhood disorder.

Conclusion: Findings highlight the need to expand our framework to better understand the mechanisms by which SES influences sleep.

Support (If Any): This study was supported by grant CIHR (MOP89886).

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A GENE-CENTRIC AND GWAS-BASED ANALYSIS OF SLEEP EFFICIENCY WITHIN THE CLEVELAND FAMILY STUDY

Cade BE[1,2], Weng J[1], Larkin EK[3], Wang R[1,2], Zhu X[4], Patel SR[1,2], Redline S[1,2]

[1]Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Medicine, Harvard Medical School, Boston, MA, USA, [3]Medicine, Vanderbilt University Medical Center, Nashville, TN, USA, [4]Epidemiology and Biostatistics, Case Western Reserve University, Cleveland, OH, USA

Introduction: Consolidated sleep is likely to contribute to human health and well-being, yet few large studies have attempted to identify genetic variants influencing sleep efficiency at a genome-wide level in a well-controlled manner. Sleep traits are influenced by numerous environmental influences and co-morbidities which we controlled for to reduce environmental heterogeneity for SNP-outcome associations.

Methods: Sleep efficiency was derived from laboratory polysomnographic recordings of 242 European-American (EA) and 327 African-American (AA) members of the Cleveland Family Study with available genotyping results. Genotyping was performed using a customized Illumina chip (~50,000 SNPs covering ~2,000 heart, lung, blood and sleep genes) and an Affymetrix 6.0 chip (AA). Three covariate models were used (demographic factors and ancestry informative principal components); socio-behavioral exposures (alcohol, smoking, education level, working status); and co-morbidities (body mass index, depression, diabetes, hypertension, snoring), with each higher order model including prior variables. Calculations used the GWAF Framingham R routine, with genomic control applied via METAL. A principal components-based chip-wide significance threshold was determined by SimpleM (AA 9.8E-8, EA 2.3E-6), with a suggestive threshold defined as within an order of magnitude of significance.

Results: Significant EA chip-level associations were observed for rs2293554 (CASP8) and rs16959280 (GAS7) (all p < 1.6E-6). Suggestive results were observed at rs6435072 (CASP8, EA) and rs12801961 (near SLC35F2, AA). The strongest circadian rhythm-based candidate gene result was on the gene NPAS2 at rs13430345 (AA, p = 4.3E-4). Adjustment for socio-behavioral exposures and co-morbidities provided stronger levels of significance for rs17035317 and rs12801961 respectively than models that only adjusted for demographic factors.

Conclusion: Several novel genetic associations were observed with sleep efficiency, with multiple results more significant in models that adjusted for sources of variation in sleep outcomes. Future meta-analyses and replication studies are needed to confirm these findings.

Support (If Any): NIH/NHLBI T32 HL07901, HL46380.

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SLOW-WAVE EEG ACTIVITY, GLUCOSE TOLERANCE AND INSULIN SENSITIVITY IN ADOLESCENTS

Armitage R[1], Lee J[2], Bertram H[1], Hoffmann RF[1]
[1]Psychiatry, University of Michigan, Ann Arbor, MI, USA,
[2]Endocrinology, University of Michigan, Ann Arbor, MI, USA

Introduction: It has been shown that sleep loss is associated with hyperglycemia and increased insulin resistance. Specifically, it is a reduction in slow-wave sleep, rather than sleep loss per se, that is associated with insulin sensitivity in healthy adults. Adiposity is also a factor in insulin resistance. Thus far, the relationship between slow-wave EEG activity (SWA) and metabolic measures has not been explored in adolescents. The present study was undertaken to evaluate the relationship between the time course of SWA (spectral-analyzed EEG within NREM sleep) and response to a glucose tolerance test in healthy- and over-weight adolescents.
Methods: Eighteen 13-18 year olds (15.5 ± 1.4 years; 9 females) were recruited, of whom half were overweight (body mass index >85th%). Sleep was regularized for approximately one week, followed by a single night of sleep EEG recording in the home during a 12-hr overnight fast. A 2-hr oral glucose tolerance test (OGTT) was administered within a 2 week period. Correlations, regressions and ANOVA assessed the relationship among SWA, glucose and insulin, controlling for age, BMI and Tanner maturation scores.
Results: SWA was lowest in those individuals with the highest 2-hr glucose levels. Similarly, insulin levels were highest in those with the lowest SWA, with and without BMI as a covariate. SWA accounted for 40-52% of the variance in glucose and insulin response to the OGTT. Moreover, the analysis of the SWA time course indicated that those with slowest decay of SWA across the night were the most impaired metabolically.
Conclusion: SWA and its time course predict response to an OGTT independent of BMI. Low accumulation of SWA with a slow dissipation across NREM sleep is associated with hypergylcemia and insulin resistance. These results suggest that SWA homeostasis serves an important metabolic homeostatic function.
Support (If Any): NIDDK - DK020572 pilot funding to RA.

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EVENING-TO-MORNING CHANGES IN ENDOTHELIAL FUNCTION ARE ALTERED IN CHILDREN WITH OSA

Samiei A, Bhattacharjee R, Gozal LK
Pediatrics, University of Chicago, Chicago, IL, USA

Introduction: Obstructive sleep apnea (OSA) imposes an increased risk for altered endothelial function as assessed by post-occlusive reperfusion (POR) patterns in both obese and non-obese children. Most studies have however relied on a single measurement in the morning, and have not explored changes in POR overnight. Furthermore, most studies have assessed POR using either laser Doppler or ultrasound techniques. In this study, we explored the effect of OSA on POR using pulse-arterial tonometry approaches.
Methods: Pre-pubertal non-hypertensive children being evaluated for habitual snoring were recruited and underwent overnight polysomnographic evaluation and BMI assessments. Endothelial function was assessed both during evening and in a morning fasted state, using a modified hyperemic test involving cuff-induced occlusion of the radial and ulnar arteries for 60 sec followed by reperfusion. To assess POR, digital pulse wave amplitude was measured with a PAT device placed on the tip of each index finger (Endo-PAT2000, Itamar Medical, Caesarea, Israel). Endothelial function was measured via a reactive hyperemia (RH)-PAT ratio. An RH-PAT protocol consists of a 5 min baseline measurement, after which a blood pressure cuff on the test arm was inflated to 60 mmHg above baseline systolic blood pressure or at least 120 mmHg for 1 min. Occlusion of pulsatile arterial flow was confirmed by the reduction of the PAT tracing to zero. After 5 min, the cuff was deflated and the PAT tracing was recorded for a further 5 min. The ratio of the PAT signal after cuff release compared with baseline was calculated through an algorithm automatically normalizing for baseline signal and indexed to the contra lateral arm. The calculated ratio reflects POR and changes in evening POR to morning POR being computed and compared.
Results: 23 children have thus far been recruited and completed the protocol (mean age: 7.17±2.0 years; mean BMI z-score: 1.0 ± 1.51; mean OAHI: 7.0±9.8/hrTST). Preliminary analyses demonstrate that with increasing OSA severity reduced POR evening to morning changes emerge.
Conclusion: As in previous studies, this study confirms that OSA imposes adverse effects on endothelial function. Digital pulse wave amplitude measurements offer a simple and non-invasive approach to longitudinal assessments of endothelial function in children.

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REVERSIBLE BRAIN INJURY WITH TREATMENT OF CHILDHOOD OBSTRUCTIVE SLEEP APNEA

Halbower AC[1], Janusz J[2], Brown M[3], Strain J[5], Friedman N[6], Green C[2], Accurso F[1], Smith P[4]
[1]Pediatrics, University of Colorado Denver, Aurora, CO, USA,
[2]Neurology, Children's Hospital Colorado, Aurora, CO, USA,
[3]Radiology, University of Colorado Denver, Aurora, CO, USA,
[4]Medicine, Johns Hopkins University, Baltimore, MD, USA,
[5]Radiology, Children's Hospital Colorado, Aurora, CO, USA, [6]Dept of Otolaryngology/ Head and Neck Surgery, University of Colorado Denver, Aurora, CO, USA

Introduction: To determine the reversibility of brain neuronal abnormalities with treatment of Pediatric Obstructive Sleep Apnea (OSA), OSA patients were compared to healthy controls (HC) matched by age, gender, race, and SES. We hypothesized that neuronal alterations of the hippocampus and frontal cortex associated with childhood sleep-disordered breathing would reverse with treatment.
Methods: OSA patients (N=17) and healthy controls (N=11) age 8-11 years, Tanner stage I-II, underwent neuropsychological tests spanning 7 domains. Magnetic resonance spectroscopy imaging of the brain was performed in 15 OSA and 7 HC. OSA patients underwent Adenotonsillectomy followed by monitored CPAP if AHI>3, or nasal treatments if AHI 2-3. Six months after treatment, 11 OSA patients returned for brain imaging and neuropsychological tests compared to HC.
Results: Children were mean age 10 yr, 55% male, 50% Hispanic, 20% AA. Mean OAHI for OSA patients = 13.6, for HC =0 .3. Confirming our previous findings, N-acetyl aspartate to choline ratios (NAA/Cho) in the left hippocampus and left frontal cortex were significantly decreased in OSA patients compared to HC (p=0.03 and 0.04 respectively). OSA patients had a significant decrease in the executive function of working memory (p= 0.00), attention (p=0.00) and verbal memory (p=0.02. After treatment, both left and right frontal cortex neuronal metabolites normalized (p= 0.03) while the hippocampal metabolites did not. Verbal memory improved (p=0.04) and improvements in attention were correlated with the normalization of NAA/Cho in the frontal lobes (r=0.67, p=0.05).
Conclusion: This is the first study demonstrating that brain metabolites of the neuronal network responsible for attention and executive function, the frontal cortex, normalize with treatment of pediatric OSA. We speculate that earlier diagnosis and treatment of childhood OSA may improve the trajectory of development, thus implying the need to identify these patients and expedite management.
Support (If Any): NIH/NCRR K23 RR024257 Colorado CTSI NIH/ NCRR 1 UL 1RR025780-01 University of Colorado Deptartment of Pediatrics.

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UTILITY OF QUANTITATIVE ESOPHAGEAL PRESSURES DURING POLYSOMNOGRAPHY IN CHILDREN

Chervin RD[1], Ruzicka DL[1], Hoban TF[2], Fetterolf J[1], Garetz S[3], Guire K[4], Dillon JE[5], Felt B[6], Hodges E[7], Giordani B[7]

[1]Sleep Disorders Center and Department of Neurology, University of Michigan, Ann Arbor, MI, USA, [2]Sleep Disorders Center and Dvision of Pediatric Neurology, Department of Pediatrics and Communicable Diseases, University of Michigan, Ann Arbor, MI, USA, [3]Sleep Disorders Center and Department of Otolaryngology/ Head and Neck Surgery, University of Michigan, Ann Arbor, MI, USA, [4]Department of Biostatistics, University of Michigan, Ann Arbor, MI, USA, [5]Division of Child and Adolescent Psychiatry, University of Michigan, Ann Arbor, MI, USA, [6]Division of Behavioral and Developmental Pediatrics, University of Michigan, Ann Arbor, MI, USA, [7]Neuropsychology Section, University of Michigan, Ann Arbor, MI, USA

Introduction: Esophageal pressure monitoring during pediatric polysomnography provides a gold-standard evaluation for work of breathing, but few studies have directly examined the additional clinical utility provided by the procedure. We therefore investigated the predictive value of a standard pediatric apnea/hypopnea index in comparison to quantitative esophageal pressures with respect to some key health outcomes in pediatric obstructive sleep apnea (OSA), namely neurobehavioral morbidity and its response to adenotonsillectomy.

Methods: Children aged 7.8±2.8 [s.d.] years (n=81, including 44 boys) underwent traditional laboratory-based polysomnography, with esophageal pressure monitoring, using standard American Academy of Sleep Medicine (AASM) 2007 procedures for children. Evaluations also included multiple sleep latency tests, full psychiatric evaluations, validated parental behavior rating scales, and cognitive testing by a neuropsychometrist, all just before clinically indicated adenotonsillectomy, and again 7.2±0.8 months later. Esophageal pressures, nasal pressure monitoring, and oro-nasal thermocouples were used to identify AASM-2007-defined respiratory events. In addition, we recorded the most negative esophageal pressure during sleep, and percent of sleep time spent with pressures lower than -10 cm of water.

Results: Both OSA and neurobehavioral measures improved after adenotonsillectomy. Before surgery, one or both quantitative esophageal pressure measures predicted a disruptive behavior disorder (DSM-IV-defined Attention-Deficit/Hyperactivity Disorder, Conduct Disorder, or Oppositional Defiant Disorder) and more sleepiness, and their future improvement after surgery (each $p<.05$). The AASM-2007 pediatric apnea/hypopnea index did not predict these morbidities or treatment outcomes (each $p>.10$). Addition of respiratory effort-related arousals to the apnea/hypopnea index, to create an AASM-2007 respiratory disturbance index, did not increase the predictive value. Neither the pre-operative apnea/hypopnea indices nor quantitative esophageal pressures predicted baseline hyperactive behavior ratings, cognitive performance, or improvement in these measures after surgery.

Conclusion: Quantitative esophageal pressures during sleep appear to add predictive value for mental health diagnoses and daytime sleepiness, if not other neurobehavioral outcomes of pediatric OSA.

Support (If Any): NIH grants R01 HL08094 , R01 HL105999, UL1 RR024986, and M01 RR000042.

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REM-RELATED BREATHING ABNORMALITIES IN ASTHMATIC CHILDREN WITH OBSTRUCTIVE SLEEP APNEA (OSA)

Nino G[1], Zhu J[2], Gutierrez M[3], Nino CL[4]

[1]Division of Pediatric Pulmonology, Pennsylvania State University, Hershey, PA, USA, [2]Department of Public Health Sciences, Pennsylvania State University, Hershey, PA, USA, [3]Division of Pulmonary, Allergy and Critical Care, Pennsylvania State University, Hershey, PA, USA, [4]Department of Electronics Engineering, Javeriana University, Bogota, Colombia

Introduction: Asthma is associated with an increased risk of OSA in children. We hypothesized that the connection between asthma and OSA involves a higher prevalence of REM-related breathing abnormalities in asthmatic children with OSA. In addition, we investigated if the presence of REM-related OSA in asthmatic children is linked to obesity or poor asthma control.

Methods: We conducted a retrospective cross-sectional analysis of 142 children aged 2-12 years with OSA diagnosed by polysomnography (PSG) in our sleep center. Asthma classification was based on pre-established clinical criteria. Children with cardio-respiratory comorbidities or dysmorphic syndromes were excluded. Demographics and other relevant variables were recorded. Outcomes included PSG parameters, maximal %SaO2 REM desaturations and presence of REM sleep disordered breathing (RSDB) defined as OAHI REM:NREM ratio >2. Two-sample T-test was used to compare continuous variables and chi-square test for the proportion of binary outcomes. Multivariate general linear model was built to study the joint effect of asthma and OSA parameters with control for potential confounders. Tukey's tests were used for pairwise comparisons (significance level $p<0.05$).

Results: Baseline respiratory parameters, OAHI severity and oxygenation during NREM sleep were unaffected by the presence of asthma in children with OSA. In contrast, maximal %SaO2 REM desaturation, REM OAHI and prevalence of RSBD in children with moderate-severe OSA were significantly increased in asthmatic children with OSA compared to subjects with OSA alone. Multivariate analysis revealed that the association between asthma and REM-related OSA parameters is independent of asthma control, BMI, age and gender.

Conclusion: These results demonstrate that asthma is associated with REM-related breathing abnormalities in children with moderate-severe OSA. The link between asthma and REM-related OSA is independent of asthma control, obesity, age and gender. Further research is needed to delineate the sleep neurobiological mechanisms that modulate the phenotypical expression of OSA in asthmatic children.

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EVALUATION OF A NEW PEDIATRIC POSITIVE AIRWAY PRESSURE MASK

Kushida CA[1], Halbower A[2], Kryger MH[3], Pelayo R[1], Assalone V[3], Cardell C[1], Huston S[2], Willes L[4], Mendoza J[5], Wimms AJ[5]

[1]Stanford University, Stanford, CA, USA, [2]Children's Hospital Colorado and The University of Colorado Anschutz Medical Campus, Aurora, CO, USA, [3]Gaylord Sleep Medicine, Wallingford, CT, USA, [4]Willes Consulting Group, Inc., San Diego, CA, USA, [5]ResMed Science Center, ResMed Ltd., Sydney, NSW, Australia

Introduction: A frequent problem in treating children with PAP therapy is the lack of availability of pediatric masks, particularly for those with craniofacial anomalies. This study's primary endpoint was to assess AHI equivalence to a patient's current mask with a specially designed pediatric mask; secondary endpoints were to assess whether unintentional leak is reduced compared to the patient's current mask, patient/legal guardian satisfaction with the mask, and treatment adherence.

Methods: Children (age 2-7 yrs) with OSA who used PAP (CPAP or BPAP) for at least 1 month were enrolled in a multicenter (Stanford

University, CA; Children's Hospital Colorado; Gaylord Sleep Medicine, Wallingford, CT) IRB-approved study. Patients were assessed at three clinic visits and 2 follow-up phone calls. Baseline assessment at the 1st visit included the following data collection from guardians: medical history, current PAP pressures, average usage, PSG results, and PAP comfort scores (visual analog scale). Patients were set up with the Pixi (Nemo) mask and a VPAP III ST-A flow generator (ResMed Ltd, Sydney, NSW, Australia), and were instructed to use their current mask and the VPAP III ST-A for a minimum of 10 nights at home to acclimate to the device. Once acclimated, their current mask was switched to the Pixi mask, and used for a minimum of 2 nights prior to returning to the site for the 2nd visit, in which patients had a PSG study with the Pixi mask. Subsequent to the PSG study, patients were instructed to use the Pixi mask at home for a minimum of 21 nights. At the final visit, adherence data were downloaded, and guardians completed the final PAP comfort questionnaire and a usability questionnaire for the Pixi mask.
Results: 16 patients (12F, 4M; 6.0 ± 1.6 yrs) were enrolled and 14 were considered evaluable in terms of the primary endpoint. For treatment efficacy, the mean AHI on their current vs. Pixi mask was 2.7 ± 5.6 vs. 1.2 ± 1.5, respectively (p = 0.3538). For the secondary endpoints, as compared to their current mask, maximum leak was significantly less for the Pixi mask; patients reported significantly more restful sleep, and less trouble getting/staying asleep with the Pixi mask; and the average daily usage was 1 hr less for the Pixi mask (8.4 ± 2.4 vs. 7.2 ± 2.5 hrs, p = 0.0035). No adverse events related to the study mask were reported.
Conclusion: There is an unmet need for pediatric masks, and these data indicate that the Pixi mask can address this need by adequately treating OSA in children.
Support (If Any): ResMed Corp, San Diego, CA.

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NIGHT TO NIGHT VARIABILITY OF POLYSOMNOGRAPHIC PARAMETERS IN OBESE CHILDREN AND ADOLESCENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

Chaudhry H, Brockbank J, Vandyke R, Fenchel M, Dixon M, Amin R, Simakajornboon N
Pediatrics, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

Introduction: There is limited information on the night to night variation of polysomnography parameters in children with OSA. While one study showed that there is little night to night variation in sleep and respiratory parameters, the other study demonstrated night to night variation in only sleep parameters. However, these studies focused only non-obese patients. Since obesity is common among children and adolescents with OSA, we conducted this study to evaluate the night to night variation in morbidly obese compared to non-obese patients.
Methods: A prospective study was conducted in children and adolescents with OSA. These subjects underwent 2 sleep studies within 3 months apart. No intervention was done between the studies. Patients with predominately central sleep apnea or significant periodic limb movement disorders were excluded. Differences in sleep measures for the 2 studies were examined with repeated measures analyses.
Results: 26 children and adolescents with 52 sleep studies met the criteria for entry into analysis. The average age was 15.3 ± 2.1 yo. The average obstructive apnea/ hypopnea index (OI) was 14.5 ± 15.4. For sleep architectures, there were significant differences between the first(A) and second night(B) in sleep efficiency (76.2±2.0%[A] vs 84.1±2.0[B], P<0.05), arousal index (19.6±2.4/hr) [A] vs 15.0±2.4[B], P<0.05), and % NREM1 (4.7±0.5%[A] vs 2.7±0.5[B], P<0.05). There was no significant difference between the nights in respiratory disturbance index or OI (15.6±3.0/hr) [A] vs 13.4±3.0[B], P=NS). However, subgroup analysis of patients with BMI>40 showed a trend toward difference in OI (18.6±4.2/hr) [A] vs 12.3± 4.2[B], P=0.13). The intra-class correlation (ICC) coefficients demonstrated a significant variation in OI only in obese patients (ICC=0.57 for BMI >40 and 0.91 for BMI<40).
Conclusion: There is a significant night to night variation in sleep parameters in children and adolescents with OSA. In addition, morbidly obese patients with OSA have significant night to night variability in respiratory parameters. This information is important in evaluating obese children for sleep disordered breathing. Further studies are needed to evaluate factors that play a role in night to night variation in obese population.
Support (If Any): Cincinnati Children's Hospital Research Fund.

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ANATOMIC PREDICTORS OF INCOMPLETE REMISSION IN PEDIATRIC SLEEP APNEICS AFTER TONSILLECTOMY AND ADENOIDECTOMY: A 3DCT ANALYSIS

Lin C[1,2], Huang Y[1,3], Guilleminault C[4]
[1]Sleep Center, Chang Gung Memorial Hospital and Chang Gung University, Taoyuan, Taiwan, [2]Craniofacial Center, Chang Gung Memorial Hospital and Chang Gung University, Taoyuan, Taiwan, [3]Pediatric Pschiatry, Chang Gung Memorial Hospital and Chang Gung University, Taoyuan, Taiwan, [4]Div. Sleep Medicine, Stanford University, Redwood City, CA, USA

Introduction: High incidence of recurrence or refraction to treatment has been observed in pediatric sleep apneics after tonsillectomy and adenoidectomy. The purpose of this study was to evaluate the anatomical predisposing factors in pediatric patient refractory to tonsillectomy and adenoidectomy.
Methods: From September 2010 to August 2011, 41 (12 females) patients (aged 12.7± 3.3), were noted to have recurrent symptom and signs after adeno-tonsillectomy treatment for obstructive sleep apnea. The relapse or incomplete remission of sleep disordered breathing was confirmed by over-night polysomnography in the sleep center. With positive findings in the head and neck examination, 3DCT evaluation of head and neck region including pharyngeal airway were provided to the patients. Three-dimensional cephalometry and anatomical factors were studied and treatment recommendations were explained to the patients and/or guardian.
Results: The AHI at symptom relapse was 6.7±4.4/hr. All the patients were found still having more than one anatomic predisposing factor to sleep disordered breathing. The risk factors included hypertrophic turbinates (96%), deviated nasal septum (38%), regeneration of adenoid tissue (21%), Mallampati score higher than 3 (77%), retrognathism (46%), and malocclusion (93%). During the study period, nine patients received secondary treatment with improved polysomnographic results.
Conclusion: Continual follow up and sleep study is recommended for pediatric patients after tonsillectomy and adenoidectomy. Complete anatomical evaluation is indicated whenever relapse of symptoms and signs was noted or recurrence was confirmed by polysomnography.

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THE RELATIONSHIP BETWEEN POVERTY, POOR SLEEP HYGIENE, AND SHORTENED NIGHTTIME SLEEP DURATION IN TODDLERS

Calamaro CJ[1], Hager E[2], Hurley K[2], Patel F[2], Black M[2]
[1]Family and Community Health, University of Maryland School of Nursing, Baltimore, MD, USA, [2]Department of Pediatrics, University of Maryland School of Medicine, Baltimore, MD, USA

Introduction: Poverty is a risk factor for adverse health outcomes in children. Few studies have examined how living in poverty relates to sleep hygiene (routine) and duration. Lack of structure/routine common among families living in poverty may interfere with sleep hygiene, thus impacting nighttime sleep duration.
Methods: 240 low-income mother-toddler dyads were recruited. Mothers reported on income/dependents (poverty calculated, 2009 US Census Bureau) and completed the Brief Infant Sleep Questionnaire (BISQ). Hours of nighttime sleep were calculated. Based on factor analysis of

BISQ scores, a 6-item sleep hygiene score was formed. Regression models assessed relations among poverty, sleep hygiene, and nighttime sleep duration. Using Sobel's Test (Baron & Kenny's criteria), we examined whether the relation between poverty and nighttime sleep was attenuated when including sleep hygiene in the model.
Results: Toddlers were 53% male, 69% Black, mean age (months) 20.2±5.6. Mean poverty ratio was 0.8 (range 0.1-3.2), with 68.1% living in poverty (poverty ratio < 1.0). Average nighttime sleep duration was 9.1hrs (5.5-13hrs). Mean sleep hygiene score was 3.9±1.4, composed of the following items (frequency): sleep onset time >9pm (63%), >1 hour to fall asleep (11.4%), awakenings >1/night (26.9%), slept in bed with parent/sibling (32.1%), slept in parent's room (60.4%), sleep reported as problem (15.8%). Poverty predicted lower toddler nighttime sleep (β=0.43;CI:0.06-0.80;p=0.022) and worse sleep hygiene (β=0.62;CI:0.23-1.0;p=0.002). The relationship between poverty and nighttime sleep was attenuated with the introduction of sleep hygiene (β=0.21;CI:-0.16-0.59;p=0.266; Sobel's Test =2.33;p=0.02), suggesting that sleep hygiene mediated the relation between poverty and nighttime sleep duration.
Conclusion: Among low-income families, living in poverty is characterized by poor sleep hygiene, resulting in shortened nighttime sleep duration among toddlers. Given the adverse effects of shortened sleep duration on child development, strategies are needed to incorporate sleep hygiene into pediatric services for low-income families with toddlers.
Support (If Any): USDA #2006-04808.

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SLEEP AND DEVELOPMENT IN INFANTS AND TODDLERS

Mindell JA[1,2], DuMond C[3], Gerdes M[1], Gunn E[4]
[1]Children's Hospital of Philadelphia, Philadelphia, PA, USA, [2]Saint Joseph's University, Philadelphia, PA, USA, [3]Upstate Golisano Children's Hospital, Syracuse, NY, USA, [4]Johnson & Johnson Consumer Products Company, Skillman, NJ, USA

Introduction: The aim of this study was to assess the relationship between sleep and overall development in infants and toddlers.
Methods: A longitudinal study was conducted with 97 infants/toddlers (starting age = 3 to 12 months). Measures completed included the Brief Infant Sleep Questionnaire (3, 6, 9, 12 months), the Bayley Scales of Infant Development-III (cognitive, language, and motor development; 12 months), and the Infant-Toddler Social and Emotional Assessment (competence, internalizing, and externalizing; 12 months).
Results: Bivariate correlations were first conducted, with significant variables then entered into linear regressions. Infant sleep at 3 months accounted for 25% of the variance in motor development (same routine) and 31% of competence (bedtime, total sleep time) at 12 months. At 6 months, sleep variables predicted 12-month language (sleep onset latency, same routine, bedtime; 30%), externalizing (nightwakings, total sleep time; 32%), internalizing (nightwakings, daytime sleep; 19%) and competence (waketime; 13%) scores. At 9 months of age, sleep variables were significantly related to all 12-month developmental outcomes, such that cognitive (20%), language (10%), and motor scores (7%) were predicted by nightwakings alone. Externalizing was accounted for by nightwakings and same routine (15%), competence by nightwakings and longest stretch asleep (13%) and internalizing by daytime sleep (8%). Finally concurrent sleep at 12-months accounted for significant variance in cognitive (night wakings, longest stretch asleep; 12%), motor (longest stretch asleep, total nighttime sleep; 9%) and internalizing (bedtime, waketime, total nighttime sleep; 12%) outcomes.
Conclusion: Overall, maternal report of infant sleep from 3-12 months of age was associated with development outcomes at 12 months of age. At 3 months of age, only parent-initiated sleep factors (bedtime and same routine) predicted long-term outcomes. By 9-months of age, primarily child-oriented sleep variables (sleep consolidation and nighttime sleep) predicted 12-month development. Interestingly, sleep at 6 and 9 months was more highly predictive of developmental outcomes than concurrent sleep.
Support (If Any): This study was supported by Johnson & Johnson Consumer Products Company, Division of Johnson & Johnson Consumer Companies, Inc.

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TEEN SLEEP, MEDIA EXPOSURE, AND PHYSICAL ACTIVITY: RESULTS FROM THE 2009 YOUTH RISK BEHAVIOR SURVEY

Fitzgerald CT[1], Messias E[2], Altintas N[1], Burman D[1], Buysse DJ[1]
[1]Pulmonary, University of Pittsburgh Medical Center, Pittsburgh, PA, USA, [2]Psychiatry, University of Arkansas for Medical Sciences, Little Rock, AR, USA

Introduction: To quantify the association between media exposure, vigorous physical activity, and self-reported sleep time in teens.
Methods: Data from the 2009 Youth Risk Behavioral Survey (YRBS) was analyzed, producing a nationally representative sample of 9th through 12th grade students (total sample N=16,410, average age 16 years). Weights were applied to adjust for non-response and oversampling. Descriptive statistics are presented for each variable, by outcome. Exposure variables included physical activity as well as light (considered to be 1hr or less/day) or heavy (considered to be 3hrs or more/day) media usage. Media usage was obtained with two questions: "On an average school day, how many hours of TV do you watch?" and "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work?" Physical activity was assessed with the question "On how many of the past 7 days did you exercise or participate in physical activity for at least 20 minutes that made you sweat and breathe hard…" The outcome variable of self-reported sleep duration was measured with the question: "On an average school night, how many hour of sleep do you get?" Logistic regression models were used to adjust for age, gender, race/ethnicity, presence of sadness, and substance abuse.
Results: Teens sleeping less than 7hrs/night were more likely to report heavy videogame/Internet use (adjusted odds ratio 1.6 (95% C.I. 1.4-1.8)) while being less likely to meet recommended physical activity levels (adjusted odds ratios 0.7 (95% C.I. 0.7-0.8)). TV exposure did not display statistical association with self-reported sleep duration in this sample.
Conclusion: Gaming/Internet is negatively correlated to self-reported sleep duration, while TV shows no association, and vigorous physical activity carries a positive correlation.

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PSYCHOMETRIC CHARACTERISTICS AND SENSITIVITY OF A SIMULATED CLASSROOM PROCEDURE FOR MEASURING THE IMPACT OF SLEEP RESTRICTION ON ADOLESCENTS

Beebe DW[1,2], Baum K[3], Jacola L[3], Miller L[1], Desai A[4], vonThomsen S[1]
[1]Behavioral Medicine & Clinical Psychology, Cincinnati Children's Hosp Med Center, Cincinnati, OH, USA, [2]Pediatrics, University of Cincinnati College of Medicine, Cincinnati, OH, USA, [3]Psychology, University of Cincinnati College of Arts and Sciences, Cincinnati, OH, USA, [4]Rollins School of Public Health, Emory University, Atlanta, GA, USA

Introduction: Correlational studies have associated sleep restriction during adolescence with academic difficulties, but experimental data are scant. We have developed a simulated task that allows for objective coding of behaviors, collection of EEG data, and evaluation of learning. Here we report preliminary psychometric data and comparisons of behavioral and learning findings in adolescents after experimental sleep restriction.

Methods: 36 healthy adolescents aged 13.9-16.9 years completed a three-week experimental protocol that included a baseline week followed in counterbalanced order by a sleep-restricted week (SR; 6.5 hours in bed Monday-Friday nights) and a healthy sleep duration week (HS; 10 hours in bed Monday-Friday), verified via actigraphy. Assessments were conducted on the Saturday morning immediately following each condition. After the baseline week, subjects completed an IQ screener. After the SR and HS weeks, subjects viewed half-hour prerecorded lectures while undergoing video/EEG monitoring, followed by a relevant quiz. Pairs of condition-blind raters later coded the video/EEG for episodes lasting >1 sec of several behaviors: inattention, eye closures, head down, yawning, stretching, eye-rubbing.
Results: Subjects averaged 2.5 hrs/night more sleep during HS than SR, p<.001. Complete quizzes were obtained on 34 subjects, and behavior coding is complete on 20 so far. There has been strong interrater reliability across behaviors (Spearman correlation range=.62-.98, median=.86, p<.005), and the quizzes have had good internal consistency (alpha=.70-.71) and appropriate correlations with IQ (r=.45-.47, p<.005). After covarying IQ, quiz scores correlated with ratings of inattention (r=-.53, p<.05) and eyes-closed (r=-.72, p=.001) during SR and inattention during HS (r=-.49, p<.05). Subjects showed greater inattention (p<.05) and eye closures (p<.005) and lower quiz scores (p=.05) after SR than HS.
Conclusion: Data support the psychometric qualities of the simulated classroom procedure and its sensitivity to sleep restriction. Findings also provide experimental evidence that sleep restriction during adolescence can worsen classroom learning and behaviors.
Support (If Any): National Institutes of Health (R01 HL092149).

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MANIPULATING SLEEP DURATION ALTERS MEMORY, ATTENTION, AND EMOTIONAL FUNCTIONING IN CHILDREN

Vriend JL[1], Davidson F[1], Corkum PV[1,3], Rusak B[1,2], Chambers C[1,3], McLaughlin E[1,3]
[1]Psychology, Dalhousie University, Halifax, NS, Canada, [2]Psychiatry, Dalhousie University, Halifax, NS, Canada, [3]Psychology, IWK Health Centre, Halifax, NS, Canada

Introduction: Daytime consequences of sleep loss have been well documented in adults, but the pediatric literature includes mostly correlational studies. A few studies have manipulated sleep experimentally in school-aged children to examine effects on emotional and cognitive functioning, but more well-controlled, experimental studies are needed.
Methods: Thirty-two children (8-12 y) wore actigraphs for 3 weeks. During the baseline week, actigraphic data were used to estimate the child's typical daily sleep duration. During the second week, the child was randomly assigned to go to bed either one hour earlier (Extended condition) or one hour later (Restricted condition) than their typical bedtime. Each child then completed the opposite schedule during the third week of the study. After each of the 3 weeks, emotional functioning, memory, and attention were assessed using objective and subjective measures.
Results: The sleep manipulation was effective; the children slept significantly longer in the Extended (M = 9.3 h, SD = 0.6) versus Restricted (M = 8.1 h, SD = 0.7) condition and children were significantly sleepier in the Restricted condition according to parent, child, and research assistant report. Results revealed impaired functioning in the Restricted relative to Extended condition on measures of positive affective response, emotion regulation, memory, and aspects of attention. However, some aspects of emotional functioning and attention were not affected by the sleep manipulation.
Conclusion: These results suggest that even a modest degree of chronic sleep restriction can have negative consequences for children's daytime functioning. These findings support emphasizing the importance of promoting healthy sleep habits for children, and they have implications for understanding how inadequate sleep can affect cognitive and emotional development.

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CONCURRENT AND LONGITUDINAL ASSOCIATIONS OF SLEEP-DISORDERED BREATHING WITH BEHAVIORAL AND ADAPTIVE FUNCTIONING IN YOUTH

Perfect MM[1], Archbold K[2], Goodwin JL[3], Quan SF[3,4]
[1]Disability and Psychoeducational Studies, University of Arizona, Tucson, AZ, USA, [2]College of Nursing, University of Arizona, Tucson, AZ, USA, [3]Arizona Respiratory Center, College of Medicine, University of Arizona, Tucson, AZ, USA, [4]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Sleep-disordered breathing (SDB) has been associated with behavioral difficulties, but little is known about the long-term impact of SDB into adolescence or its effects on self-care and social skills. The current study examined the rate of impairment on behavioral and adaptive functioning in youth with persistent and/or current SDB.
Methods: Two-hundred and sixty-three youth had valid PSG and neurobehavioral data at two timepoints (approximately 5 years apart) from the prospective Tucson Children's Assessment of Sleep Apnea (TuCASA) study. Primary outcomes were the Behavior Assessment Scale for Children-2nd Edition Parent Report Form (BASC-PRF) and Self-Report (cutoffs of T-score =>60 for clinical scales and =<40 for adaptive scales), and the Adaptive Behavior Assessment System-2nd Edition (standard score cutoff =<90). A respiratory disturbance index (RDI) =>1 event/hour associated with 3% oxygen desaturation was considered indicative of SDB.
Results: Seventy youth had SDB at the initial examination and 44 youth (M=13.23, SD=1.69) had SDB at follow-up. Since there were no significant differences between never and remitted SDB or between persistent and current SDB on outcomes, groups were divided based on current SDB status. Individuals with SDB had significant odds and greater impairment rates on the BASC-PRF Externalizing Problems (OR=3.95; 9.6% versus 28.9%), Internalizing Problems (OR=2.84; 11.2% versus 26.3%), Adaptive Behaviors (OR=2.97; 14.9% versus 34.2%), and Behavioral Symptoms (OR=4.96; 8.5% versus 31.6%) Composites and the ABAS-II Social (OR=2.72; 21.3% versus 42.4%) and General Adaptive Composites (OR=2.87; 24.7% versus 48.5%). Related subscales on these measures also significantly associated with SDB.
Conclusion: The prevalence of SDB declined into adolescence, but youth with persistent and/or current SDB exhibited ADHD-like symptoms, aggressivity, mood dysregulation, lower social competency, and diminished self-care skills. Parents' ratings yielded a higher prevalence of impairment relative to SDB than self-reports.
Support (If Any): The TuCASA study was supported by HL 62373.

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A RANDOMIZED, PLACEBO-CONTROLLED, DOUBLE-BLIND, FIXED-DOSE STUDY OF THE EFFICACY AND SAFETY OF ESZOPICLONE IN CHILDREN (6 TO 11 YEARS) AND ADOLESCENTS (12 TO 17 YEARS) WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD)-ASSOCIATED INSOMNIA

Zammit G[1], Huang H[2], Sangal RB[3], Versavel M[2]
[1]Clinilabs Inc., New York, NY, USA, [2]Sunovion Pharmaceuticals Inc., Marlborough, MA, USA, [3]Oakland University William Beaumont School of Medicine, Sterling Heights, MI, USA

Introduction: It has been reported that 19.3% of children with ADHD have moderate-to-severe sleep problems. Currently, no approved sedative hypnotics are indicated for the treatment of pediatric insomnia. The goal of this study was to evaluate the efficacy and safety of eszopiclone in pediatric subjects with ADHD associated insomnia.

Methods: Multicenter, randomized, double blind, placebo controlled, fixed dose study of eszopiclone in subjects 6 through 17 years of age (inclusive), with ADHD associated insomnia. Subjects received either low dose oral eszopiclone (1 mg for children ages 6 -11 years, 2 mg for adolescents ages 12- 17 years), high dose oral eszopiclone (2 mg or 3 mg, respectively), or placebo. The primary efficacy endpoint, change from baseline to the end of double-blind treatment (Week12) in PSG-defined latency to persistent sleep (LPS), was analyzed using ANCOVA with treatment group as a fixed effect and the baseline value as a covariate. Key secondary assessments were WASO, CGI-I (parent), CGI-I (child), and Conners Inattention Score.
Results: Of the 486 subjects randomized, 371 (76.3%) completed the 12-week study. For all 3 groups there was a reduction in LPS (meanΔ±SD: -8.44±54.93: high dose; -29.92±77.27: low dose; -29.20±53.02: placebo); however there was no statistically significant difference from placebo for either high dose eszopiclone (p=0.375) or low dose eszopiclone (p>0.999). Unadjusted p values suggested improvements in WASO and CGI in the high dose eszopiclone groups. TEAEs were reported by 97 (61%), 97 (59.5%) and 74 (46%) subjects in the high dose, low dose, and placebo groups, respectively. The most commonly reported TEAEs were headache (12.4%), dysgeusia (6.6%), and upper respiratory tract infection (5.2%).
Conclusion: The study did not show statistically significant differences between either dose of eszopiclone and placebo on the primary efficacy endpoint, change from baseline in LPS. Eszopiclone doses of up to 3 mg were generally well tolerated in pediatric subjects with ADHD-associated insomnia.
Support (If Any): Sunovion Pharmaceuticals Inc.

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RELATIONSHIP BETWEEN SLEEP-DEFICIENCY AND POOR DAYTIME-BEHAVIOR IN CHILDREN WITH AUTISM-SPECTRUM-DISORDER

Loddenkemper T[1,3], Sullivan J[2], McConnell K[4], Coulter D[3], Braga-Kenyon P[4], Kothare SV[1,3], Lockley SW[1,2]
[1]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [2]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [3]Department of Neurology, Children's Hospital Boston, Boston, MA, USA, [4]The New England Center for Children, Boston, MA, USA

Introduction: Disrupted-sleep is a major co-morbidity associated with autism-spectrum-disorders (ASD). Our aim was to investigate the relationship between sleep-duration and poor daytime-behavior in children with ASD.
Methods: 42 ASD patients (13F, 8-21 years) were randomly selected and two months of data per child were examined. Sleep-wake was recorded by observation every 15 minutes from 21:00-7:00h (~90,000 observations) and 3 (of ~40 available) behaviors were chosen for preliminary-analysis, each assessed every hour (8:00-21:00h) on weekdays (~20,000 observations per behavior). The Cochran-Mantel-Haenszel method (SAS 9.2) stratified by subject was used to calculate the odds-ratio (OR±95%CI) for the occurrence of severe behavior the next day.
Results: The average sleep-duration was 8.2±0.9h/night in 5-10year-olds, and 8.1±1 h/night in 11-17 year-olds. 92% of sleep-time in children <11years-old did not meet the recommended minimum of 10hours per day, and 48% of sleep-time in the 11-17 year age group did not meet the National Sleep Foundation (NSF) recommended minimum sleep-durations. Behaviors examined were environmental destruction(ED), self-injurious behavior (SIB) and bolting. Children were 2.62(1.21,5.67) times more likely to exhibit severe-ED on days following <5hours of sleep as compared to days after obtaining >=5 hours of sleep (n=12;615 day-night data pairs), and 4.97 times(1.63,15.08) more likely after <4hours sleep(n=6;300 pairs). The risk of SIB was 6.49 times (2.31,18.33) more likely after <4hours as compared to >=4hours sleep(n=8;404 pairs), and the risk of Bolting was 3.03 (1.16,7.87) times more likely(n=4;210 pairs). The number of hours with severe-behavior was negatively correlated with the prior night's total-sleep-time (r=-0.47, F(1,100)=27.7, p<0.001, n=12) such that 3hours of lost sleep was associated with an additional hour of ED.
Conclusion: A large proportion of children with ASD do not meet the NSF-recommended minimum sleep-duration for age. Behavioral problems were more likely in children who had less than 4hours of sleep/night and were inversely correlated with total-sleep-time.

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THE ASSOCIATION BETWEEN NOCTURNAL SLEEP DURATION AND DAYTIME ACTIVITY IN SCHOOL-AGE CHILDREN

Hart CN[1,2], Lawton J[1], Samuels A[1], Jelalian E[1,2], Fava J[2], Owens J[3], Raynor H[4], Wing R[1,2]
[1]Weight Control & Diabetes Research Center, The Miriam Hospital, Providence, RI, USA, [2]Psychiatry & Human Behavior, Alpert Medical School of Brown University, Providence, RI, USA, [3]Pulmonary & Sleep Medicine, Children's National Medical Center, Washington, DC, USA, [4]Nutrition, University of Tennessee, Knoxville, TN, USA

Introduction: Short sleep in childhood is associated with obesity with evidence suggesting that males may be at particular risk. Most research to date has focused on eating pathways as a mechanism through which sleep affects obesity. This study examined whether experimental changes in children's nocturnal sleep are associated with changes in daytime physical activity (PA). It was hypothesized that children would be less active with a decreased (DEC) time in bed (TIB) compared to an increased (INC) TIB, which would be more pronounced in males.
Methods: This study will end January 2012; final data will be analyzed for the meeting (N=38). Using a within-subject, crossover design, 28 children 8-11 years (mean=9.7 ([0.9]) who reported average sleep of 9.5 hrs/night were enrolled in a 3-week study. Children were 78% non-Hispanic White; 61% male; mean BMI percentile=52.9(25.6). All children first slept their typical amount for 1 week; they were then randomized to either INC or DEC TIB by 1.5 hrs/night for 1 week (& completed the alternate schedule the last week). Children wore actigraphs on their non-dominant wrist throughout. Standard procedures were used to score sleep; mean daily activity counts were used to estimate PA.
Results: Thus far children achieved a mean 141 minute difference in actigraph-measured sleep period time during INC and DEC, F(1,27) = 1003.4, p< .001. There was a significant gender-by-condition interaction, F(1, 26) = 5.53, p = .03, such that males were more active during INC (mean activity counts/day: 603.4 [116.7]) than DEC (569.8 [107.0]); no difference for females (547.7 [117.6] during INC vs. 555.2 [105.0] during DEC).
Conclusion: Preliminary findings suggest that compared to short sleep, when boys are provided the opportunity to sleep more they are more active. Activity pathways may mediate the association between sleep and obesity risk in males.
Support (If Any): This work was supported by Grant No. 1-09-JF-22 from the American Diabetes Association.

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SLEEP VARIABILITY AND BODY FAT DISTRIBUTION IN ADOLESCENTS: THE PENN STATE CHILD COHORT STUDY

He F[1], Vgontzas AN[2], Liao D[1], Shaffer M[1], Calhoun S[2], Kritikou I[1], Bixler EO[2]
[1]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA, [2]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA

Introduction: Chronic sleep problems in adults have been associated with visceral obesity and clinical cardiometabolic disorders. However, the data from adolescents are limited. We report preliminary findings associating actigraphy-based 6-night sleep and sleep variability and body

fat distribution in adolescents who participated in the population-based Penn State Child Cohort (PSCC) follow up examination.
Methods: We used available data from the first 169 adolescents who have completed the follow-up examinations in the PSCC for this preliminary report. Actigraphy was used to record total sleep time and total in-bed time on a nightly basis at home for 7 consecutive days. We then calculated sleep efficiency as "total sleep time / total in-bed time" (%). First night data were excluded from this report. Using a mixed-effects model, we calculated the average within-subject sleep efficiency and the within-subject variability of sleep efficiency. Body fat distribution was assessed using a standardized Dual-energy X-ray Absorptiometry (DXA) system, including Android/Gynoid Fat Ratio, Android/Total Body Fat (%), and Gynoid /Total Body Fat (%). Linear regression models were used to assess the sleep variability and body fat distribution relationships.
Results: The mean age of the study sample was 17.1 years (SD=2.0), with 44% female and 75% white. After adjusting for age, gender, and ethnicity, lower average within-subject sleep efficiency is associated with higher Android/Gynoid Fat Ratio (β=0.04, SE=0.02, $p < 0.05$), higher Android/Total Body Fat (β=0.55, SE=0.25, $p < 0.05$), and lower Gynoid /Total Body Fat (β= - 0.55, SE=0.42, p =0.19). Higher within-subject variability of sleep efficiency is significantly associated with lower Gynoid /Total Body Fat (β=-0.85, SE=0.43, p =0.05).
Conclusion: Data from a sample of the population-based PSCC study suggested that lower sleep efficiency and higher night-to-night variability of sleep efficiencies are associated with body fat distribution towards abdominal fat dominant (apple shape body) in healthy adolescents.
Support (If Any): NIH R01 HL603772, R01 HL97165, UL1 RR033184, C06 RR16499.

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MELATONIN TREATMENT EFFECTS ON ADOLESCENT STUDENTS' SLEEP PHASE AND SLEEPINESS - A PLACEBO-CONTROLLED CROSSOVER STUDY

Lowden A[1,2], Eckerberg B[1], Åkerstedt T[1,2]
[1]Stress Research Institute, Stockholm University, Stockholm, Sweden, [2]Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden

Introduction: During the last few decades the incidence of sleep-onset insomnia, due to delay of circadian sleep phase, has increased.
Methods: A small dose of melatonin as a single treatment was administered in the afternoon, to advance the sleep phase in teenagers. 21 students, aged 14 to 19 years, with sleep-onset difficulties were recruited. The study was a randomized, double blind, placebo-controlled crossover trial, lasting 5 weeks. During the first six days in week 2 and 4 the students received either placebo or melatonin (1 mg) capsules between 16:30h and 18:00h. During week 5 all students received melatonin. In the last evening of each week and the following morning the students gave melatonin saliva samples. The samples were produced the same time each week, as late as possible in the evening and as early as possible in the morning. Diaries of presumed sleep, subjective sleepiness during the day (Karolinska Sleepiness Scale, KSS) were completed daily.
Results: Primary analysis over five weeks gave significant results for melatonin, sleep and KSS. Post-hoc analysis showed that presumed sleep onset times were advanced after melatonin school weeks compared with placebo school weeks ($p<.005$) and sleep length was longer ($p<.05$). After the last melatonin school week the students fell asleep 68 minutes earlier and slept 62 minutes longer each night compared with the baseline week. Morning melatonin values in saliva diminished compared with placebo ($p<.001$) and evening values increased ($p<.001$), indicating a sleep phase advance. Compared with placebo school weeks the students reported less awakenings ($p<.05$) and daytime sleepiness ($p<.05$) and increased evening sleepiness ($p<.005$) during melatonin weeks.
Conclusion: In conclusion, a small afternoon dose of melatonin could advance the sleep phase and make the students more alert during school days even if they continue their irregular sleep habits during weekends.
Support (If Any): Natural Pharma International, NPI AB provided the melatonin and placebo capsules and supported saliva melatonin analysis.

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LONGITUDINAL CHANGES IN FREQUENCY OF PEAK SIGMA POWER ACROSS ADOLESCENCE

Darchia N[1], Campbell IG[2], Feinberg I[2]
[1]T.Oniani Laboratory of Sleep-Wakefulness Cycle Studies, Ilia State University, Tbilisi, Georgia, [2]Department of Psychiatry and Behavioral Sciences, University of California–Davis, Davis, CA, USA

Introduction: Sleep states and their EEG waveforms change profoundly across childhood-adolescence. We have previously reported different maturational trajectories for NREM delta and theta power. A third key NREM frequency is sigma (12-15 Hz), whose power is largely determined by organized sleep spindles. It is known that there is an age-related increase in the frequency within 12-15 Hz that shows the highest power. However, the trajectory of this increase has not been established. Our longitudinal study now enables us to describe this age trend.
Methods: 67 subjects in 2 cohorts, spanning the age range 9 to 18 years, were followed longitudinally. Semiannually, all-night EEG was recorded for 3 consecutive nights at the subjects' homes on their habitual school-night sleep schedule. Artifact-free epochs were analyzed with FFT (PASS PLUS, St. Louis). We calculated average power across the first 5 hours of NREM sleep for 0.2 Hz bands between 10.8 and 15.0 Hz, and we determined the 0.2 Hz band in which sigma power showed a clear peak.
Results: Mixed effect analysis showed that the frequency of the sigma peak increased linearly from 12.1 Hz at age 9 years at a rate of 0.12 Hz per year ($F_{1,723}$=469, $p<0.0001$). The linear model of age-related change in peak frequency provided a better fit than various non-linear models.
Conclusion: The change in the frequency of the sigma peak may reflect maturation of the thalamocortical circuits that generate sleep spindles. Our data suggest a linear maturation of these circuits. This linear trend differs from the non-linear maturational trends in delta and theta EEG activity, trends that we propose reflect cortical maturation driven by synaptic pruning. Sleep EEG data provide a powerful tool for tracking adolescent brain maturation. The distinctly different maturational trajectories we have found for the main NREM frequency bands indicate a challenging research agenda.
Support (If Any): US Public Health Service Grant R01 MH62521.

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SLEEP VARIABILITY AND CARDIAC ARRHYTHMIA IN ADOLESCENTS: THE PENN STATE CHILD COHORT STUDY

Bixler EO[1], Shaffer M[2], He F[2], Vgontzas AN[1], Calhoun S[1], Rodriguez-Colon S[2], Liao D[2]
[1]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA

Introduction: Cardiometabolic effects of sleep and its variability in adults have been examined. However, the data from adolescents are very limited. We report preliminary findings associating actigraphy-based 6-night sleep and sleep variability and cardiac arrhythmia in adolescents who participated in the Penn State Child Cohort (PSCC) follow up examination.
Methods: We used available data from the first 169 adolescents who have completed the follow up examinations in the population-based PSCC study for this preliminary report. Actigraphy was used to record total sleep time on a nightly basis for 7 consecutive nights at home. Using a mixed-effect model, we calculated the average within-subject sleep time and the within-subject variability of sleep time. Cardiac arrhyth-

mia, predominantly premature ventricular complex (PVC), was assessed using a 39-hour high resolution Holter system. The PVC data were analyzed on an hourly basis and scaled as number of PVC per hour, thus resulting in 39 hourly repeated measures. Negative binomial regression models were used to assess the insomnia and PVC relationship.
Results: The mean age of the study sample was 17.1 years (SD=2.0), with 44% female and 75% white. The average PVC frequency was 0.43 per hour (ranging 0 - 133). After adjusting for age, gender, and ethnicity, individuals with higher within-subject variability of sleep time have a 4-fold increase in the PVC frequency as compared to individuals with lower within-subject variability (RR=3.95, 95% CI (1.17, 8.34), p = 0.01).
Conclusion: Data from a sample of the population-based PSCC study suggested a significant adverse association between nigh-to-night variability of sleep time and PVC frequency in healthy adolescents.
Support (If Any): NIH R01 HL603772, R01 HL97165, UL1 RR033184, C06 RR16499.

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SLEEP DURATION DURING THE SCHOOL WEEK IS ASSOCIATED WITH C-REACTIVE PROTEIN IN HEALTHY ADOLESCENTS

Hall MH[1,2], Owens JF[1], Matthews KA[1,2,3], Dahl R[4]
[1]Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA, [2]Psychology, University of Pittsburgh, Pittsburgh, PA, USA, [3]Epidemiology, University of Pittsburgh, Pittsburgh, PA, USA, [4]Community Health and Human Development, University of California Berkeley, Berkeley, CA, USA

Introduction: Mounting evidence suggests that short sleep duration in adolescents comes at a high cost to cognitive, emotional and social functioning. Comparatively less is known about the health consequences of short sleep duration in this age group. Short sleep duration in adolescence may be especially relevant to cardiovascular pathophysiology which begins decades before the detection of disease. The present study evaluated relationships among actigraphy-assessed sleep duration and fasting high-sensitivity C-reactive protein (hs-CRP) levels in Caucasian and African-American high school students. We evaluated CRP in this study as it provides important prognostic information about cardiovascular risk in adulthood.
Methods: Participants were 244 (56% African Americans, 48% males) healthy adolescents (M age = 15.7 years). Wrist actigraphy was used to assess mean sleep duration on weekdays (Sun - Thurs) and weekends (Fri-Sat). Participants with fasting hs-CRP levels >/= 3 mg/L were designated as belonging to a high cardiovascular risk group (Circulation, 108:e81-5, 2003). Logistic regression was used to examine relationships among weekday and weekend sleep duration with CRP risk status after adjusting for age, race, gender and body mass index (BMI). Sleep duration was examined as a continuous variable due to the paucity of long sleepers in this sample.
Results: Sleep duration was significantly shorter on weekdays (5.9 +/- 0.9 hrs.) compared to weekends (7.4 +/- 1.2 hrs.) (p<.001). Adolescents with shorter weekday sleep durations were more likely to belong to the high risk CRP group, compared to those who slept longer on weekdays (p<.05). This relationship was independent of age, race, gender and BMI. Weekend sleep duration was not associated with CRP.
Conclusion: These cross-sectional data confirm that short sleep duration in adolescents is associated with elevated CRP, an important marker of cardiovascular risk in adulthood. Longitudinal studies are needed to establish whether short sleep during the school week in adolescents prospectively contributes to cardiovascular pathophysiology.
Support (If Any): Support for this project was provided by grants from the National Institutes of Health: HL025767 and RR024153.

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EFFECTS OF SLEEP ON OBJECTIVE MEASURES OF COGNITIVE FUNCTION IN HEALTHY ADOLESCENTS

Cohen Zion M[1,2], Weiner A[1], Kessler M[1], Shabi A[1], Avdar M[1], Sweiger A[1,3]
[1]Behavioral Sciences, Academic College Tel Aviv-Jaffa, Tel Aviv-Jaffa, Israel, [2]Sleep Disorders Center, Assuta Hospital, Tel Aviv, Israel, [3]Loewenstein Rehabilitation Hospital, Raanana, Israel

Introduction: According to published reports, four out of five teens today are not getting the necessary number of nightly sleep hours and one out of two teens reports excessive sleepiness during the day. Chronic sleep loss and its clinical correlates have been consistently linked to self-reported cognitive and academic impairment in youth, however few studies have attempted to objectively quantify these associations.
Methods: Fifteen high school students (16.7 years; 5 male) participated in the study. Past month sleep was assessed using the School Sleep Health Questionnaire (SHQ). A computerized cognitive assessment battery (MindStreams®, Neurotrax Corp.) was used to measure performance in cognitive domains of interest: attention, visual spatial processing, memory, information processing speed, motor skills, and executive function. Normalized index scores for each domain were calculated from individual outcome parameters (accuracy, response time (RT), and RT standard deviation) for relevant tests. Pearson correlations were performed to examine relationships between self-reported sleep, sleepiness, and cognitive index scores.
Results: Later weekend wakeup times were related to poorer information processing speed (IPS; r=-0.53, p=0.041) and motor skills (MS; r=-0.52, p=0.046) performance. Earlier school day wakeup times were related to poorer IPS (r=-0.52, p=0.017) and executive function (EF; r=-0.44, p=0.036), and possibly to poorer MS performance (r=-0.42, p<0.10). Interestingly, shorter weekday sleep duration may be linked to poorer IPS, MS, EF, and attention (r=0.41-0.49, p<0.10), however none achieved statistical significance. Significant relationships were not found between other cognitive domains and measures of subjective sleep or sleepiness.
Conclusion: Weekend "catch-up" sleep (likely due to weekday sleep loss) and early weekday wakeups (likely due to early school start times) are common phenomena among teens. These data suggest this unhealthy sleep/wake behavior and the associated sleep loss may underlie objectively-measured deficits in multiple cognitive areas. These findings, if corroborated by further data, are of great concern given the known neurodevelopmental changes and neural plasticity during the adolescent years, the advancement and reorganization of cognitive abilities, and the emphasis on academics during this critical developmental period. Additional data are currently being collected to further elucidate these relationships.
Support (If Any): EU PIRG05 GA 2009 248169, Israeli Ministry of Absorption.

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VALIDATION OF A SELF-REPORT MEASURE OF SLEEP PATTERNS IN ADOLESCENTS

Gamble HL[1], Meltzer LJ[2], Rach A[1,3], Biggs SN[4], Reynolds A[5], Crabtree VM[1]
[1]Psychology, St. Jude Children's Research Hospital, Memphis, TN, USA, [2]Pediatrics, National Jewish Health, Denver, CO, USA, [3]Psychology, The University of Memphis, Memphis, TN, USA, [4]The Ritchie Centre, Monash Institute of Medical Research, Monash University, Melbourne, VIC, Australia, [5]Centre for Sleep Research, University of South Australia, Adelaide, SA, Australia

Introduction: Several self-report and parent-report measures exist to document sleep difficulties during adolescence; however, none span across development from school-aged children through adolescence. The Children's Report of Sleep Patterns (CRSP) is a multi-dimensional

self-report measure of sleep for school-aged children. The present study examines the reliability and validity of the CRSP for adolescents.
Methods: 274 adolescents, ages 13-18 (73% female; M=14.55, SD=1.32years), recruited from schools, sleep clinics, and a children's oncology hospital completed the CRSP. Reliability of the CRSP was assessed using Cronbach's alpha. Validity was examined using one-way ANOVA for group differences (age: 13-14, 15-16 and 17-18; clinical vs. community populations).
Results: Cronbach alpha coefficients for four sleep disturbances scales range from moderate (Bedtime Fears/Worries=0.56; Parasomnias=0.53) to acceptable (Restless Legs=0.74; Insomnia=0.77). Significant group differences were found for age on the Activities Before Bed Index ($p < .05$) and Sleep Location Index, ($p < .001$), with older adolescents (17-18 years) engaging in more alerting activities in the hour before bed and sleeping somewhere other than their own bed compared to younger adolescents (all post-hoc $p < .05$). For the clinical and community populations, significant differences were found on the Sleep Location Index, Sleep Environment Index, Restless Legs Scale, Parasomnias Scale, and Sleepiness Scale, (all $p < .05$), and Bedtime Fears/Worries Scale and Insomnia Scale, (both $p < .001$). Adolescents from clinical settings reported sleeping somewhere other than their own bed more often and more use of electronics at sleep onset (both post-hoc $p < .01$). Adolescents from schools reported more sleep disturbances related to bedtime fears/worries, symptoms of restless legs syndrome, parasomnias, and insomnia (all post-hoc $p < .05$). The community sample also endorsed greater sleepiness than the clinic sample ($p < .01$).
Conclusion: The Children's Report of Sleep Patterns was designed as a self-report measure of sleep for school-aged children. This study demonstrates its extended utility in adolescents, providing a consistent measure to track sleep patterns, sleep hygiene, and sleep disturbances across development.
Support (If Any): This study was supported in part by K23 MH077662.

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HOMESCHOOLED ADOLESCENT SLEEP HABITS - A COMPARATIVE ANALYSIS
Shaheed K, Meltzer LJ
National Jewish Health, Denver, CO, USA

Introduction: Early school start times are one of the primary reasons adolescents don't obtain sufficient sleep, resulting in poorer school performance, negative mood, and behavior problems. To date, no one has examined the sleep patterns of homeschooled adolescents. Because homeschooled youth have more flexibility in school start time and do not have to catch an early bus, it is likely that they obtain more sleep than adolescents attending public/private schools. The purpose of this study was to compare the sleep patterns of home schooled adolescents to a sample of nationally representative adolescents who attend public/private school.
Methods: Participants included 1725 students (11-17 years, 49.6% male) and their parents who completed questions about sleep patterns and sleep hygiene. Homeschooled students (HS, n=163) were recruited from a national survey panel group of homeschool families. Public/private school students (PS, n=1562) were part of the National Sleep Foundation's (NSF) 2006 Sleep in America poll. The PS participants were more diverse (Caucasian=61.4%, Hispanic=18.5%) than HS participants (Caucasian=83.9%, Hispanic=6.8%).
Results: Although school-night bedtimes were not significantly different (PS=22:14, HS=22:16, p=0.14), PS wake time was 1.75 hours earlier than HS (PS=06:29, HS=08:13, $p<0.005$). While PS left for school at 07:08, 85% of HS parents reported flexible school start times (average 09:06). School-night total sleep time (TST) also differed (PS=7.6 hours, HS=8.5 hours, $p<0.005$). No significant difference in weekend bedtimes, wake times or TST was found. More PS had televisions and telephones in their bedrooms ($p<0.005$). Each of these items were independently associated with shorter TST ($p<0.005$).
Conclusion: Homeschooled adolescents obtained significantly more sleep on school nights than public/private school students, primarily due to significantly earlier wake times amongst public/private school students. Additionally, homeschool students had fewer TVs and phones in their bedrooms. Results of this study support the need for flexible and later school start times. In addition, more education is needed for parents, pediatricians and school districts regarding the sleep needs and sleep hygiene of adolescents.
Support (If Any): This study was supported in part by K23MH07762.

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SLEEP AND MORNING ABSENTEEISM IN MIDDLE SCHOOL ADOLESCENTS
Marczyk KD[1], Francetich JM[1], Wilkerson AK[1], Petrie TA[1], Martin SB[2], Greenleaf C[2], Taylor DJ[1]
[1]Psychology, University of North Texas, Denton, TX, USA, [2]Department of Kinesiology, Health Promotion, & Recreation, University of North Texas, Denton, TX, USA

Introduction: Adolescents and young adults tend to be sleep-deprived because they typically require about 9 hours of sleep each night, but receive only 7 to 8. Early start times for school are problematic to this age group, as adolescents are biologically driven toward a delayed sleep phase. Little research has been done to examine the relationship between total sleep time and morning absenteeism in adolescents. The present study examines this relationship in middle school-aged children.
Methods: Participants were 778 male and 802 female middle school students from a suburban school district in Texas (U.S.). The mean age was 12.33 years (SD = .978). Information on attendance was provided by the school district. The mean of morning absences for the sample was 2.97 (SD = 3.18). Total sleep time was assessed with the Pittsburg Sleep Quality Index.
Results: A simple linear regression was used to assess total sleep time as a predictor of morning absenteeism in adolescents. Results indicate that total sleep time statistically significantly predicts morning absenteeism, $F(1, 1079) = 5.21$, $p = .023$, and accounts for 0.4% of the variance.
Conclusion: The current analyses revealed that greater total sleep time is a significant predictor of increased morning absences in middle school adolescents. These analyses indicate that children may be extending their morning sleep time and subsequently missing class.

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PREDICTORS OF ADOLESCENTS` INTENTION TO ADVANCE BEDTIME
Cassoff J[1,2], Ianakieva I[1], Knäuper B[1], Gruber R[2,3]
[1]Psychology, McGill University, Montreal, QC, Canada, [2]Douglas Mental Health University Institute, Montreal, QC, Canada, [3]Psychiatry, McGill University, Montreal, QC, Canada

Introduction: Sleep deprivation as a result of late bedtimes is common among adolescents and results in poor physical and emotional health. Current school-based sleep interventions aimed at preventing sleep deprivation are largely ineffective. A potential reason for this is that adolescents are generally unmotivated to go into bed at an earlier hour. However, effective motivational factors to improve sleep remain largely unknown. As such, this study aimed to identify motivational elements that would predict adolescent intention to advance bedtime. We hypothesized that positive attitudes, higher self-efficacy, and increased social influences regarding sleep would predict increased intention to advance bedtime. This is important for developing interventions effective in motivating healthy sleep in adolescence.
Methods: 128- typically developing adolescents (ages 13-17, Mean = 14.79, SD = 1.43) completed an online survey during class time. Social influences regarding sleep were measured using 3 validated questionnaires. Social norms evaluated the extent to which others would want them to change their bedtime. Social modeling measured perceptions

of the bedtimes of those around them. Social pressure assessed pressure from others to modify their bedtime. Self-efficacy to advance bedtime was assessed by the Sleep Self-efficacy Scale. Intention to advance bedtime was evaluated by the Readiness to Change Questionnaire modified for sleep. All questionnaires demonstrated high internal reliability.
Results: A multiple linear regression analysis examined self-efficacy, social pressure, social norms, social modeling, and attitudes as predictors of the intention to advance bedtime. Perceived social norms regarding sleep ($\beta = 0.38$, $p < .001$) and positive attitude towards sleep ($\beta = 6.63$, $p < .001$) were significant predictors of the intention to advance bedtime, $R^2 = .37$, $F(5,121) = 14.02$, $p < .001$. Social modeling, social pressure and self-efficacy were non-significant.
Conclusion: Positive attitudes towards sleep and social norms are associated with a higher intention to advance bedtime. This suggests that adolescents are influenced by their own mindset and internal perceptions of sleep, as opposed to mimicking others or succumbing to social pressure. The insignificant self-efficacy findings may reflect a general lack of will-power or desire to improve sleep behavior. Accordingly, future sleep interventions should focus on modifying adolescents' attitudes and perceptions of social norms to promote healthier sleep.

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ANTHROPOMETRIC PREDICTORS OF VISCERAL ADIPOSITY IN ADOLESCENTS WITH AND WITHOUT OBSTRUCTIVE SLEEP APNEA

Koren D[1], Marcus CL[2], Kim C[3], Gallagher PR[4], Schwab R[5], Zemel B[6]
[1]Pediatrics, Division of Endocrinology/Diabetes, University of Pennsylvania, Philadelphia, PA, USA, [2]Pediatrics, Division of Pulmonology, University of Pennsylvania, Philadelphia, PA, USA, [3]Research - Center for Sleep & Respiratory Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [4]Biostatistics Core, Clinical and Translational Research Center, The Children's Hospital of Philadelphia, Philadelphia, PA, USA, [5]Medicine - Division of Pulmonology, Allergy and Critical Care Medicine, University of Pennsylvania, Philadelphia, PA, USA, [6]Pediatrics - Division of Gastroenterology and Nutrition, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Visceral obesity is an important risk factor for obstructive sleep apnea (OSA) and cardiovascular disease in adults; however, there are few data regarding visceral adiposity and OSA risk in adolescents. Visceral adiposity assessment entails imaging, which is impractical and expensive. Accurate surrogate anthropometric measurements of visceral vs. subcutaneous adipose tissue [VAT vs. SAT] are needed. We hypothesized that obese adolescents with OSA (vs. without OSA) would have greater visceral adiposity, and that sagittal abdominal diameter (SAD), which measures abdominal thickness at waist level in the supine position, would better correlate with VAT volume than other anthropometrics.
Methods: 98 adolescents ages 12-16 years [57 obese (30 with OSA), 41 lean] underwent Tanner staging, anthropometrics [including waist circumference (WC) and SAD] and magnetic resonance imaging of the abdomen. Volumetric SAT, VAT and total abdominal fat were calculated.
Results: There were no significant differences between obese adolescents with and without OSA. All anthropometric and abdominal fat values were greater in obese than lean adolescents. There were no significant differences between obese adolescents with and without OSA. All anthropometric and abdominal fat values were greater in obese than lean adolescents. WC, SAD and BMI correlated strongly with SAT [r=0.94, 0.92, 0.90 respectively], VAT [r=0.70, 0.71, 0.65] and total fat [R=0.94, 0.93, 0.90]. All relationships were highly significant ($p<0.0005$). On stepwise regression analysis (examining anthropometrics and BMI only), only SAD predicted VAT (adjusted $R2=0.50$, $p<0.0005$). When Tanner stage, age, sex and race were included, only WC predicted VAT (adjusted $R2=0.56$, $p<0.0005$.).
Conclusion: There was no difference in VAT or anthropometrics between obese adolescents with and those without OSA. WC and SAD were good indicators of visceral fat in these adolescents. The correlation between VAT and BMI disappeared after controlling for either WC or SAD, suggesting that WC or SAD are modestly better predictors of VAT than BMI. Our data suggests that anthropometric measurements provide a good tool to assess the likelihood of visceral adiposity in obese adolescents.

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ADOLESCENTS' MEDIA USE AND ITS EFFECT ON SLEEP

Davis A, Cox M, Avis K, Schwebel DC
University of Alabama at Birmingham, Birmingham, AL, USA

Introduction: Media use increases significantly from age 11 to 14, such that 14-year-olds spend an average of almost 12 hours daily using entertainment media. Increased media use has negative consequences for teens, including later bedtime and shorter sleep time. This study investigated adolescents' use of media and its effects on sleep time.
Methods: Using actigraphy over a one-week period, we evaluated sleep patterns in 55 adolescents (mean age=14.89 years, SD=0.62) and administered a media scale assessing average time using media sources (e.g. television, texting, Facebook, etc.), time of media use once in bed, and number of awakenings by media during sleep.
Results: Adolescents spent an average of 23.32 hours (SD=17.93) engaging in media daily (measured by total multi-tasking time, so texting for an hour while also watching television was counted as 2 hours of exposure). 35% reported having 4 or more media sources in their bedroom, and 90% as having at least 2 media sources in their bedroom. Adolescents reported spending an average of 31 minutes (SD=37.72) using media after bedtime nightly, and 35% reported being awakened by their cell phone at least once nightly. Correlations revealed adolescents who use more media have later bedtimes [$r(47) = 0.33$, $p < .05$] and waketimes [$r(48) = .34$, $p < .05$]. Greater daily media use was associated with more use of media after bed [$r(51) = 0.40$, $p < .01$] and increased nighttime awakenings by media [$r(52) = 0.39$, $p < .01$]. Adolescents awakened more times at night had lower sleep efficiency [$r(45) = -0.33$, $p < .05$] and slept later [$r(47) = 0.33$, $p < .05$].
Conclusion: Adolescents spend much time engaging in media during the day and at bedtime, resulting in poor sleep health, as evidenced by delayed bedtime, waketime, nocturnal awakenings, and low sleep efficiency.
Support (If Any): National Science Foundation (NSF), Decision, Risk, and Management Sciences Program; Center for Child Injury Prevention Studies (CChIPS).

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EXPECTATION VS. REALITY: AN EXAMINATION OF ADOLESCENTS' ACCURACY AT PREDICTING MOOD CHANGES UNDER SLEEP RESTRICTION

Burnham MM[1], Kranovich S[2], Bruck D[3], Beebe DW[4]
[1]Educational Psychology, Counseling, & Human Development, University of Nevada, Reno, Reno, NV, USA, [2]Psychology, University of Nevada–Reno, Reno, NV, USA, [3]Psychology, University of Cincinnati, Cincinnati, OH, USA, [4]Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, OH, USA

Introduction: Adolescents are developmentally capable of predictive thinking, but also are at a stage riddled with egocentric thought. Adolescents' tendency to believe they are invulnerable to consequences that others experience can interfere with their developing logical thinking capacity. The intention of this analysis was to examine adolescents' expectations of mood changes under sleep restriction against how their moods actually changed between a healthy sleep duration and a sleep-restricted week.

Methods: 58 healthy adolescents (aged 14 to 17 years; M = 15.6; 30 male) participated in a 3-week experimental protocol during the summer. A baseline week preceded in counter-balanced order 5 consecutive nights of sleep restriction (SR; 6.5 hours in bed M-F) versus healthy sleep duration (HS; 10 hours in bed M-F), with a 2-night "washout" before each condition, all monitored by actigraphy. During the baseline week, teens rated expected mood changes under sleep restriction. Teens filled out a Profile of Mood States (POMS) on the Saturday following each experimental condition, rating their anxiety, depression, anger, energy, fatigue, and confusion. Change in mood was measured by a simple subtraction of the SR week from the HS week mood subscale ratings. Nonparametric correlations examined relationships between expected and actual mood changes.
Results: 4 subjects dropped out mid-study and 4 were non-adherent to the sleep protocol. In the remaining 50, mood ratings differed significantly between the HS and SR conditions, with teens reporting more anxiety, depression, anger, fatigue, and confusion, and less energy during the SR week (paired samples t-tests, all ps < .05). Only expected vs. actual mood change correlations for anxiety (rs = .41; p = .002) and fatigue (rs = .53; p < .001) were significant. No other mood change expectations were significantly correlated with actual changes in mood. No consistent variables emerged to explain expectations or actual mood changes (e.g., age, IQ, GPA, sleepiness scale ratings, or typical sleep habits).
Conclusion: Consistent with the developmental tendency for adolescents to be relatively poor judges of their own future experiences or outcomes, teens in this study were relatively poor judges of their actual changes in mood under sleep restriction, especially with regard to depression, anger, vigor, and confusion.
Support (If Any): National Institutes of Health (R01 HL092149, UL1 RR026314).

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EFFECTS OF THE SLEEP-SMART PROGRAM ON EARLY ADOLESCENTS' PERCEIVED HEALTH, EMOTIONAL WELL-BEING, AND CAFFEINE USE

Johnson M[1], Harkins E[1], Marco CA[2], Ludden AB[1], Wolfson A[1]
[1]Psychology, College of the Holy Cross, Worcester, MA, USA, [2]Psychology, Rhode Island College, Providence, RI, USA

Introduction: The Sleep-Smart Pacesetter Program is a social learning based, preventative-intervention program projected to help early adolescents develop healthy sleep hygiene practices and in turn positively influence behavioral well-being. The Program assumes 3-way dynamic process between developmental factors (sleep need), environmental influences (sleep arrangements), and behavior (caffeine use). The aim of the current analysis was to examine effects of the Sleep-Smart intervention on adolescent' self-reported health, emotional well-being, and caffeine use.
Methods: Cluster sampling of 7th graders from 2 urban, public middle schools (SST = 8:37am) was used with health classes assigned to Sleep-Smart (SS = 70) or Comparison group (C = 75). Participants' parents provided background information with 53% of the 7th graders from minority backgrounds and 34% in families with incomes below $30,000. Pre- (T1) and Post-program (T2), SS and Comparison adolescents completed questionnaires (Child Health Questionnaire, Youth Self Report) and filled out a daily diary that included caffeine use. Data were analyzed using repeated measures (controlling income, gender, pubertal, BMI status).
Results: Sleep-Smart 7th graders reported significantly (p's < .05) lower YSR Total and Internalizing Problems, an improved sense of health on the CHQ (e.g., more easily do things that take a lot of energy, better emotional well being, and more readily do family activities), and decreased daily afternoon/evening caffeine use (12.63 to 4.74 mg) following the intervention. Comparison participants showed no change in internalizing/total problems, CHQ scores, or caffeine use from T1 to T2.
Conclusion: Previous findings showed that the Sleep-Smart Program improved adolescents' sleep hygiene practices and sleep competence (Harkins et al., 2011). Current analyses demonstrate that Sleep-Smart participants' also showed fewer health and behavioral difficulties and decreased caffeine use following the program, whereas their peers' behaviors remained the same over 7th grade. Further analyses will examine the participants during 8th grade.
Support (If Any): NIH, NICHD, R01 HD47928.

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NOT ONLY ADOLESCENTS HAVE THEIR SLEEP/WAKE CYCLE IMPAIRED BY MORNING SCHOOL STARTING TIMES

Anacleto TS, Adamowicz T, Louzada FM
Physiology, Federal University of Parana (UFPR), Curitiba, Brazil

Introduction: The association between morning school starting times and partial sleep deprivation in adolescents has been described in several studies. However, there are few studies investigating the effects of school schedules on children's sleep. The aim of this study was to investigate the effect of two different school schedules on childrens sleep/wake cycle.
Methods: The sample comprised 54 children (38 girls and 16 boys) with a mean age of 8,98 years grouped in morning (7:30am to 12:30pm) (Morning group - MG) and afternoon (1pm to 6pm)(Afternoon group - AG) shifts, 27 in each group. Children wore an actigraph for seven consecutive days. The dependent variables obtained were the average of onset, offset and duration of sleep, during school days and weekends. Variables were compared by means Mann-Whitney test considering school shift the independent variable.
Results: During school days, children from MG slept at 22:26pm (± 51min), while children from AG slept at 23:35pm (± 50min) (U=120, p<0.001). MG children woke up earlier during school days, 6:27am (± 25min) while AG children woke up at 8:48am (± 57min) (U=8, p<0.001) As a consequence MG had a shorter sleep duration (441,87min ± 43,8min) during school days when compared to AG (502,57min ± 34,7min). During weekends, both groups delayed the sleep onset compared to school days. However, only MG showed late sleep offset during the weekend (8:18am ± 54min) in relation to school days (T=0.00, Z= 4.54, p<0.001).
Conclusion: Thus, it is possible to infer that school schedules can also generate a partial sleep deprivation in children, as previously described for adolescents.

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PREVALENCE AND CORRELATES OF EARLY INFANT SLEEP, CRY AND FEEDING PROBLEMS: A COMMUNITY SURVEY OF AUSTRALIAN INFANTS

Hiscock H[1,2], Cook F[3], Bayer J[1,4], Coe A[3], Bucalo Z[3], Kearins T[1], Cann W[3]
[1]Community Child Health, Murdoch Childrens Research Institute, Melbourne, VIC, Australia, [2]Paediatrics, University of Melbourne, Melbourne, VIC, Australia, [3]Parenting Research Centre, Melbourne, VIC, Australia, [4]School of Psychological Science, La Trobe University, Melbourne, VIC, Australia

Introduction: Infant sleep, crying and feeding problems are common clinical presentations in the first 6 months of life. However, their early prevalence, co-existence, and associated child and caregiver characteristics, are unknown. Identifying associated characteristics could help to target prevention programs to families. We therefore aimed to document the (1) prevalence of early infant sleep, cry and feed problems, (2) extent to which they co-exist and (3) associated child and caregiver characteristics.
Methods: Nurses invited families with term, healthy infants to take part at the routine, well-child home visit (7-14 days post partum). Caregiv-

ers completed a survey about infant sleep, crying and feeding problems (yes/no), child characteristics, parenting efficacy and the doubt scale of the Maternal Infant Sleep Cognitions Scale. We calculated proportions of infant with one or more of sleep, feeding and crying problems and conducted logistic regressions to determine characteristics associated with each problem, adjusting for factors associated with the outcome in bivariate analyses at p <0.1 level.
Results: 783 families took part. Mean infant age was 4 weeks, 53.5% were male and 56% first born. Infant sleep, crying and feeding problems were reported by 38%, 27% and 25% of caregivers, respectively. 199 (25%) infants had one problem, 160 (20%) two problems and 57 (7%) three problems. Maternal but not child characteristics were associated with sleep, crying and feed problems including lower parenting efficacy (adjusted ORs: 1.99 (95% CI 1.72, 2.41) for sleep; 1.87 (1.62, 2.27) for crying; 1.73 (1.52, 2.03) for feeding) and more maternal doubt cognitions (adjusted ORs: 1.18 (1.13, 1.24) for sleep; 1.12 (1.07, 1.18) for crying; 1.07 (1.01, 1.12) for feeding).
Conclusion: A concerning number of parents report infant sleep, crying and feeding problems at this early age. Prevention programs targeting caregivers with doubt cognitions and low parenting efficacy should be developed and evaluated.
Support (If Any): This study was funded by the Victorian government's Department of Education and Early Childhood Development and the Scobie and Claire Mackinnon Trust. Associate Professor Hiscock's salary is supported by a National Health and Medical Research Council (Australia) Career Development Award.

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BREASTFEEDING MAY IMPROVE NOCTURNAL SLEEP AND REDUCE INFANTILE COLIC: POTENTIAL ROLE OF BREAST MILK MELATONIN

Cohen A[1], Hadash A[2], Shehadeh N[2], Pillar G[1,3]
[1]Sleep Lab, Rambam Medical Center and Technion, Haifa, Israel, [2]Pediatrics Department A, Rambam Medical Center, Haifa, Israel, [3]Pediatrics Department, Carmel Hospital, Haifa, Israel

Introduction: Melatonin is secreted during the night in adults, but not in infants. It has a hypnotic effect and a relaxing effect on the gastrointestinal smooth muscle. It is plausible that breast milk, which consists of melatonin, may have an effect on improving infants' sleep and reducing infantile colic. Purpose: To study the effect of way of feeding (breastfeeding vs artificial formula) on infants sleep and colic, and to test whether breast milk contains melatonin.
Methods: Ninety-four mothers of two to four months old infants filled a questionnaire regarding infantile colic and sleep. Then melatonin levels were measured in breast milk and in commonly used artificial formulas.
Results: Exclusively breast-fed infants had a significantly lower incidence of colic attacks (p=0.04), lower severity of irritability attacks (p=0.03) and a trend for longer nocturnal sleep (p=0.06). Melatonin in breast milk showed a clear circadian curve, and was unmeasurable in artificial milks.
Conclusion: Breastfeeding is associated with reduced infantile colic and a trend toward better nocturnal sleep compared to artificial formula. It is plausible that the melatonin which was observed in breast milk but not in commercial formula partially mediates these findings.

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SLEEP STAGE EFFECTS ON BODY TEMPERATURES AND VASOMOTRICITY IN PRETERM NEONATES

Bodin E[1,2,3], Décima P[1], André L[1,2], Stéphan-Blanchard E[1], Libert J[1], Chardon K[1], Telliez F[1], Bach V[1]
[1]PériTox-INERIS (EA 4285 - UMI 01), University of Picardy Jules Verne, Amiens, France, [2]Neonatal and Intensive Care Unit, Amiens University Medical Center, Amiens, France, [3]Pediatric Neurology Department, Amiens University Medical Center, Amiens, France

Introduction: Core and skin body temperatures and thermoregulatory responses vary along the sleep-wake cycle as a result of the close relationship between thermoregulation and sleep processes. This has been observed in adults but seldom studied in neonates. This study aimed at analyzing whether body skin temperatures and the difference between internal (~proximal, assessed by the abdominal skin temperature) and distal skin temperatures, reflecting the vasomotor control - which is the first thermoregulatory response to be sought in case of thermal stress - vary according to the sleep stages in preterm neonates.
Methods: A nocturnal polysomnography was performed in 6 preterm neonates (gestational age: 30±0.4 wk) at 9th day of life. Wakefulness (W), active (AS) and quiet (QS) sleeps were scored. Skin temperatures (T) were measured every 5 min during the sleep stage by infrared thermography on 10 sites (proximal = abdominal temperature; distal = foot, hand, thigh, arm temperatures; others: cheek and pectoral). Temperature differences were calculated between abdominal skin and distal skin temperatures (especially foot) as an index of vasomototricity.
Results: Abdominal temperature was greater (+1.5±0.4°C) and more stable than foot temperature, reflecting efficient vasomotricity. A sleep stage effect was observed on the levels and time variability of the skin temperatures (W<AS<QS) and on the difference between proximal and distal skin temperatures (W>AS>QS).
Conclusion: Vasomotricity is efficient in 9 day-old preterm neonates and depends on sleep stages, as evidenced by different levels in cutaneous temperatures, their variability according to time and the difference between proximal and distal temperatures. These results are consistent with those already found in adults but have never been previously reported in neonates.
Support (If Any): ANR-TECSAN Project (08-006).

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INFLUENCE OF AMBIENT TEMPERATURE ON AUTONOMIC NERVOUS SYSTEM IN SLEEPING PRETERM NEONATES

Stéphan-Blanchard E[1], Décima P[1], Delanaud S[1], André L[1,2], Bach V[1], Chardon K[1], Telliez F[1]
[1]PériTox-INERIS (EA 4285 - UMI 01), University of Picardy Jules Verne, Amiens, France, [2]Neonatal and Intensive Care Unit, Amiens University Medical Center, Amiens, France

Introduction: A failure of autonomic nervous control mechanisms during sleep is believed to play a role in sudden infant death syndrome (SIDS). Environmental factors such as thermal stress are associated with SIDS but the physiopathological mechanisms by which it contributes to increased infant vulnerability are unknown. This study aimed at evaluating the influence of slight variations in ambient temperature on autonomic nervous activity in sleeping infants.
Methods: Autonomic nervous control was assessed according to sleep stages in thirty-four preterm neonates (postmenstrual age: 36.2 ± 0.9 weeks, weight at study: 2083 ± 277 g) recorded polygraphically and exposed to three different ambient temperatures (thermoneutrality: 32.5 ± 1°C, warm condition: 34.1 ± 0.7°C and cool condition: 30.4 ± 0.7°C). Time- (SDNN, r-MSSD, pNN25) and frequency-domain (VLF, LF and HF powers) parameters, and Poincaré Plot data (cardiac vagal and sympathetic indexes) were used to characterize the functional state of the autonomic nervous system.

Results: We observed a classical shift from a higher sympathetic tone during active sleep to a higher vagal tone during quiet sleep, whatever the thermal condition. Increase in ambient temperature resulted in significantly higher basal heart rate and lower overall variability in both active and quiet sleep, with lower short- and long-term heart rate variability, higher sympathetic tone and lower parasympathetic tone.
Conclusion: The present study demonstrates that even small variations in environmental temperature (such as those encountered during routine care) led to disruptions of autonomic nervous control in sleeping preterm neonates. These changes in HRV are closely similar to those reported in infants at risk of SIDS. This may help understanding how exposure to thermal stress leads to potential deficits which may increase the likelihood of SIDS.

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MATURATIONAL CHANGES OF SLEEP PATTERNS IN VERY PRETERM NEONATES

Décima P[1], Bach V[1], André L[1,2], Krim G[1,2], Dégrugilliers L[1,2], Delanaud S[1], Libert J[1], Stéphan-Blanchard E[1]
[1]PériTox-INERIS (EA 4285 - UMI 01), University of Picardy Jules Verne, Amiens, France, [2]Neonatal and Intensive Care Unit, Amiens University Medical Center, Amiens, France

Introduction: Sleep-wake state organization is of paramount importance in the neurophysi¬ological development of preterm neonates. The very early developmental period features major changes in sleep patterns, reflecting the degree of brain maturation and plasticity. The aim of this preliminary study was to assess the short-term maturational changes of sleep patterns in preterm neonates during the first days of life.
Methods: 12-hour overnight polysomnography was performed in closed incubators at thermoneutrality in 8 healthy preterm neonates (gestational age: 30.5 ± 0.4 wk, birth weight: 1604 ± 172g) at the 6th (N6; weight: 1479 ± 195 g) and 9th (N9; weight: 1533 ± 154 g) days of life. Caregiving did not change between N6 and N9. A first polysomnography was performed on their 3th day to avoid any first night effect on sleep. Sleep was analyzed (visual scoring based on EEG and EOG) for stability and structure using total and average durations, percentage and frequency of active (AS), quiet (QS), indeterminate (IS) sleep stages and wakefulness after sleep onset (WASO) episodes. Wilcoxon tests were used for statistical analyzes.
Results: Between N6 and N9, total sleep time and total durations of sleep stages did not significantly differ whereas the mean duration of QS episodes (+2.0min, p=0.017) and IS (+2.9min, p=0.017) increased. Simultaneously, the frequency of sleep stage changes decreased (-19.2%, p=0.012) as a consequence of a decrease in the frequency of WASO (-26.8%, p=0.030), AS (-17.9%, p=0.050) and IS (-15.8%, p=0.017).
Conclusion: Results point out unmodified total durations of sleep stages between N6 and N9, but underline stabilization in sleep-wake state organization. For very preterm neonates, during their first days of life in neonatal care units and even within a short period of time, sleep is determinant for the maturation of central nervous system.
Support (If Any): ANR-TECSAN Project (08-006).

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IMPORTANCE OF BEDTIME ROUTINES IN LOW-INCOME PRESCHOOL CHILDREN

Wilson KE[1,2], Chervin RD[1], Lumeng J[2,4], Miller A[3,4]
[1]Department of Neurology, University of Michigan, Ann Arbor, MI, USA, [2]Department of Pediatrics and Communicable Diseases, University of Michigan, Ann Arbor, MI, USA, [3]School of Public Health, University of Michigan, Ann Arbor, MI, USA, [4]Center for Human Growth and Development, University of Michigan, Ann Arbor, MI, USA

Introduction: Sleep problems are common in preschool-age children; children growing up in poverty may be at higher risk. A regular bedtime routine and consistent bedtime is recommended to improve sleep. We sought to better define benefits of a bedtime routine and consistent bedtime among low-income preschool children.
Methods: Parents of Head Start preschoolers completed sleep questionnaires as part of a larger study. Validated sleep surveys included: 1) General Sleep Information Questionnaire (GSI) to evaluate sleep schedules and sleep duration, 2) Children's Sleep-Wake Scale (CSWS) to evaluate sleep behaviors, and 3) Children's Sleep Hygiene Scale (CSHS) to evaluate sleeping environment and bedtime routines.
Results: Among 381 preschool children (mean age 4.1 ±0.5, range 2.8-5.0 years), 49.9% were boys, 61.7% were Caucasian, and 16.3% of parents did not have a high school degree. Overall, 84.5% of children were reported to have a bedtime routine and 89.2% a consistent bedtime; average routine lasted 41.4 minutes (± 26.8 min). T-tests revealed that children with regular routines and consistent bedtimes went to bed earlier compared to children who did not (all p's reported < 0.05); children with a regular routine also obtained an additional 2.3 hours of sleep per week(p=0.03). Bedtime routines were associated with fewer problems going to bed (p=0.02). Consistent bedtimes were associated with easier return to wakefulness in the morning (p=0.003). Both bedtime routines and consistent bedtimes were associated with fewer sleep problems (p<0.001).
Conclusion: Regular bedtime routines and consistent bedtimes are associated with increased sleep duration and fewer sleep problems among Head Start preschool children. Although this correlational study cannot prove causality, establishing adequate routines and bedtimes may be important for low-income children, who may be especially vulnerable to consequences of sleep deficiency and sleep problems.
Support (If Any): 5RC1DK086376-02, 5T32NS007222-30.

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FETAL COMPLEX MOVEMENT PATTERNS ASSOCIATED WITH BEHAVIORAL AROUSAL ARE RELATED TO LATER INFANT NEURODEVELOPMENT

Singer-Clark T[1,2], Young ME[1,2], Salisbury AL[1,2]
[1]Brown Center for Children, Warren Alpert Medical School at Brown University, Providence, RI, USA, [2]Brown Center for Children, Women & Infants Hospital, Providence, RI, USA

Introduction: Arousal from sleep during infancy is thought to be a mechanism of protection against harmful stimuli. An excessive proclivity to arouse, however, can be associated with irregular development. Although fetal sleep states have been observed by 36 weeks gestational age (GA), the concept of fetal arousal has not been fully examined. The objective of this study was to examine the emergent properties of fetal state and arousal and their relations to early infant development.
Methods: The participants in this study (N=150) were part of a larger study investigating the effects of maternal depression and antidepressant use during pregnancy. Fetal ultrasound video was recorded for fifty minutes at 26-31 and 32-38 weeks GA. The recordings were coded for fetal behaviors in 10-second epochs. Factor analysis procedures revealed seven factors, accounting for 65.76% of the variance with four emerging behavioral patterns: isolated, complex, and stress-related. Complex movement patterns (CMPs) comprise arousal behaviors seen in the infant (stretch, yawn, head rotation, etc.) and were therefore examined for their relationship to later infant neurobehavioral development.
Results: The frequency of CMPs was positively correlated from early to later gestation (rho=.34, p<.001). More fetal CMPs were related to more optimal standardized infant neurobehavioral scores on the NICU Network Neurobehavioral Scale (NNNS) for infant self regulation (rho=.21, p<.018), attention (rho=.21, p<.02), state (rho= -.29, p<.001), and arousal (rho= -.28, p<.001). More CMPs were also related to a higher percentage of active sleep during direct observation (rho=.22, p<.03). These relationships were confirmed with generalized linear models using covariates of gestational age at birth, maternal age, race, ethnicity, and maternal depression status.

Conclusion: Results suggest CMPs might indicate fetal behavioral arousals and predict infant neurobehavioral development. Future work will utilize simultaneous measures of fetal heart rate patterns and CMPs to examine relationships to 24-hour infant behavioral state.

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INFLUENCE OF APNEIC STATUS ON AUTONOMIC NERVOUS SYSTEM IN SLEEPING PRETERM NEONATES

Stéphan-Blanchard E[1], Décima P[1], Delanaud S[1], André L[1,2], Telliez F[1], Bach V[1], Chardon K[1]

[1]PériTox-INERIS (EA 4285 - UMI 01), University of Picardy Jules Verne, Amiens, France, [2]Neonatal Intensive Care Unit, Amiens University Medical Center, Amiens, France

Introduction: Many studies suggest that preterm infants with impaired autonomic control are a subgroup at greater risk of sudden unexpected death from potentially life-threatening events during sleep, such as severe central apneas. Non-linear heart rate dynamics analysis has been shown to provide valuable information on even subtle abnormalities in cardiovascular regulation. The aim of the present study was to evaluate the influence of the apneic status on autonomic nervous activity in sleeping preterm neonates.

Methods: Autonomic nervous control was assessed according to sleep stages in 33 preterm neonates (postmenstrual age: 36.2±1 weeks, weight at study: 2062±276 g) recorded polygraphically. Time- (SDNN, r-MSSD, pNN25) and frequency-domain (LF and HF powers) parameters, and non-linear methods (detrended fluctuation analysis, approximate and sample entropy) were used to characterize heart rate variability. Healthy infants with <25 overall apneas/h (control group, n=10) were compared to 1) infants with >25 overall apneas/h of which <25 were accompanied with bradycardia and/or desaturation (moderate group, n=14), and 2) infants with >25 overall apneas/h of which >25 were accompanied with bradycardia and/or desaturation (severe group, n=9).

Results: No significant difference was found between the groups for the time- and frequency-domain parameters. Interestingly, non-linear methods revealed significant effects of apneic status on autonomic nervous activity which were observed in the severe group only. We showed an increase in the values of approximate and sample entropy in both sleep stages. We also found an increase in the short-term scaling exponent α1 in active sleep and a decrease in the long-term scaling exponent α2 in quiet sleep.

Conclusion: This study suggests that preterm infants displaying frequent apneas with bradycardia and/or desaturation are at risk of disturbed autonomic nervous control during sleep. These changes are more likely to be revealed with non-linear heart rate dynamics analysis than with conventional methods.

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LONGITUDINAL TRAJECTORIES OF BEHAVIORAL SLEEP PROBLEMS IN A GENERAL POPULATION SAMPLE OF PRESCHOOL-AGED CHILDREN

Garrison MM[1,2], Christakis DA[1,3]

[1]Center for Child Health, Behavior, and Development, Seattle Children's Hospital, Seattle, WA, USA, [2]Health Services, University of Washington, Seattle, WA, USA, [3]Pediatrics, University of Washington, Seattle, WA, USA

Introduction: Behavioral sleep problems are common in children, and information about the natural history can help parents decide when intervention may be indicated.

Methods: Parent surveys were collected at baseline and 6, 12, and 18-month follow-ups in a RCT of 3-5 year-olds in a non-clinical sample. The analysis is restricted to the control arm, to follow the natural history of sleep with questions were drawn from the Child Sleep Habits Questionnaire, assessing the frequency of problems with sleep onset latency, night awakenings, nightmares, difficulty waking in the morning, and daytime tiredness. Total sleep problem scores could range from 5-15. Repeated measures regression models were used to examine the impact of time on both the overall sleep problem score and the individual symptoms.

Results: The analysis included 279 children with a mean age at baseline of 51.5 months (SD 7.7), of whom 64% at baseline had a sleep problem >= 2 nights per week and 18% >= 5 nights per week. The mean sleep problem score was 6.3 (SD 1.4). Over the study period, significant decreases were observed in the sleep problem score (mean change of 0.23 per year, 95%CI 0.13 - 0.32), as well as the frequency of problems with sleep onset latency, night awakenings, and daytime tiredness ($p < 0.01$ for each). At baseline, 6% of children had repeated awakenings 5-7 nights per week and 22% for 2-4 nights, as compared to 1% and 14% 18 months later ($p < 0.01$). The greatest overall improvement in sleep problem score was observed between 48-54 months, largely due to changes in night awakenings. Sleep onset latency, however, saw the greatest improvements at 66-71 months of age. Despite this, 60% of children still had sleep problems at least 2 nights per week at the 18-month follow-up, and 8% had problems 5-7 nights. In part, this is due to a significant increase was observed over time in parent-reported frequency of the child having difficulty waking in the morning (19% at baseline to 30% 18 months later, $p < 0.01$). In an exploratory analysis, we examined whether this could be a sign that underlying problems with sleep initiation and maintenance were persisting but parental awareness was decreasing as the child grew more independent.

Conclusion: Although significant improvements in sleep was observed over time, the majority of children still had parent-reported sleep problems >= 2 nights per week at 18 months after baseline, when the mean age was 5.7 years, with the most common being sleep onset latency and difficulty waking.

Support (If Any): This work was supported by grant 5R01HD056506 from NICHD to Dr. Christakis.

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MATERNAL SLEEP AND PSYCHOSOCIAL FACTORS PREDICT DEVELOPMENT IN INFANTS AND TODDLERS

Mindell JA[1,2], DuMond C[3], Gerdes M[1], Gunn E[4]

[1]Children's Hospital of Philadelphia, Philadelphia, PA, USA, [2]Saint Joseph's University, Philadelphia, PA, USA, [3]Upstate Golisano Children's Hospital, Syracuse, NY, USA, [4]Johnson & Johnson Consumer Products Company, Skillman, NJ, USA

Introduction: The aim of this study was to assess the relationship between maternal sleep and psychosocial factors with development in infants and toddlers.

Methods: A longitudinal study was conducted with 164 infants/toddlers (starting age = 3 to 18 months). Measures completed included the Bayley Scales of Infant Development (BSID=III; subdomain scores for cognitive, language, and motor development), and the Infant-Toddler Social and Emotional Assessment (subdomain scores for competence, internalizing, and externalizing) to assess child development at 18-months and the Pittsburgh Sleep Quality Index, Edinburgh Depression Questionnaire or Beck Depression Inventory, and Perceived Stress Scale at 3-, 6-, 9-, and 12-months.

Results: Bivariate correlations were first conducted, with significant variables then entered into linear regressions. At 3 months of age, maternal depression predicted competence scores at 18 months (19% of variance). At 6 months, maternal sleep predicted motor scores (18%), with no prediction of developmental outcomes by maternal factors at 9 months. Maternal depression, sleep, and perceived stress at 12 months of age were all predictive of developmental outcomes at 18 months (externalizing - 15% of variance; internalizing - 15%, and dysregulation - 15%). Concurrent prediction of developmental outcomes at 18 months found that sleep and perceived stress predicted externalizing scores (13%), sleep predicted internalizing scores (7%), and sleep, depression, and perceived stress predicted dysregulation (19%).

Conclusion: Overall, maternal psychosocial factors at 12 and 18 months, including depressive symptomatology, sleep quality, and perceived stress, significantly predicted negative social-emotional development at 18 months. These same maternal factors at 3-, 6-, and 9-months did not predict later problematic social-emotional development, although early maternal depression at 3 months was predictive of later competence. On the other hand, only maternal sleep at 9 months predicted developmental outcomes based on the Bayley. Thus, it seems that early maternal factors have modest impact on infant developmental outcomes, whereas maternal factors existing later in infancy/toddlerhood have a significant relationship with poor social-emotional outcomes.
Support (If Any): This study was supported by Johnson & Johnson Consumer Products Company, Division of Johnson & Johnson Consumer Companies, Inc.

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SLEEP AND THE LONGITUDINAL TRAJECTORY OF BEHAVIOR PROBLEMS IN A GENERAL POPULATION SAMPLE OF PRESCHOOL CHILDREN

Garrison MM[1,2], Christakis DA[1,3]
[1]Center for Child Health, Behavior, and Development, Seattle Children's Hospital, Seattle, WA, USA, [2]Health Services, University of Washington, Seattle, WA, USA, [3]Pediatrics, University of Washington, Seattle, WA, USA

Introduction: Studies have observed associations between sleep and behavior problems in children, but less is known about how sleep problems may influence the longitudinal trajectory of behavior in preschool-aged children.
Methods: Child sleep and behavior were measured via parent survey at baseline and 6, 12, and 18-month follow-ups in a RCT of 3-5 year-olds in a non-clinical sample. The analysis is restricted to the control arm to follow the natural history of sleep and behavior. Sleep questions were drawn from the Child Sleep Habits Questionnaire, assessing the frequency of problems with sleep onset latency, night awakenings, nightmares, difficulty waking in the morning, and daytime tiredness. Child behavior was assessed using the Social Competence and Behavior Evaluation (SCBE), parent version, which has subscales for externalizing, internalizing, and social competence. To define behavior trajectories, we conducted within-subject linear regressions of each subscale over time. Children were classified as being on an "improving" or "worsening" trajectory if the beta coefficient for the regression predicted a difference of ≥ 0.5 standard deviations between the first and last time point, and the r2 for the model was ≥ 0.4. Multinomial logistic regression models were then used to examine whether baseline sleep problems predicted behavior trajectories after controlling for baseline behavior scores.
Results: Of the 279 children in the analysis, most were on improving or flat trajectories, with 26%, 35%, and 34% on improving trajectories for internalizing, externalizing, and social competence, respectively, as compared to 17%, 13%, and 13% on worsening trajectories. Parent report of any sleep problem was associated with a worsening externalizing trajectory (RRR 3.38, 95%CI 1.44 - 7.93). In examining specific sleep problems, onset latency was associated with worsening social competence trajectories, difficult time waking with worsening externalizing trajectories, and daytime tiredness with decreased odds of improving internalizing trajectories.
Conclusion: Baseline sleep problems were associated with poor behavior trajectories. While this is likely at least in part due to unmeasured common antecedents, it seems possible that intervening on sleep problems in preschool children may positively alter behavioral trajectories.
Support (If Any): This work was supported by grant 5R01HD056506 from NICHD to Dr. Christakis.

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INCIDENCE AND REMISSION OF SLEEP PROBLEMS IN CHILDREN: A 7-YEAR FOLLOW UP OF THE TUCASA COHORT

Goodwin JL[1,2,4], Silva GE[5], Archbold KH[3], Vasquez MM[1], Quan SF[1,2,4,6]
[1]Arizona Respiratory Center, Tucson, AZ, USA, [2]College of Medicine, University of Arizona, Tucson, AZ, USA, [3]College of Nursing, University of Arizona, Tucson, AZ, USA, [4]College of Public Health, University of Arizona, Tucson, AZ, USA, [5]College of Nursing and Health Innovation, Arizona State University, Phoenix, AZ, USA, [6]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: There is little evidence of the incidence and remission of sleep problems related to sleep disordered breathing in normal children.
Methods: 216 parents of children 6-11 years of age completed baseline sleep habits questionnaires (SHQ) (1999-2001). Approximately 7 years later these adolescents and young adults were assessed at follow-up through a self-completed SHQ. The following subjective symptoms were present if they occurred frequently or more: habitual snoring (SN), excessive daytime sleepiness (EDS), witnessed apnea (WITAP), difficulty initiating and maintaining sleep (DIMS), and learning problems (LP). Sleepwalking (SW) and sleeptalking (ST) were present if they occurred 3 times per month or more. Prevalence, incidence, and remission rates were calculated.
Results: The mean age was 9.0 (6.0-12.1) and 15.4 (11.7-20.1) years at baseline and follow-up respectively. There were 50% females and 31% Hispanic subjects. The prevalence of SN, EDS, WITAP, DIMS, LP, SW, and ST in the follow-up was 6.5%, 39.8%, 5.1%, 60.2%, 7.9%, .09%, and 16.7% respectively. There were no differences in gender or ethnicity. Incidence rates were 4.3%, 39.1%, 4.4%, 58.5%, 6.7%, .09%, and 11.0% whereas remission rates were 78.6%, 56.3%, 77.8%, 36.2%, 57.1%, 100%, and 65.4%. Over this period, there were 2.8%, 6.5%, .09%, 20.4%, 1.4%, 0%, and 8.3% of subjects who persistently reported the symptom, conversely there were 83.3%, 51.9%, 91.7%, 28.2%, 90.3%, 95.8%, and 67.6% of subjects who never reported the symptom.
Conclusion: There is substantial variability in self reports of sleep problems as children age from childhood to adolescence. Nevertheless, there are a small number of young children who persistently have sleep problems over this age span.
Support (If Any): HL 62373.

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DEVELOPMENT OF A SHORT VERSION OF THE DYSFUNCTIONAL BELIEFS ABOUT SLEEP QUESTIONNAIRE FOR USE WITH CHILDREN (DBAS-C10)

Blunden SL[1], Crawford M[2], Gregory AM[3]
[1]University of South Australia, Adelaide, SA, Australia, [2]University of Glasgow Sleep Centre, Glasgow, United Kingdom, [3]Goldsmiths, University of London, London, United Kingdom

Introduction: There is a link between dysfunctional beliefs about sleep (DBAS) and sleep problems in adult populations. Questionnaires addressing these beliefs are well validated. Whether these cognitions are meaningful in paediatric populations remains to be further established. We aimed to develop and validate a short version of the DBAS scale (DBAS-C-10) to assess whether these beliefs are present in children aged 9 years and older; and also amenable to change after a treatment intervention.
Methods: To ensure age appropriateness the scale was adapted from the adult DBAS. This occurred through focus groups with experts in the field and pilot testing in a small sample of children. The final version was validated as part of a larger randomised control trial. Of a sample year 6/7 students (n=134, mean age= 12.73y [SD=.09y]) 91 students completed the DBAS-C-10 pre and post sleep education intervention,

whilst 43 acted as controls, completing the questionnaire at time point 1 and 2 (5-7weeks apart).
Results: The DBAS-C-10 preserved the adult version factor structure [(1) Beliefs about the immediate negative consequences of insomnia (2) Beliefs about the long-term negative consequences of insomnia (3) Need to control the insomnia]. Internal consistency of the total scale was moderate (0 .71, range .51 -.78). Two sample analysis of agreement revealed that the test-retest reliability measure for each item was acceptable. The questionnaire was only moderately sensitive to change post intervention, which might be due to the education intervention not explicitly targeting dysfunctional beliefs.
Conclusion: This scale has acceptable psychometric properties and could be used to investigate dysfunctional beliefs in children and potentially detect changes in sleep related cognitions in children across treatment interventions.
Support (If Any): Alice M. Gregory is currently supported by a Leverhulme Research Fellowship.

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DIFFERENCES IN OBJECTIVE SLEEP PATTERNS DURING SCHOOL TIME AND VACATIONS: DURATION, TIMING, AND VARIABILITY

Bei B[1], Allen N[1,2], Trinder JA[1]
[1]Psychological Sciences, University of Melbourne, Melbourne, VIC, Australia, [2]Orygen Youth Health, University of Melbourne, Melbourne, VIC, Australia

Introduction: It is well-established that during school time, a significant number of adolescents obtain insufficient sleep. Studies have reported significant discrepancies between sleep patterns during school weekdays and weekends. Sleep patterns during extended non-school periods however, have not been examined using objective measurements.
Methods: 68 high-school students (32 males, 36 females, average age 16.2±1.1) wore an actigraph continuously for four weeks: the last week of a term, the two weeks of a school break, and the first week of the next term. A number of sleep parameters were derived from actigraphy data and compared between school weekdays and vacations using paired-sample t-tests. Sleep quantity and quality were assessed by total sleep time (TST), sleep efficiency (SE), and sleep onset latency (SOL), and average bedtimes (BT) and rise-times (RT) were calculated to indicate sleep timing. The standard deviations (SD) of the above variables were calculated to indicate sleep variability.
Results: TST was significantly longer during vacations (435.1±43.0min) than during school weekdays (391.8±38.7min), $p<.001$. However, SE was lower during vacations (79.5±4.9%) compared to school weekdays (80.8±4.7%), $p<.001$, whilst SOL was not statistically different between times. Vacations were associated with significantly later sleep timing, with vacation BT 69.1 minutes and RT 129.9 minutes later than that of school weekdays, both $p<.001$. Standard deviations of all sleep parameters were significantly higher during vacations than school weekdays (all $p<.05$). Largest differences in variability were observed in RT and BT, with vacation SD 2.5 and 1.8 times that of school weekdays. The SD of vacation TST, SE, and SOL were 1.7, 1.4, and 1.3 times that of school weekdays respectively.
Conclusion: Results are consistent with the view that in high-school students, school weekdays are associated with sleep restriction compared to vacations. However, sleep during vacations is characterized by a phase delay and a considerable day-to-day variability.

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SLEEP FOR SUCCESS - THE IMPACT OF SCHOOL-BASED PROGRAM ON THE SLEEP AND THE DAY TIME FUNCTIONING OF SCHOOL-AGE CHILDREN

Gruber R[1,2], EGillies-Poitras E[4], Enros P[4], Kestler M[4], Lessard I[4], Bergmame L[2], Monette C[2], Fontil L[2], Michaelsen S[2], Somerville G[3]
[1]Psychiatry, McGill, Montreal, QC, Canada, [2]ABS Lab, Douglas Mental Health University Research Center, Montreal, QC, Canada, [3]Complementary Services, Riverside School Board, Montreal, QC, Canada, [4]Riverside School Board, Montreal, QC, Canada

Introduction: Mounting evidence indicates that sleep has beneficial effects on health, learning, memory, attention, emotional regulation, and academic success. Conversely, fatigue and insufficient sleep can negatively affect health, academic performance, and self-regulation, all of which are necessary for success in school. Given the critical importance of sleep for the health and daytime functioning of elementary school students,the objective of this study was to develop and evaluate a school-based program aimed at improving the sleep habits and extending the sleep of school-age children.
Methods: Using a community-based participatory research approach we created "Sleep for Success" (SFS); a school-based program aimed to change sleep habits of school-age children. Implementation of the program was carried out in three elementary schools. 15 teachers and 192 students participated in program activities, where 74 children (Mean Age 9.13 + 1.85, 47 girls, 27 boys) participated in program evaluation. 23 of these students were randomly allocated to the control group. Sleep and daytime functioning were evaluated at baseline and post-implementation using the "Children's Sleep Habits Questionnaire" (CSHQ), "Child Behavior Checklist" (CBCL), and the Child Depression Inventory (CDI). In addition, in a sub-sample of randomly selected students, objective assessment of sleep patterns was conducted over 5 successive nights using actigraphy.
Results: Following implementation of the program, CSHQ measures of sleepiness and sleep onset delay were lower [$F(1, 39)=8.27$, $p<0.006$, $F(1,39)=6.45$, $p<0.01$]; scores on the internalizing and externalising CBCL scales [$F(1, 39)=6.13$, $p<0.02$, $F(1,39)=21.45$, $p<0.001$] and on the anhedonia score of the CDI [$F(7, 33)=3.99$, $p<0.003$] were lower, and sleep duration measured by actigraphy in the sub-group was significantly longer [$F(1,21)=5.81$; $p<0.05$]), compared to baseline. Parallel analyses on the control group revealed no significant change.
Conclusion: Participation in SFS had a significantly positive impact on children's sleep, daytime sleepiness, and daytime functioning.
Support (If Any): Canadian Institute of Health Research Grants # 187977, 238576 to Reut Gruber.

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LONGITUDINAL EFFECTS OF SLEEP QUALITY ON NEUROENDOCRINE STRESS REACTIVITY IN MIDDLE CHILDHOOD

Vargas I, Olson S, Lopez-Duran N
Psychology, University of Michigan, Ann Arbor, MI, USA

Introduction: The impact of sleep quality on basal Hypothalamic-Pituitary-Adrenal (HPA) axis functioning has been well documented in both children and adults. Specifically, decreased sleep quality is associated with higher basal cortisol levels, an index of HPA-axis functioning. However, few studies have examined the impact of sleep quality on HPA-axis stress reactivity. Furthermore, these investigations have been limited to adult samples and cross-sectional designs. Thus, this is the first investigation to prospectively examine the impact of sleep quality on endocrine stress reactivity in middle childhood.
Methods: The sample included 54 (26 females) children between the ages of 5 and 6 (mean age = 5.25), assessed at two different time points 1 year apart. At Time 1, sleep quality was assessed with the parent-completed Sleep Habits Questionnaire (SHQ). At the 1-year follow-up,

participants completed one of two standard laboratory stress tasks. Sixteen post-stress samples of salivary cortisol were used to assess various indices of HPA-axis stress reactivity.
Results: Three indices of HPA-axis functioning, baseline cortisol (base), post-task cortisol reactivity (peak controlling for baseline), and Area Under the Curve-increased (AUCi) as a global measure of reactivity and regulation, were each entered as outcomes in three separate hierarchical regressions. For all analyses, three indices of sleep quality (i.e., total sleep time, sleep disturbance, and night waking) and gender were entered as predictor variables. Results showed that increased sleep disturbance ($p = .025$) and night waking ($p = .030$) significantly predicted greater post-stress AUCi reactivity. However, only increased sleep disturbance ($p = .013$) predicted greater post-task peak levels.
Conclusion: These findings suggest that sleep disturbances may be associated with anomalies in HPA-axis reactivity and regulatory processes, while night waking may only be associated with anomalies in regulatory processes. Our study contributes to the understanding of the association between sleep and neuroendocrine reactivity in children.
Support (If Any): Funding for this project was provided by National Institute of Mental Health (NIMH) Grant R01MH57489 awarded to Sheryl Olson.

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FIVE FACTOR MODEL PERSONALITY AND SLEEP IN MIDDLE CHILDHOOD
Keller P[1], Haak E[1], Brown B[1], Razor MB[1], El-Sheikh M[2]
[1]Psychology, University of Kentucky, Lexington, KY, USA, [2]Human Development and Family Studies, Auburn University, Auburn, AL, USA

Introduction: Infants with difficult temperaments are unable to soothe themselves and fall back asleep upon normal night waking (Keener, Zeanah, & Anders, 1988). Temperament is a precursor to personality, and there is some limited research suggesting that difficult personality types (e.g., introverted, neurotic) or personality disorders (e.g., borderline, antisocial) are linked to poor sleep in adulthood (Gray & Watson, 2002; Lindberg et al., 2003; Philipsen et al., 2005). There is much less research during middle childhood or adolescence, when temperament transitions into personality, leading to questions about associations between temperament/personality and sleep across development. Further, all prior research considers personality dimensions as having linear associations with sleep. Modern perspectives propose that personality dimensions have curvilinear associations with health, such that moderate levels of each factor are most adaptive (Widiger, 2011). The current study hypothesizes that personality will have curvilinear associations with sleep parameters in middle childhood.
Methods: 64 children (aged 6 - 12 years) and their parents participated. Child sleep was monitored via actigraphy for one week. Average sleep minutes per night, sleep efficiency, physical activity during sleep, and sleep latency were derived. Children reported on their daytime sleepiness (Student Sleep Habits Survey). Mothers reported on child personality, including four of the big five factors: Introversion/Extraversion, Conscientiousness, Agreeableness, and Neuroticism (Dimensional Personality Symptom Item Pool). Data were analyzed using multiple regression.
Results: Introversion was related to daytime sleepiness and sleep activity. Agreeableness was associated with sleep efficiency, and Neuroticism was related to sleep activity. In all cases, associations were curvilinear. Children with moderate levels of Introversion, Agreeableness, or Neuroticism had the best predicted sleep.
Conclusion: Findings extend research on temperament and sleep to personality and sleep in older children. Results also support recent personality theory developments, namely that personality dimensions are bipolar and extremes on either pole are unhealthy.
Support (If Any): This project was supported by NIH grant R21 HD 062833 awarded to the first author.

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SLEEPINESS AND STRATEGIC AND NONSTRATEGIC PREDICTORS OF RECALL IN CHILDREN
Gaultney JF, Hale A
Psychology, University of North Carolina at Charlotte, Charlotte, NC, USA

Introduction: Sleep and sleepiness have the potential to affect memory performance. Earlier we found that excessive daytime sleepiness in children predicted recall but not strategy-use in a sort-recall memory task, suggesting that sleepiness may play a non-strategic role in memory. We examined the contributions of sleepiness, strategy use, and non-strategic factors to recall, predicting that regressing recall on strategic and non-strategic factors would eliminate associations with sleepiness.
Methods: Fourteen children in grade 1, 3, or 5 indicated their level of sleepiness by pointing to the "happy face" on a 5-pt scale that indicated how they felt. Recall on three trials of a sort-recall task using 18 categorizable words (different words/categories on each trial) was regressed on strategy use, nonstrategic variables (speed of processing, working memory, motivation), and sleepiness. In the trial-1, no strategic prompts were given. After trial-1, children were shown the "trick" (sorting cards into categories, grouped rehearsal) that could help them remember more, then given a new list of words that were equally typical. On trial-2, the words, although known by the 1st-graders, were much less typical, making strategy use and recall more difficult.
Results: Recall at each trial was analyzed separately (controlling for age and cognitive ability). On trial-1 ($R2=.79$), greater sleepiness predicted lower recall (trend only, $p<.09$). On trial-2 ($R2=.72$) sleepiness did not predict recall beyond that already accounted for by motivation and strategy use. On the 3rd, more difficult task ($R2=.93$), sleepiness remained near-significant ($p<.06$), along with processing speed and strategy-use. Sleepiness did not predict strategy-use on any trial.
Conclusion: Under some conditions (e.g. no strategy prompting or a difficult memory task), sleepiness predicts recall over and above the role of both strategic and nonstrategic factors. Future research should examine whether sleepiness acts as a mediator or moderator of strategic and/or nonstrategic predictors of recall.

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SLEEP AND POSITIVE HEALTH IN SCHOOL-AGED CHILDREN
Ambler DM[1], Peightal A[1,2], Meltzer LJ[1]
[1]Pediatrics, National Jewish Health, Denver, CO, USA, [2]Psychology, University of Denver, Denver, CO, USA

Introduction: Disturbed or insufficient sleep has been associated with negative health outcomes, including obesity, decreased cognitive functioning, difficulties with emotion regulation, depression and anxiety. However, few studies have examined the association between good sleep and positive aspects of health (increased activity, good sleep hygiene, and well-being) in school-aged children.
Methods: Participants were 50 children (7-13 years, 50% male, 76% Caucasian) who wore an actigraph for one week. In addition, children completed questions about their activities during the week of actigraphy, sleep hygiene (Children's Report of Sleep Patterns), as well as their health related quality of life (Healthy Pathways Questionnaire).
Results: Good sleep was found to be related to different aspects of positive health. For physical activity, sleep efficiency was better for children who regularly participated in physical education (93.2% vs. 87.4%, $p=.04$). Further, children who reported being active at recess got more sleep (pretty active=492.4 min; somewhat active=502.7 min; little bit active=448.6, $p=.04$). In terms of sleep hygiene, total sleep time and bedtime were significantly related to the use of electronics in the hour before bed ($p=.04$ and .002 respectively), and bedtimes were 41 minutes earlier for children who reported only occasional use of the computer (mean=21:50) compared to children who used the computer most nights

(mean=22:19, p=.03). Children who reported watching television only a few days per week had an earlier bedtime (mean=21:33) than children who watched television most days of the week (mean=22:04). Although not statistically significant, this 31 minute difference is clinically meaningful. Reports of life satisfaction were higher in children who slept more than 8 hours/night (p=.04) and children who went to bed before 10pm (p=.05). Further, children who went to bed before 10pm reported having more energy (p=.02).
Conclusion: Children who reported being more active and having less screen time, in particular in the hour before bed, had better sleep as measured by actigraphy. Further, children who obtained more sleep reported better health related quality of life. Together these results highlight the need for educating parents and youth about the benefits of being active during the day, reducing screen time, and obtaining sufficient sleep.
Support (If Any): This study was supported by K23MH077662.

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RESTLESS LEGS SYNDROME IN PEDIATRIC CHRONIC KIDNEY DISEASE: IS IRON STATUS TO BLAME?

Riar S[1], Greenbaum L[1], Bliwise DL[2], Leu RM[3]
[1]Department of Pediatrics, Division of Nephrology, Emory University School of Medicine, Atlanta, GA, USA, [2]Department of Neurology, Emory University School of Medicine, Atlanta, GA, USA, [3]Department of Sleep Medicine, Emory University School of Medicine, Atlanta, GA, USA

Introduction: Restless legs syndrome (RLS) can adversely affect sleep. Central nervous system iron deficiency is thought to be involved in RLS pathogenesis, with serum ferritin levels used to guide treatment. Children with chronic kidney disease (CKD) are at risk of iron deficiency, but are also in an inflammatory state, which increases ferritin. We studied the prevalence of RLS in children with CKD and compared serum ferritin and inflammatory status in those with and without RLS.
Methods: This observational study examined RLS prevalence in CKD patients (non-transplant, non-dialysis [NT, ND] CKD patients with an estimated GFR < 60 mL/min/1.73 m2; renal transplant [Tx]; and dialysis patients). RLS was diagnosed using an NIH criteria based questionnaire. Serum ferritin <100 ng/mL or transferrin saturation <20% defined iron deficiency. Serum high sensitivity C-reactive protein of >/= 1 mg/L defined inflammation.
Results: Of the 90 patients with CKD, 51 were renal Tx patients, 16 were on dialysis, and 23 were NT, ND CKD patients. RLS was seen in 14.3% of children with CKD. RLS prevalence was significantly higher in patients without iron deficiency compared to those with iron deficiency (28.6% vs 9.5%, p= 0.024). Median ferritin levels were significantly higher in RLS+ patients versus RLS- patients (86.4 vs 38.7 ng/mL; p= 0.023). There was no significant difference in RLS rates in CKD patients based on inflammatory status.
Conclusion: In pediatric CKD, RLS subjects had high ferritin values, contrary to non-CKD subjects with RLS. Inflammation is unlikely to be responsible for this finding as an inflammatory state (elevated CRP), wasn't more common in CKD patients with RLS. This study suggests that the pathogenesis of RLS in pediatric CKD is different from those without CKD. This study was limited by small sample size. Further studies should be done to verify these findings.

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DIFFERENT RESTLESS LEGS SYNDROME/WILLIS EKBOM DISEASE (RLS/WED) PHENOTYPES. A MISSED CO-MORBIDITY IN CHILDREN AND YOUTHS WITH NEURODEVELOPMENTAL DISORDERS THAT CAN AGGRAVATE CHALLENGING BEHAVIOUR?

Ipsiroglu OS[1], Hung Y[1], Soo S[1], Ho G[1], Barbosa AV[2], Vatikiotos-Bateson E[2], McKellin W[3]
[1]Department of Pediatrics, University of British Columbia, Vancouver, BC, Canada, [2]Department of Lingustics, University of British Columbia, Vancouver, BC, Canada, [3]Department of Anthropology, University of British Columbia, Vancouver, BC, Canada

Introduction: Sleep related day- and night-time symptoms may not be recognized or may be missed in children with neurodevelopmental disorders (NDD), as NDD are usually associated with challenging behaviour and insomnia. Results of sleep assessments suggest that optimizing our clinical understanding before triaging patients for further diagnostic/therapeutic care would be helpful.
Methods: We use an ethnographic approach adapted from medical anthropology to explore parent(s)/caregiver(s)' perceptions of 'challenging behaviour' and of sleep problems (SP). In addition, we developed and piloted home-based over-night-video-sleep-studies to clinically understand and describe SP.
Results: We are presenting day- and night-time related symptoms and behaviours in 25 children and youth (2-17 years) with global developmental delay or intellectual disability with familial RLS/WED and diagnoses like fetal alcohol and autism spectrum disorders, cerebral paresis, and additional syndromes (e.g. Trisomy-21, cri-du-chat, 22q-deletion, 13x chromosome deletion). The challenging behaviours of these patients were given diagnoses such as attention deficit hyperactive, anxiety, obsessive compulsive, oppositional defiant disorders, emotional lability, and/or depression. However, RLS/WED-related discomfort/urge-to-move/pain had been missed. We identified RLS/WED as one main cause of both insomnia and aggravated challenging behaviour over the day. At quite a young age these children have developed movement-based adaptive strategies to overcome difficulties in sitting still and falling asleep. These strategies range from subtle to quite extreme and can even result in passing out from exhaustion, hiding typical well-known symptoms that may indicate RLS/WED. However, all parents/caregivers generally described the sleep quality of their child as restless and light with major problems in sleep maintenance.
Conclusion: History and analysis of behavioural patterns in conjunction with family sleep history seems to be a key in understanding RLS/WED of patients with NDD. These observations open our understanding of SP causality and diagnostic/therapeutic options.

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THE PREVALENCE OF RESTLESS LEGS SYNDROME IN YOUNG KOREAN CHILDREN

Kim J[1,4], Lim M[2,4], Paik K[2,4], Ha M[3,4], Kwon H[3,4], Yoo S[4], Kim E[4]
[1]Department of Neurology, Dankook University Hospital, Cheonan, Republic of Korea, [2]Psychiatry, Dankook University College of Medicine, Cheonan, Republic of Korea, [3]Preventive Medicine, Dankook University College of Medicine, Cheonan, Republic of Korea, [4]The Environmental Health Center (Neurodevelopment), Dankook Medical Center, Cheonan, Republic of Korea

Introduction: The aim of this study was to investigate the prevalence of RLS in Korean children and to show the difference of prevalence between normal children and children with neurodevelopmental disorder trait.
Methods: Parents of 6- to 7-year-old children attending elementary schools in the neighborhood of Cheonan city were surveyed. Screening questionnaire regarding autism spectrum disorder (ASD) and attention-deficit hyperactivity disorder (ADHD) were also performed. To diag-

nose RLS, the first-degree family history of RLS and self-expression of his or her own leg symptoms were asked as well as four essential criteria of RLS.
Results: 11,673 children were surveyed and 0.92% of them were suspected to have definite RLS. Prevalence of probable RLS with family history was 0.12%. Definite RLS was significantly more frequent in children with ADHD trait or ASD trait than normal children.
Conclusion: RLS is more prevalent in children with neurodevelopmental disorder trait than in normal Korean children.
Support (If Any): This research was supported by grants from Ministry of Environment of Republic of Korea.

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SLEEP PATTERNS AND BEHAVIORS IN ADOLESCENTS FOLLOWING MILD TO MODERATE TRAUMATIC BRAIN INJURY
Tham S[1], Palermo T[1,2], Vavilala M[1,3], Rivara F[2,3]
[1]Anesthesia and Pain Medicine, University of Washington, Seattle, WA, USA, [2]Pediatrics, University of Washington, Seattle, WA, USA, [3]Harborview Injury Prevention and Research Center, University of Washington, Seattle, WA, USA

Introduction: Sleep disturbances such as frequent night wakings have been documented in children after traumatic brain injury (TBI) and conceptualized as part of post-concussive syndrome. More recently, sleep disturbances have been recognized to persist well past the expected recovery phase in adults with TBI, but it remains unknown whether sleep problems are also common in pediatric TBI. This study was designed to examine sleep patterns and behaviors in adolescents 3 to 12 months after mild to moderate TBI compared to a healthy cohort, and to identify clinical and behavioral factors predictive of sleep patterns.
Methods: This is an ongoing study with a target sample size of 120 adolescents (n = 60 with TBI and n = 60 age- and sex-matched healthy adolescents). To date, 22 adolescents,12 to 18 years old (64% males, M = 16.1, SD = 1.7), 11 with mild TBI and 11 healthy adolescents have been recruited. Adolescents completed questionnaires to assess demographics, sleep habits and quality, and underwent 10 day actigraphy monitoring (Actiwatch 64). Actigraphy variables included sleep duration, wake time after sleep onset (WASO) and sleep efficiency averaged over 10 days.
Results: Assessments were performed at 8.3 to 12.6 months from injury date. T-tests did not reveal any group differences on self-reported sleep habits or quality. Average sleep duration was similar, M = 368.9 minutes (SD = 60.5) for teens with TBI and M= 398.4 minutes (SD = 40.5) for healthy teens. However, adolescents with TBI displayed significantly higher WASO of 107.9 minutes (M = 53.2) compared to 60.7 minutes (M = 26.4) in the healthy group (p = 0.02), with lower sleep efficiency of 76.1% (M = 10.5) compared to 84.0 % (M = 7.1) in the healthy group (p = 0.05).
Conclusion: These findings suggest that sleep disturbances may develop and persist during the first year post-TBI. Further analyses will be performed with the complete sample to examine the relationship between clinical factors (e.g., injury severity, presence of pain), behavioral factors (e.g., depressive symptoms) and sleep patterns and behaviors.
Support (If Any): National Institutes of Health, Grant Number 5T32GM086270-03 National Research Service Awards Institutional Research Training (T) Grant National Institute of Nursing Research, Grant Number P30 NR011400, ITHS Sleep Pilot Award, Sleep-wake Disturbances in Adolescents Following Mild to Moderate Traumatic Brain Injury.

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SLEEP PROBLEMS IN CEREBRAL PALSY
Kothare SV[1], Gajewska D[2], Vendrame M[3], Steinborn B[2], Zarowski M[1,2]
[1]Neurology, Children's Hospital, Harvard Medical School, Boston, MA, USA, [2]Neurology, Poznan University, Poznan, Poland, [3]Neurology, Boston University, Boston, MA, USA

Introduction: Cerebral palsy (CP) is defined as a group of non-progressive disorders leading to motor deficits that can be attributed to insults in the perinatal period. CP is estimated to occur in 1.5 to 2.5 children per 1000 live births and is the most common cause of childhood physical impairment. The aim of the study was to determine the frequency of sleep disorders in children with CP and to identify factors associated with these problems and attempt to correlate type of sleep problems with the level of motor disability.
Methods: The study group comprised 99 subjects with CP, fifty four girls, aged 2-20 years, (mean 7.3 years ± 4.3). Parents completed 4 questionnaires (Intake Sleep Questionnaire; Pediatric Sleep Questionnaire (PSQ); Pediatric Daytime Sleepiness Scale). The level of motor disability was scored using Manual Ability Classification System (MACS) and Gross Motor Function Classification System (GMFCS) scales.
Results: The CP subjects had symptoms of sleep disordered breathing (36% snoring; 63% mouth breathing), problems with sleep onset [more than 26% of them taking > 20 minutes to fall asleep], sleep maintenance [wake up at night screaming (41%), and having trouble falling back to sleep (23%), waking up early in the morning (25%)]. Symptoms of excessive daytime sleepiness were frequently reported [sleepiness during the day (22%), and day time naps (45%)]. Parents observed their children with CP with difficulty organizing tasks (33%), and easy-distractibility (57%). Subjects with dystonic/dyskinetic CP had higher Sleepiness subscale on PSQ (p=0.044). Sleepiness subscale also correlated with level of motor disability in MACS (Spearman rho=0.233 (p=0.020)) and GMFS scales (Spearman rho=0. 247 (p=0.014)).
Conclusion: Sleep problems are frequent in subjects with CP. Daytimes sleepiness correlated with the level of motor disability.

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DIMINISHED PHASIC EYE AND BODY MOVEMENTS IN SYMPTOMATIC AND NEUROLOGICALLY COMPROMISED NEWBORN INFANTS
Sassower KC
Neurology, Massachusetts General Hospital, Boston, MA, USA

Introduction: The visual scoring of active sleep in healthy newborn infants culminated in the formation of a Pediatric Task Force in 2007. We evaluated active sleep phasic eye and body movements in symptomatic neurologically compromised newborns.
Methods: We reviewed simultaneous 21 channel routine scalp diurnal sleep EEG recordings (average duration 30 minutes) and prolonged nocturnal video EEG telemetry monitoring studies (average duration 60 minutes after 20:00) of all symptomatic neurologically compromised newborns admitted to the ICU from 2008-2011.
Results: 26 newborns (15 males, 11 females) range 35-43 weeks gestation were studied. Chief complaints in 88% were active clinical seizures and/or CNS depression. EEG abnormalities included 54% with interictal spikes and/or electrographic seizures and 27% with nonepileptiform attentuation of amplitude. 54% of infants demonstrated MRI brain evidence of hypoxic ischemic injury, cerebral infarcts, focal hemorrhage and/or intraventricular bleeding. Only 8% of infants demonstrated phasic eye and/or body movements during either diurnal or nocturnal sleep EEG recording.
Conclusion: In contrast to sleep findings in healthy newborns, the marked diminution in phasic motor activity in our group of newborn infants may be related to the presence of marked CNS compromise and not due to circadian rhythm effect.

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SLEEP DEPENDENT MEMORY CONSOLIDATION IN CHILDREN WITH AUTISM SPECTRUM DISORDERS (ASD) USING A PROBABILISTIC CATEGORICAL LEARNING TASK

Maski K[1,2], Holbrook H[4], Hanson E[4,5], Manoach D[6,7,8], Stickgold R[3,7]
[1]Neurology, Children's Hospital Boston, Boston, MA, USA, [2]Neurology, Harvard Medical School, Boston, MA, USA, [3]Psychiatry, Beth Israel Deaconess Medical Center, Boston, MA, USA, [4]Developmental Medicine, Children's Hospital Boston, Boston, MA, USA, [5]Psychology, Harvard Medical School, Boston, MA, USA, [6]Psychiatry, Massachusetts General Hospital, Boston, MA, USA, [7]Psychiatry, Harvard Medical School, Boston, MA, USA, [8]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, USA

Introduction: Although children with ASD often have disturbed sleep and sleep plays a critical role in the consolidation of recent memories, sleep-dependent memory consolidation has yet to be evaluated in ASD. In this initial investigation, we hypothesized that children with ASD would have reduced overnight improvement of task performance on the "Mr. Potato Head" probabilistic categorical learning (PCL) task compared to typical developing (TD) children.
Methods: To date, six children with ASD (mean age 11.83 +/-2.23 years) and 9 TD children (mean age 13.56 +/-2.24 years) have participated. In the home environment, children were trained and tested on the PCL task 60 minutes before sleep and then wired for polysomnography. The next morning, participants were retested on the PCL task 30 minutes after their natural wake time.
Results: There were no significant differences in sleep architecture or quality in the ASD and TD groups when corrected for age. PCL data from two ASD subjects were lost. The mean overnight improvement did not significantly differ between groups (ASD: -0.3+/- 5.0%; TD 0.5 +/-11.9%; p =0.173). Measures of sleep quality correlated with task improvement at a trend level in the TD group (sleep efficiency: p=0.061; wake time after sleep onset: p=0.065; number of arousals: p=0.072) but not in the ASD group (all p's >0.3). There were no correlations between task overnight improvement and NREM or REM sleep stages in either group.
Conclusion: In this novel study, measures of sleep quality showed near significant correlations with overnight improvement of task performance in the TD children. The small number of ASD subjects makes the lack of similar correlation in the ASD group difficult to interpret. These findings suggest that sleep is important for the consolidation of probabilistic learning in TD children.
Support (If Any): Autism Speaks, Inc.

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TREATMENT COMPLIANCE IN CHILDREN WITH AUTISM AND SLEEP DISORDERED BREATHING

Mahon S[1], Bourque E[1], Kirk V[1,2]
[1]Alberta Children's Hospital, Calgary, AB, Canada, [2]Pediatrics, University of Calgary, Calgary, AB, Canada

Introduction: Children with autism often have heightened sensory perception and difficulties with changes in general which can make it especially difficult for them to accept and adapt to positive airway pressure therapy. We reviewed treatment compliance in children with autistic spectrum disorder and sleep disordered breathing.
Methods: A retrospective review of children, aged 1 to 18 years with both autism and sleep apnea requiring mask therapy. Data was collected; demographics, polysomnography findings, number of visits/phone contacts to treatment coordinator and/or sleep psychologist, need for homecare involvement, time to compliance with prescribed therapy (≥ 4 hours per night).
Results: A total of 9 subjects (2 females) met inclusion criteria. The mean age was 9.7 years and was distributed as follows: age 5-8 years (n=5) age 8-12 years (n=1), age 12-16 years (n=3). One outlier had an apnea hypopnea index of >95/hour. The mean index in the remaining 8 subjects was 6.9/hour with a range from 0.8 to 16.0/hour. Eight of 9 met criteria for obstructive sleep apnea, the remaining subject had obstructive hypoventilation. Overall compliance rate was 66.7%. After over 20 contacts with psychology, 31 contacts with the treatment coordinator and involvement of a pediatric homecare team, one child achieved compliance after 46 months. The remaining 8 subjects had between 6-12 contacts with the treatment coordinator only (mean 8.6) and 5 of these (62.5%) achieved compliance. The time to achieve compliance in this group was: within 24 hours (n=2), 3 weeks (n=1), 4 months (n=1) and 6 months (n=1).
Conclusion: With individualized supports,compliance rates with positive airway pressure similar to the general pediatric population can be achieved in children with Autism.

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THE RELATIONSHIP BETWEEN TOTAL SLEEP TIME AND BEHAVIORAL AND EMOTIONAL INDICATORS IN CHILDREN WITH AUTISM SPECTRUM DISORDERS (ASD)

Holbrook HM[1], Sorrentino E[1], Maski K[3], Hanson E[1,2], Manoach D[6,7], Stickgold R[4,5]
[1]Developmental Medicine, Children's Hospital Boston, Boston, MA, USA, [2]Psychology, Harvard Medical School, Boston, MA, USA, [3]Neurology, Children's Hospital Boston, Boston, MA, USA, [4]Psychiatry, Beth Israel Deaconess Medical Center, Boston, MA, USA, [5]Psychiatry, Harvard Medical School, Boston, MA, USA, [6]Psychiatry, Massachusetts General Hospital, Boston, MA, USA, [7]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, USA

Introduction: Sleep has been found to be a critical mediator for disruptive behaviors in children, such as hyperactivity and emotional instability. We hypothesize that sleep disturbances will correlate with indicators of behavioral and emotional difficulties in children with ASD.
Methods: 19 children aged 9-18 years have completed the study. Currently, data have been analyzed for 9 TD children and 6 children with a previous diagnosis of ASD. Behavioral and emotional data were collected through parent reports of the Social Responsiveness Scale and Conners' Parent Rating Scale- Revised (L) one week prior to a home-based polysomnogram recording.
Results: The mean age of children with ASD (11.8 years SD +/- 2.2) was similar to that of TD children (13.7 years SD +/- 2.2). Mean total sleep time (TST) for children with ASD (517.5 minutes SD +/- 47.1) did not differ from that of TD children (468.9 minutes SD +/- 51.5). In the ASD group, TST, but not sleep efficiency, was significantly correlated with difficulties in social cognition (r = -.933, p = .007), social communication (r = -.879, p = .021), autistic mannerisms (r = -.890, p = .017) and anxiety, (r= -.976, p = .001). None of these reached significance in the TD children, perhaps due to the restricted range of behavioral parameters in this population. Adding age and IQ as covariates did not alter any of these findings except the anxiety correlation (p=.063).
Conclusion: This preliminary data analysis supports past evidence for a relationship between sleep measures and the behavioral and emotional functioning of children with ASD. As our sample population increases, correlations of specific sleep stages with these behavioral outcomes measures will be assessed. These findings highlight the need to educate families about this relationship and the importance of good sleep hygiene for children with ASD.
Support (If Any): Autism Speaks, Inc.

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PILOT STUDY: SLEEP CHARACTERISTCS IN CHILDREN WITH AUTISM SPECTRUM DISORDER

Sayed R, Bhalerao N, Hegde A, Devnani P
Jaslok Hospital and Research Centre, Mumbai, India

Introduction: 1. To describe sleep characteristics in children with Autism Spectrum Disorder (ASD) 2. To identify association between sleep disturbances and the severity of ASD.
Methods: Cross section study was performed in collaboration with the NeuroPediatric clinic at Jaslok hospital and Research Centre, Mumbai, India. Neuropsychological assessment, Children's Sleep Habit Questionnaire and Polysomnogram were administered 1. Neuropsychological Assessment battery included Vineland Social Maturity Scale(VSMS) for Social Quotient, Childhood Autism Rating Scale (CARS), Attention Deficit Hyperactivity Disorder (ADHD) Test. 2. One night Polysomnography with Extended video-EEG Montage was performed. 3. Sleep Quality was characterized in a Likert-type scale Child Sleep Habit Questionnaire ((CSHQ) that assessed total hours of sleep, Awakenings, Sleep Onset Latency(SOL), Abnormal movement/Parasomnias and Daytime functioning.
Results: 9 children (7 males, 2 females) with mean age 5.5(range 3-11years) years were evaluated. SQ was directly proportional to Total Sleep Time. Mean ranks of N1, N2, REM percentage and Total Sleep Time were higher in children with lower CARS score. Mean ranks of SOL, N2, REM Latency were higher in children with moderate to severe ADHD. Children with higher CARS score had lower REM percentage and reduced Total SleepTime. CARS scores were found to be directly proportional to REM Latency. Subject having lowest SQ and highest CARS value had highest sleep dysfunction total score. Parasomnias reported in 3/9. Epileptiform activity was noted in 2/9.
Conclusion: A positive trend was observed between sleep disturbances and Childhood Autism Rating Scale and an inverse relation to Social Quotient. In Sleep architecture, the REM correlation and TST are of noted interest.There was observed a trend between daytime functioning scores on CSHQ sub-variant and neuropsychological parameters. Addressing sleep disturbances with behavioral and pharmacological interventions can help improve clinical outcome.

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ATTENTION BIASES IN CHILDREN WITH AUTISM SPECTRUM DISORDERS AND SLEEP PROBLEMS

Ellis JG, Aldridge D
Northumbria Centre for Sleep Research, Northumbria University, Newcastle Upon Tyne, United Kingdom

Introduction: Despite the reported high prevalence of sleep problems in children with Autism Spectrum Disorders (ASDs) little data on potential implicit markers within this group exists. Recent research consistently demonstrates sleep-related attention biases as one marker of sleep problems in typically developing adults and children alike. The aim of this study was to examine the presence of sleep-related attention biases in children with sleep problems and ASDs.
Methods: A group of 40 children (Mean age 10.25 years SD 3.25) were recruited from a school in the North East of the UK which provides specialist education for children with ASD. Of the 40 children, 20 had a confirmed diagnosis of ASD and sleep problems, by parental report (Child Sleep Habits Questionnaire), and 20 were children with no sleep problems matched on reading age, and level of functioning. Both groups completed a card sorting task containing sleep and non-sleep related symbols. The discrepancy in reaction times between the two conditions (sleep-related and non sleep-related) was used as an index of attention bias. Additionally, the number of errors was also recorded.
Results: There was no observable attention bias between the two groups ($t(38) = .65$, $p=.51$) and no differences in the number of errors made ($t(38) = .71$, $p=.052$). However, there was a significant positive correlation between the overall time taken to complete the task and the level of sleep disturbance reported ($r(40) = .56$, $p<.01$) and a positive correlation between the number of errors made and levels of sleep disturbance ($t(40)= .32$, $p<.05$).
Conclusion: The results suggest that an attention bias may not be a facet of sleep problems in children with ASD. However, the task itself provides an objective index of the relationship between sleep difficulties and daytime performance decrements. Future research may wish to explore other attention bias paradigms to replicate the present findings.

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LET US TALK NIGHT-TIME-RELATED-QUALITY-OF-LIFE FOR CHILDREN AND ADOLESCENTS WITH NEURODEVELOPMENTAL DISORDERS

Ipsiroglu OS[1,2], McKellin W[3], Carey N[1], Loock C[1]
[1]FASD & SLEEP Research Group, BC Children's Hospital/Sunny Hill Health Centre for Children, Vancouver, BC, Canada, [2]Department of Pediatrics, University of British Columbia, Vancouver, BC, Canada, [3]Department of Anthropology, University of British Columbia, Vancouver, BC, Canada

Introduction: Insomnia is a major sleep problem (SP) for children and adolescents with neurodevelopmental disorders (NDD) like Fetal Alcohol Spectrum Disorder (FASD). Children and adolescents with FASD and SP are often sleep deprived, and have significant challenges remaining awake at the times required for normal activities. Their daytime sleepiness, inattention, and hyperactive behaviour are often seen as part of the NDD and are medicated.
Methods: Focusing on children with FASD, we employed a narrative approach based on the concept of therapeutic emplotment and analyzed how decisions are made in the clinical setting and the factors that encourage or impede working towards optimized patient outcomes. We conducted qualitative interviews with parents/caregivers and health care professionals to understand the lack of recognition and ineffectual treatment of paediatric SP. In addition, we investigated 27 patients with FASD and SP (mean: 6.3 years; median: 5.25 years; range 2-14).
Results: All patients with FASD had SP and several co-morbidity diagnoses: 19/27 affected daytime wellbeing and challenging behaviour; 14 ADHD; 5/27 anxiety disorder. 22/27 patients were medicated with melatonin, 14/27 for ADHD and 11/27 with antipsychotics/-depressants. 22/27 patients had symptoms suggestive of Restless Legs Syndrome and associated Periodic Limb Movements which had not been diagnosed before. Qualitative interview data revealed that caregiver reports about SP are not given appropriate attention by health care professionals. The interviews also verified that symptoms were identified, but not connected to possible SP. Clinical investigations revealed that the provision of a categorical diagnosis of FASD obscured the need for full functional assessment and intervention.
Conclusion: Our study highlights the deficits in current clinical practice and education regarding diagnostics and treatment of SP in vulnerable populations. We propose the use of a different clinical strategy for assessing children and adolescents with NDD that acknowledges and formalizes the input from the patient and caregivers.

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PARENT-BASED SLEEP EDUCATION PROGRAM FOR CHILDREN WITH AUTISM

Malow BA[1,6], Reynolds AM[2], Weiss S[3], Adkins K[1], Artibee KJ[1], Clemons T[4], Frank K[6], Goldman SE[1], Katz T[2], Loh A[5]
[1]Neurology/Sleep, Vanderbilt University, Nashville, TN, USA, [2]Pediatrics, University of Colorado Denver, Denver, CO, USA, [3]Neurology, Hospital for Sick Children, Toronto, ON, Canada, [4]EMMES Corporation, Rockville, MD, USA, [5]Surrey Place, Toronto, ON, Canada, [6]Pediatrics, Vanderbilt University, Nashville, TN, USA

Introduction: Training parents to improve sleep habits in their children with autism spectrum disorders (ASD) has shown promise on sleep and child/family functioning, although findings have been limited to small studies.
Methods: To test the efficacy of parent-based sleep education for children with ASD, we carried out a multisite protocol at three sites within our Autism Treatment Network (ATN). The aim of our larger study is to compare individualized and group sessions. Children ranged in age from 2-10 years with clinical diagnosis of ASD confirmed by the Autism Diagnostic Observation Schedule. All had sleep onset delay, defined by a sleep latency of 30 minutes or greater. Children were evaluated for medical co-occurring conditions that affect sleep, and children with these conditions were either excluded or treated prior to enrollment in the protocol. Parents met with an educator in either individualized and group sessions to: (1) Learn techniques related to appropriate timing of sleep and sleep hygiene (e.g., daytime/evening habits, sleep environment); (2) Develop/implement an individualized bedtime routine; and (3) Discuss strategies to interact with their child to minimize bedtime resistance and night wakings. Questionnaires and two weeks of actigraphy were completed before and one month after parent education. Parents received training in actigraphy collection and educators at each site followed a manualized curriculum, with fidelity checks performed to ensure completeness and consistency in the education provided.
Results: Data from 33 children [24 boys, 9 girls; ages 6.2 ± 2.4 years (mean ± standard deviation)] completing the protocol have been analyzed to date. As our results are preliminary, we combined group (n = 13) and individual (n = 20) education. Paired t-tests were used to analyze results. Actigraphy showed an improvement in sleep latency from 58.3 ± 24.7 minutes to 40 ± 24.7 minutes (p =0.002); sleep duration and night wakings were not significantly improved. Parents also reported improvements in sleep-onset delay on Children's Sleep Habits Questionnaire ($p < 0.001$), compulsive behavior on Repetitive Behavior Scale ($p = 0.01$); parenting satisfaction ($p = 0.05$) and parenting efficacy ($p = 0.05$) on Parenting Sense of Competence scale, and total score on Pediatric Quality of Life Scale ($p = 0.007$) with treatment.
Conclusion: Based on our preliminary findings, parent-based sleep education improves sleep latency and aspects of child and family functioning in children with ASD.
Support (If Any): We acknowledge the members of the Autism Treatment Network (ATN) for use of the data and the families who participated in the Registry. The ATN is funded by Autism Speaks and a cooperative agreement (UA3 MC 11054) from HRSA to the Massachusetts General Hospital.

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CHILD SLEEP PROBLEMS DECREASE IN RESPONSE TO TREATMENT FOR DISRUPTIVE BEHAVIORAL DISORDERS

Insana S[1], Germain A[1,2], Kolko D[1,2,3]
[1]Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA, [2]Psychology, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA, [3]Pediatrics, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

Introduction: Bullying, conduct problems, and oppositional-defiant behaviors are hallmark to child disruptive behavior disorders (DBDs). Increased disruptive behaviors are associated with increased sleepiness among schoolchildren. The study objectives were to characterize sleep disturbances in relation to disruptive behaviors, and to identify whether a cognitive-behavioral treatment for DBDs indirectly decreased sleep problems.
Methods: Participants were 6-11 year-old children (N=208; 9.0±1.7 years; 84.1% male) who were clinically diagnosed with a DBD (n=139), or were demographically matched healthy controls ([HC] n=69). Children with DBDs received an 18-month modular based treatment for their disorder. DBD children were assessed pre-treatment, post-treatment, and at a one-year post-treatment follow-up; HC children were assessed during matched time-points. Parents completed the IOWA Conners Rating Scale to report their child's oppositional/defiant behaviors, and the Child Behavior Checklist (CBCL) to report their child's internalizing and externalizing behaviors. Six CBCL sleep related items were summed to create a sleep problems component (α=.64).
Results: Children with DBDs were more likely to exhibit at least one sleep problem(s) compared to HC children ([71.3% and 35.3%, respectively] X^2=24.39, p<.001; OR=4.6; CI=2.5-8.5; RR=2.7). During pre-treatment assessment among all children, increased sleep problems were associated with increased oppositional/defiant (r=.37, p<.001), internalizing (r=.35, p<.001), and externalizing (r=.40, p<.001) behavioral dimensions. Among children with DBDs, multi-level analyses indicated that both oppositional/defiant behaviors (F[1,169.5]=87.4, p<.001), and sleep problems (F[1,137.5]=28.8, p<.001) decreased linearly across the three treatment-centered time-points. Notably, the linear decrease in oppositional/defiant behaviors had a significant effect on the linear decrease in sleep problems (F[1,113.7]=36.5, p<.001).
Conclusion: DBDs during childhood may be comorbid with sleep problems, and sleep problems may exacerbate internalizing, externalizing, and oppositional/defiant behavioral dimensions. A modular-based treatment for DBDs effectively decreased oppositional/defiant behaviors and appeared to concurrently decrease sleep problems. Behavioral sleep treatments may be central to decreasing childhood disruptive behaviors that lead to subsequent psychopathological trajectories.
Support (If Any): 5-R01-MH057727-09 (DJK).

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SLEEP DISTURBANCES AND SLEEPINESS DURING ADOLESCENCE ARE ASSOCIATED WITH SCHOOL PERFORMANCE AND SELF-DETERMINED ACADEMIC MOTIVATION

Michaud F, Green-Demers I, Forest G
Psychoeducation and Psychology, Université du Québec en Outaouais, Gatineau, QC, Canada

Introduction: During adolescence, sleep goes through modifications characterized by a delay in sleep-wake pattern. This contrasts with the fixed schedules imposed by social and school demands and therefore has an influence on teenagers' sleepiness and daytime functioning. The aim of our study is to examine the relationship between sleep disturbances arising during adolescence, self-determined academic motivation (SDAM) and school performance.
Methods: A total of 737 adolescents (43% males; 57% females; 13 to 17,5 years old, grade 9th to 11th) from 3 high schools completed questionnaires on sleep habits, academic motivation and school performance. Path analyses were performed to examine the relationship between sleep disturbances (SD: including sleep habits, sleep disorders, sleep initiation disorders and nocturnal awakenings), daytime sleepiness, SDAM and school performance.
Results: First, a significant positive relationship was obtained between SD and daytime sleepiness (β=0.44, P<0.0001, Ra2=0,19) and a significant negative relationship was established between daytime sleepiness and SDAM (β =-0.37, P<0.0001, Ra2=0,13). Second, when considering the contribution of SD and SDAM to school performance, both were

found to be significantly correlated to school performance (βSD= -0.23, P<0.0001; βSDAM= 0.20, P<0.0001, Ra2=0,12, respectively).
Conclusion: These results suggest that SD are associated with significant impairment as measured by related increased daytime sleepiness. This sleepiness is in turn related to a diminished SDAM, which ultimately is associated with decreased school performance. These results also suggest that the link between SDAM and school performance is as crucial as the link between SD and school performance. The efforts put into the identification of academic success factors need to address the issue of sleep problems in teens as extensively as they do with the academic motivation issues.

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SLEEP STATE DEVELOPMENT IN EARLY INFANCY AFTER PRENATAL EXPOSURE TO MATERNAL DEPRESSION AND ANTIDEPRESSANT MEDICATION USE

Bloomhardt H, Young ME, Salisbury AL
Brown Center for Children, Warren Alpert Medical School at Brown University & Women and Infants Hospital, Providence, RI, USA

Introduction: Prenatal maternal depression is associated with less optimal sleep development. Antidepressant medications decrease REM sleep and may also affect infant sleep state. This study examined the effects of prenatal exposure to depression and antidepressants on newborn sleep state development.
Methods: As part of a larger study examining the effects of maternal depression and antidepressant exposure on infant development, maternal depression and medication use was measured prospectively during pregnancy. Participants (N=136) were categorized into four groups: controls (CON), depression/no medications (DEP), medications/remitted depression (AD/noDEP), and medications with current depression (AD+DEP). Direct observation of newborn sleep-wake states, coded in 10 second epochs, was conducted before (20 minutes) and after (40 minutes) completing a neurobehavioral examination on the 2nd and 30th days after delivery. Analyses were conducted using generalized linear models.
Results: Significant main effects were found for age of observation and baseline to post-exam changes in active (AS) and quiet sleep (QS). Significant interactions indicated that infants in the DEP groups had more AS in the baseline period on Day 2 (62.0%, 63.2%) than infants in the CON (48.3%) and AD/NoDEP (48.7%) groups (W=12.18, p<.007). In the post-exam period, both AD groups had higher amounts of AS (68.1%, 75.3%) compared to infants in the CON (52.8%) and DEP (41.8%) groups (W=15.18, p<.02). The amount of AS decreased over age for all groups (W=57.22, p<.001). In contrast, infants in both DEP groups had less AS at Day 30 compared to those in the CON and AD/noMDD groups .
Conclusion: Results indicate that prenatal exposure to depression may have an influence on active sleep development in early infancy and that antidepressant treatment may alter this pattern, particularly in response to a mild stressor (handling). Results will be discussed in relation to other sleep and wake states measured and relationships to later sleep development.
Support (If Any): NIMH R01MH078033 (Salisbury).

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THE CHILDREN'S SLEEP HABITS QUESTIONNAIRE AS A SCREENER FOR SLEEP PROBLEMS IN PEDIATRIC ACUTE LYMPHOBLASTIC LEUKEMIA

Daniel L[1], Schwartz L[1,2], Reilly A[1,2], Barakat LP[1,2]
[1]Oncology, The Children's Hospital of Philadelphia, Philadelphia, PA, USA, [2]Department of Pediatrics, Perelman School of Medicine of University of Pennsylvania, Philadelphia, PA, USA

Introduction: Sleep is not regularly assessed in children with cancer despite disruptions in their sleep that may be attributed to circadian rhythm alterations, dysregulation of sleep-wake patterns, and treatment-related fatigue, pain, and/or environmental changes. No valid screeners for sleep problems in children with cancer exist, making it difficult to assess changes in sleep and behaviors across treatment. This study compares the frequency of sleep problems captured by the Children's Sleep Habits Questionnaire (CSHQ) and daily sleep diaries to assess the utility of the CSHQ as a screening measure in pediatric oncology.
Methods: Parents of 27 children ages 3-10 on maintenance treatment for acute lymphoblastic leukemia (ALL) completed the CSHQ at baseline and a 28-day parent-report sleep diary to correspond with one month of maintenance treatment that includes chemotherapy and corticosteroids. Sleep diary variables of children below (n = 15) and above (n = 12) the clinical referral cut-point of 41 on the CSHQ were compared.
Results: Preliminary analyses indicate that children with ALL experience significantly more bedtime resistance, sleep onset delays, sleep anxiety, and night wakings compared to the CSHQ validation sample. Children above and below the cut-point did not differ in sleep opportunity, total sleep time, sleep onset latency, number of wakings, daytime sleepiness, calling out to parents at bedtime, or frequency of falling asleep in their own bed. Parents of children above the cut-point reported lower child sleep quality on diaries [F (1, 26) = 10.95, p = .003] and more nights moving sleeping locations [F (1, 25) = 4.94, p = .036] than parents of children below the cut-point.
Conclusion: The CSHQ clinical cut-point may not be sensitive enough to capture sleep problems specific to children with ALL. The development of an oncology-specific sleep screening measure is important to ensure accurate assessment and effective intervention during cancer treatment.

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CHANGES IN SLEEP AND FATIGUE IN NEWLY TREATED PEDIATRIC ONCOLOGY PATIENTS

Crabtree VM[1], Rach A[1,2], Hammarback T[3], Gamble H[1], Wise MS[4], West NK[3], Mandrell B[3]
[1]Psychology, St. Jude Children's Research Hospital, Memphis, TN, USA, [2]Psychology, University of Memphis, Memphis, TN, USA, [3]Nursing Research, St. Jude Children's Research Hospital, Memphis, TN, USA, [4]Methodist Healthcare Sleep Disorders Center, Memphis, TN, USA

Introduction: Pediatric oncology patients have sleep disturbances, particularly early in a chemotherapy cycle. Little attention has been paid to changes in sleep and fatigue across treatment in this cohort. We characterized sleep and fatigue in newly diagnosed pediatric oncology patients to determine if changes emerged across the first 8 weeks of treatment.
Methods: The prevalence of sleep problems and fatigue in pediatric oncology patients, ages 2 to 18, within 14 days of diagnosis (T1) and 8 weeks later (T2), was assessed by the Children's and Adolescent Sleep Hygiene Scales, Childhood Cancer Fatigue Scale, the Children's Report of Sleep Patterns, and an abbreviated form of the Kosair Pediatric Sleep Questionnaire.
Results: 166 children (52% male; mean age=7.7; leukemia=70; solid tumors=45; brain tumors=50) were enrolled. Across time, parents reported that children went to bed (p<.001) and awakened later (p =.001). Adolescents obtained less sleep (6-7 hours) than children (8-9 hours; p<.001) with later bedtimes (p<.001) at T1, though differences decreased at T2. Leukemia patients had decreased fatigue from T1 to T2 (50.14 vs. 45.06, p<.001), while solid and brain tumor patients had no changes. Girls had similar fatigue to boys at T1 with more fatigue at T2 (47.61 vs. 43.97, p<.05). Self-reported improvements were found across time in electronics use at bedtime (p<.05) and in the ASHS Physiological Scale (p<.05) for adolescents.
Conclusion: Fatigue decreased after beginning treatment in patients with leukemia, while no improvement was noted in solid or CNS tumor patients. Likely, the cytokine effect of treatment is more predominant in the leukemia cohort. Fatigue remained high, even in those who improved. Greatest risk for fatigue in pediatric oncology patients undergo-

ing the early stages of treatment appears to be related to female gender and solid/brain tumors.These preliminary data present potential for interventions to improve sleep and fatigue early in the treatment of this population.

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LONGITUDINAL SLEEP DISTURBANCE SYMPTOMS IN CHILDREN WITH EMBRYONAL TUMORS

Crabtree VM[1], Palmer S[1], Zhang H[2], Huang Q[2], Rach A[1,3], Kyle M[1,4], Gajjar A[5]

[1]Psychology, St. Jude Children's Research Hospital, Memphis, TN, USA, [2]Biostatistics, St. Jude Children's Research Hospital, Memphis, TN, USA, [3]Psychology, University of Memphis, Memphis, TN, USA, [4]Psychology, Rhodes College, Memphis, TN, USA, [5]Oncology, St. Jude Children's Research Hospital, Memphis, TN, USA

Introduction: Children with brain tumors report disrupted sleep and significant fatigue, which are described as highly distressing. Studies investigating sleep disturbance in these patients, to our knowledge, have not examined longitudinal data.

Methods: Parents of children being treated for an embryonal tumor completed the Child Behavior Checklist (CBCL) at time of diagnosis and annually for 5 years. Raw scores from seven sleep-specific items from the Child Behavior Checklist (CBCL) were retrospectively summed to calculate an empirically validated sleep composite score (SCS). Parent-reported Sleep Disturbance (PSD) was defined as a parent reporting that a child has at least one of the seven identified sleep disturbances "sometimes" or "often.".

Results: Records of 84 children (58% male; mean age = 9.73 at baseline) were reviewed. Both the PSD and the SCS remained stable from baseline through 36 months. Declines were noted in PSD at the 48-and 60-month time points. 56-58% of parents reported at least one sleep disturbance at baseline and annually through 36 months, with 46-48% of parents reporting sleep disturbances at 48 and 60 months. SCS indicated relatively low levels of sleep disturbances with means ranging from 1.06 at baseline to 0.74 at 60 months post-diagnosis.

Conclusion: Parents report a relatively low level of sleep disturbance in this cohort of patients. A majority of parents identified difficulty in at least one area of sleep at baseline and annually for 3 years following diagnosis. By four years post-diagnosis, the majority of children, as indicated by parents, were not exhibiting sleep disturbances as assessed by the CBCL, indicating lower rates of sleep disturbance than has been reported in patients with suprasellar tumors. Differences in sleep disturbances related to demographic factors, such as age at diagnosis and risk status, will be discussed.

Support (If Any): This work was supported in part by the National Cancer Institute through a Cancer Center Support (CORE) grant (P30-CA21765), the Noyes Brain Tumor Foundation, Musicians Against Childhood Cancer (MACC) and by the American Lebanese Syrian Associated Charities (ALSAC).

1107

THE RELATIONSHIP BETWEEN PARENTAL RESPONSES TO PAIN AND ADOLESCENT SLEEP IN ADOLESCENTS WITH CHRONIC PAIN

Moore M[1], Guite JW[2,3], Puzino K[4], Olsen M[2]

[1]The Sleep Center, The Children's Hospital of Philadelphia, Philadelphia, PA, USA, [2]Department of Anesthesiology & Critical Care Medicine, The Children's Hospital of Philadelphia, Philadelphia, PA, USA, [3]Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA, [4]Psychology, Saint Joseph's University, Philadelphia, PA, USA

Introduction: Parental responses to pain have been associated with critical outcomes (including disability) for adolescents with chronic pain. Though problems with sleep are common disabling symptoms for adolescents with chronic pain, the relationship between parent responses to pain and adolescent sleep problems has not been well studied. This project examines whether protective parental pain responses (such as allowing the adolescent to sleep late) are associated with perceived trouble sleeping and shorter sleep duration.

Methods: The sample consisted of 121 primarily female (89.3%), Caucasian (80.2%) adolescents (mean age 15.58 years; SD=1.53) and their parent (89.3% mothers) who presented for an initial multidisciplinary pain clinic evaluation. Adolescents' mean body mass index (BMI) percentile was 63.4 (SD=27.5). Adolescents and parents reported on the Adult Responses to Children's Symptoms (ARCS), a visual analog scale (VAS) of perceived trouble sleeping, and answered questions about pain intensity, sleep duration, and specific sleep problems.

Results: Adolescents reported a moderate level of usual pain intensity (mean=58.70, SD=21.56, range=0-100) and a mean total sleep time of 7.50 hours on weekdays (SD=1.87, range=4-15) and 8.98 hours on weekends (SD=2.24, range=4-15). Spearman correlations revealed that parent report of ARCS-protective responses to adolescent pain was associated with both parent ($r=0.24$; $p<0.01$) and adolescent ($r=0.20$; $p<0.05$) reports of adolescent trouble sleeping. Parent protective responses were not associated with parent or adolescent report of sleep duration.

Conclusion: Protective parental responses toward adolescent chronic pain relate to perceived adolescent sleep difficulties. The lack of relationship with adolescent sleep duration at the initial evaluation may in part relate to parents' willingness to relax limits (e.g., allowing a later wake time) that may provide adolescents more time to sleep. Thus, adolescent and parent perceptions of adolescent sleep problems at the initial evaluation may indicate patterns that maintain sleep-specific disability and poorer functioning that require targeted intervention.

1108

SLEEP DISORDERED BREATHING, DAYTIME SLEEPINESS, AND FATIGUE IN CHILDREN WITH JUVENILE IDIOPATHIC ARTHRITIS (JIA)

Ward TM[1], Lentz M[2], Ringold S[3], Wallace C[3], Landis CA[2]

[1]Family & Child Nursing, University of Washington, Seattle, WA, USA, [2]Biobehavioral Nursing & Health Sciences, University of Washington, Seattle, WA, USA, [3]Division of Pediatric Rheumatology, Seattle Children's Hospital, Seattle, WA, USA

Introduction: In our previous study, we found sleep disordered breathing and daytime sleepiness in children with juvenile idiopathic arthritis (JIA). The purpose of this study was to compare physiologic indicators of sleep disordered breathing (snoring time, AHI) and multiple sleep latency tests (MSLT) to self-report measures of fatigue in children with JIA. We also tested associations between fatigue intensity and SDB.

Methods: Seventy children 6-to-11 years of age (mean 8.5 ±1.9 years) with JIA (64 girls) participated. Each child and a parent underwent two consecutive nights of polysomnography (PSG). Children rated fatigue intensity on the Child Fatigue Scale in the evening. After the second night, children underwent 4 MSLTs at 2 hour intervals beginning at 0900 hr to assess daytime sleepiness. SDB was dichotomized as (mild: AHI 1.5-1.9/hour; moderate: AHI > 2/hour) of total sleep time on night 2. MSLT sleep latencies were dichotomized as: <10 minutes; 11-14minutes; and >15minutes.

Results: Children with active disease showed higher fatigue intensity (9.4 ± 5.8) compared to those with inactive disease (6.4 ± 3.8, $p<.05$). AHI, snoring time, and mean sleep latencies did not differ between the groups. Of the sample, 39% (n=28) showed mild to moderate SDB, 30% (n=21) snored more than 3 hours of TST, and 17% (n=12) had sleep latencies <10 minutes. Children with moderate SDB showed higher fatigue intensity ($11.2 + 8.7$) compared to those with mild SDB ($4.4 + 2.2$, $p<.02$). MSLT sleep latencies and total snore minutes did not differ in children with mild and moderate SDB.

Conclusion: Untreated and unrecognized SDB and daytime sleepiness may be a cause of the common sleep disturbance complaints in JIA and

represent a significant co-morbidity. JIA children are likely to be particularly vulnerable to adverse health outcomes including neurobehavioral deficits, daytime sleepiness, and poorer quality of life from unrecognized and untreated SDB.

Support (If Any): NIH Grant T32 NR0710, NR08136, Center for Women's Health and Gender Research, NR04011, GCRC #M01-RR-00037 and the Center for Research on the Management of Sleep Disturbances, 1 P30 NR 011400-01.

1109

ASSESSING THE IMPACT OF METHYLPHENIDATE ON SLEEP IN CHILDREN WITH ADHD USING POLYSOMNOGRAPHY AND ACTIGRAPHY

Gendron M[1], Rusak B[1,2,3], Rajda M[2], Corkum PV[1,2,4]
[1]Psychology, Dalhousie University, Halifax, NS, Canada, [2]Psychiatry, Dalhousie University, Halifax, NS, Canada, [3]Pharmacology, Dalhousie University, Halifax, NS, Canada, [4]Pediatrics, IWK Health Center, Halifax, NS, Canada

Introduction: Stimulant medications, such as methylphenidate hydrochloride (MPH), are the most widely used treatment for Attention-Deficit/Hyperactivity Disorder (ADHD). Although MPH can reduce symptoms of ADHD, it can also disrupt children's sleep. Previous studies reported effects of MPH on sleep duration and latency as measured with actigraphy, but results obtained using polysomnography (PSG) have been inconsistent.

Methods: In this study, 30 medication-naïve children (mean age=8.2 years, 24 males) who were newly diagnosed with ADHD participated in a placebo-controlled trial of MPH treatment. Data related to sleep quality were obtained using actigraphy recorded every night for four weeks and PSG recorded in a sleep laboratory, once after two weeks of MPH and once after two weeks of placebo treatment.

Results: Results were analyzed using repeated measures MANOVAs comparing MPH to placebo treatment. Results from actigraphy indicated that sleep duration was reduced [$F(1,25)=13.18$, $\rho<0.01$] and sleep latency lengthened significantly [$F(1,25)=13.46$, $\rho<0.01$] during MPH treatment relative to placebo, while sleep efficiency, night awakenings, and activity level did not differ between conditions ($\rho>0.05$). The PSG results for the same parameters comparing placebo and MPH treatments did not reach statistical significance [$F(4, 26)=.161$, $\rho>0.05$]; however, there were trends toward treatment effects on sleep duration, latency, efficiency, and night awakenings. PSG recordings revealed no statistically significant differences in sleep architecture between conditions [$F(6, 24)=.154$, $\rho>0.05$].

Conclusion: Although PSG is considered the gold standard for sleep assessment, results from laboratory PSG studies did not match those from actigraphy, which were obtained in the children's usual environment. These results may indicate that PSG recordings in children with ADHD could be affected by interactions among the recording environment, drug treatment, and clinical condition. It is important to establish the relevance of either method by comparing results from each approach to the impacts of MPH on daytime functioning of children undergoing treatment for ADHD.

Support (If Any): Canadian Institutes of Health Research Grant - "Iatrogenic Effects of Stimulant Medication on Sleep in Children with ADHD".

1110

ACTIGRAPHY-BASED SLEEP IN CHILDHOOD GENERALIZED ANXIETY DISORDER: WEEKEND VS. WEEKDAY SLEEP PATTERNS IN COMPARISON TO HEALTHY CONTROLS

Reynolds KC, Reddy R, Alfano CA
Psychology, University of Houston, Houston, TX, USA

Introduction: Despite frequent reports of sleep problems, a limited number of studies have examined objective sleep measures in clinically anxious children. Subjective reports also suggest the presence of differential sleep patterns on weekdays versus weekends (Hudson et al., 2009). The current study therefore sought to extend the research literature by comparing weekend and weekday actigraphy-based sleep in children with generalized anxiety disorder (GAD) and a matched control group. Relationships between sleep variables and indices of pre-sleep arousal also were examined.

Methods: The sample included 43 parent-child dyads (n=22/51% female) including 24 children with primary GAD and 19 controls, 6 to 11 years (M=8.34, SD=1.48). Structured diagnostic assessment and 7 days of actigraphy were conducted among all children.

Results: After log transformations were conducted on sleep variables to meet assumptions of normality, significant group differences were detected for weekend ($F(1,38)=4.79$, $p<.05$) and weekday sleep onset latency (SOL) ($F(1,39)=5.84$, $p<.05$) where the GAD group exhibited longer SOL than controls. No other actigraphy-based group comparisons were significant. Within the GAD sample, SOL on weekends versus weekdays did not differ significantly ($F(1,22)=.358$, $p=.55$), suggesting prolonged SOL across all 7 nights. Pearson's partial correlations indicated a moderate association between weekend SOL and cognitive (but not somatic) pre-sleep arousal ($r=.44$ $p<.01$).

Conclusion: Findings suggest that children with primary GAD exhibit similar problems initiating sleep on both weekends and weekdays. Evidence of an association between pre-sleep cognition and SOL, particularly on weekends, points toward the role of excessive mentation as an important clinical factor. Findings are discussed in terms of their implications for understanding sleep disturbances that co-occur with childhood GAD.

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DISCREPANCIES BETWEEN PARENT REPORTED AND OBJECTIVELY-ASSESSED SLEEP IN ANXIOUS AND HEALTHY CHILDREN

Reddy R, Reynolds KC, Alfano CA
Psychology, University of Houston, Houston, TX, USA

Introduction: Reports of inadequate or disrupted sleep are common in children with generalized anxiety disorder (GAD). Assessment in clinical settings does not typically include the use of objective sleep measures however and the extent to which subjective reports correspond with actual sleep parameters is unknown. The current study therefore examined correspondence between parent reported and actigraphy-assessed sleep among children with GAD in comparison to a nonclinical sample of youth.

Methods: The sample (N=43) included 24 children with primary GAD and 19 healthy control children, 6 to 11 years. All children underwent structured diagnostic interviews. Sleep was assessed based on parent report and actigraphy on 5 weekdays. Specific bedtimes, wake-up times, and total sleep duration were compared.

Results: Partial correlation coefficients revealed significant moderate associations for bedtime ($r = .48$, $p < .05$) and total sleep time ($r = .57$, $p < .05$) and a strong correlation for wake-up time ($r = .73$, $p < .01$) among controls. In the GAD group, a significant association was found for wake-up time only ($r = .64$, $p < .01$). Correspondence between parent reported and actigraphy-based total sleep was particularly low in the GAD group ($r = .13$). To better understand this finding, a paired sample

t-test was conducted comparing measurement of total sleep in the GAD group. The result indicated that parents of children with GAD overestimated total sleep time as compared to actigraphy ($t(1,23) = 5.25$, $p < .001$).
Conclusion: Findings suggest that parents of anxious children may be less accurate reporters of their children's sleep as compared to parents of non-anxious children. The clinical implications of these findings are discussed.

1112
NREM SLEEP INSTABILITY AND COGNITIVE PERFORMANCE IN CHILDHOOD

Bruni O[1], Kohler M[2,3], Novelli L[1], Kennedy D[3,4], Lushington K[2], Martin J[4], Ferri R[5]
[1]Department of Developmental Neurology, University of Rome "La Sapienza", Rome, Italy, [2]School of Psychology, Social Work and Social Policy, University of South Australia, Adelaide, SA, Australia, [3]Children's Research Centre, University of Adelaide, Adelaide, SA, Australia, [4]Respiratory and Sleep Medicine, Women's and Children's Hospital, North Adelaide, SA, Australia, [5]Department of Neurology, Oasi Institute for Research on Mental Retardation and Brain Aging (IRCCS), Troina, Italy

Introduction: Cyclic alternating pattern (CAP) is correlated with cognitive functioning in young adults; in this new study we tested the hypothesis that CAP rate during the night correlates with cognitive performance in children also.
Methods: Fourty-two healthy, non-snoring children (mean age 7.5 years) underwent standard polysomnography and neurocognitive assessment. The neurocognitive tests included the Stanford Binet Intelligence Scale (5th edition) and a Neuropsychological Developmental Assessment (NEPSY). Sleep scoring and CAP analysis were performed following standard criteria. Correlation and regression analyses were performed between CAP parameters and neurocognitive tasks scores.
Results: Fluid reasoning ability was positively associated with CAP rate, particularly during SWS and with A1 total index and A1 index in SWS. Regression analysis, controlling for age and SES, showed that CAP rate in SWS and A1 index in SWS were significant predictors of nonverbal fluid reasoning, explaining 24% and 22% of the variance in test scores, respectively.
Conclusion: Similarly to adults, also in children higher rates of CAP A1 subtypes are correlated with better cognitive functioning, whereas A3 are associated with worse cognitive functioning. Our data indicate that a microstructural analysis of sleep is able to provide important information on the role of sleep in cognitive performance in children.

1113
PERSONNALITY DIMENSIONS RELATED TO SUBJECTIVE SLEEP QUALITY AND DURATION IN EARLY PUBERTAL ADOLESCENTS

Massicotte-Marquez J[1,2,3], Artiges E[3], Miranda R[3], Gollier-Briant F[3], Lemaitre H[3], Paillere-Martinot M[3], Martinot J[3]
[1]Psychologie, Université de Montréal, Montréal, QC, Canada, [2]Laboratoire de recherche en neuropsychologie de la douleur, Centre de recherche de l'Institut universitaire de gériatrie de Montréal, Montreal, QC, Canada, [3]INSERM U-1000 Unité de recherche 'Imagerie & Psychiatrie', Université de Paris Sud et University Paris Descartes, Orsay, France

Introduction: It is estimated that only 20% of adolescents obtain the 9h of recommended sleep and that less than 45% obtain 8h. Youths with lack of sleep are at greater risk for adult insomnia and affective disorder such as depression and anxiety disorders. This study explored in early pubertal adolescents relationships between their subjective sleep quality and quantity, and certain personality traits known to be involved in insomnia and affective disorder.
Methods: 179 healthy adolescents, age range 13-15, participated to this study. They completed the Pittsburgh Sleep Inventory Questionnaire (PSQI) and the Revised NEO Personality Inventory (NEO PI-R) - the Five-Factor Model measuring major domains of personality (neuroticism, extraversion, openness, agreeableness, and conscientiousness). Correlations were used to examine associations between sleep and personality traits. Additionally, we compared the personality traits between sleep quality subgroups according to the PSQI (poor (score ≥6), moderate (score 3-5) and good sleepers (score <3)), as well as between sleep duration subgroups (short (<7h), moderate (7h to <9h) and long sleepers (≥9hrs)). p level were set at 0.001.
Results: Higher scores on the PSQI were associated with greater scores on neuroticism traits, but also with lower scores on extraversion, agreeableness and conscientiousness traits. Longer sleep duration was associated with greater scores on conscientiousness and agreeableness traits. Compared to sleepers with moderate quality, poor sleepers had higher scores on neuroticism traits. They also had lower scores on extraversion traits than good sleepers. Sleepers with long and moderate sleep duration had greater scores on conscientiousness and agreeableness traits than short sleepers.
Conclusion: This is the first study showing in adolescents with poor sleep relationships with personality traits known to be associated with insomnia and affective disorders in adults. Future longitudinal studies should evaluate whether personality during adolescence might be a predisposing factor for both insomnia and affective disorders.
Support (If Any): Study supported by Canadian Research Institutes of Health, Fonds de recherche en Santé du Québec, European Commission (Consortium IMAGEN project).

1114
PLMS MEASURED BY ACTIGRAPHY VERSUS POLYSOMNOGRAPHY IN CHILDREN WITH SICKLE CELL DISEASE

Rogers V[1], Gallagher PR[3], Marcus CL[2], Ohene-Frempong K[4], Traylor J[2], Mason TB[2]
[1]Family and Community Health, University of Maryland Baltimore, Baltimore, MD, USA, [2]Sleep Center, The Children's Hospital of Philadelphia, Philadelphia, PA, USA, [3]Clinical and Translational Research Center, The Children's Hospital of Philadelphia, Philadelphia, PA, USA, [4]Department of Hematology, The Children's Hospital of Philadelphia, Philadelphia, PA, USA

Introduction: Sickle cell disease (SCD) is an hereditary disorder characterized by hemolytic anemia and vaso-occlusion leading to chronic hypoxemia and organ damage. Elevated periodic limb movements in sleep (PLMS) have been identified in these children. PLMS are associated with cardiac acceleration and changes in cardiovascular variability, elevated blood pressure, arousals, and fragmented sleep. Elevated PLMS may present a heightened risk for cardiovascular morbidity in children with SCD, whose chronic, often severe anemia already intensifies cardiac workload. An inexpensive, convenient alternative to the "gold standard" polysomnography for measuring PLMS is required to investigate this phenomenon. This study aimed to determine agreement between PLMS measured by polysomnography and ankle-worn actigraphs.
Methods: 20 children with SCD aged 4-17 years with PSG-documented PLMS or symptoms of RLS were recruited. Polysomnography with electromyographic measurement of PLMS was performed over 1-2 nights with concurrent bilateral ankle actigraphy (PAM-RL, Philips, Inc.), followed by 3 nights of home actigraphy.
Results: Actigraphy demonstrated a mean bias of 8.1±10.7 compared to polysomnography, at the default settings. Correcting actigraphy (CorrACT) scoring to include only sleep period time (sleep onset to offset) improved agreement, with mean bias 5.0±7.4. Cut-points of 10/h to detect elevated PLMS for both polysomnography and CorrACT yielded the best sensitivity (1.00), specificity (0.69), Phi correlation (0.664, $p<0.005$) and Kappa agreement (0.612, $p<0.005$). Difference in estima-

tion of PLMS between methods (range -8.6 to 42.0 PLMS/h) correlated with sleep efficiency (r=-0.711, p=0.001) and wake after sleep onset (r=0.696, p=0.001). Mean bias between CorrACT and polysomnography decreased across 2 nights of PLMS measurement (mean bias 3.5, coefficient of repeatability 12.5).
Conclusion: The PAM-RL actigraphy is a valid measure of PLMS compared to polysomnography in children with SCD when scoring is corrected for sleep period time and a cut-point of 10 PLMS/h for both methods is used to screen for elevated PLMS.
Support (If Any): Institutional Clinical and Translational Science Award Research Center grant #UL1RR024134; 2010 American Nurses' Foundation/Sanofi-Pasteur grant.

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SLEEP DISORDERS AND TRAITS OF DEPRESSION IN CHILDREN WITH SICKLE CELL DISEASE
Potasz C, Varela MV, Carvalho LB, Prado LF, Prado GF
Neurosono, Universidade Federal de São Paulo, São Paulo, Brazil

Introduction: Sickle-cell disease (SCD) is one of the most common monogenic disorders in the world and has been recognized as a major public health problem. SCD is considered a risk factor for sleep disordered breathing (SDB) but can also be related to different sleep disorders (SD) and depression due to its clinical features. Our objective was to study a group of patients with SCD to verify how SD appeared in this population and to see if there was a relation between SD and traits of depression (TD).
Methods: We studied SD and TD in 40 children (22 boys) with SCD, mean age 10.15 ± 3.54 years. They form a group that is treated in a public hospital in Sao Paulo, Brazil. We used the Children's Depression Inventory and the Sleep Disturbance Scale for Children as measurement instruments.
Results: One child showed awakening disorders and TD. 04 children presented disorders in initiating and maintaining sleep and had TD. 2 patients showed sleep-awakening disorders and both had TD. One child showed daily excessive sleepiness and TD. 12 children presented sleep hyperhydrosis and one had TD. 37.5% of our sample showed SDB (n=15), a lower number than other children surveyed in the same hospital in a previous study of ours (55%), and 4 had TD. Other SD showed no difference between SCD group and the group of the previous study. 10 patients in this group showed more than one SD. There were no differences between boys and girls concerning SD or TD (P=0.64 and P=1 respectively).
Conclusion: Our data showed less cases of SDB in patients with SCD than in other children. TD also did not seem increased in this population, but further studies are necessary to understand these two factors.

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SLEEP, NEUROCOGNITIVE FUNCTION, AND ASTHMA IN CHILDREN
Yoon H[1], Kang S[2], Kim L[1], Lee H[1]
[1]Psychiatry, Korea University Anam Hospital, Seoul, Republic of Korea, [2]Psychiatry, Catholic University of Daegu School of Medicine, Daegu, Republic of Korea

Introduction: It has been reported that the sleep problem and neurocognitive deficit in the asthmatic children is prevalent. However, the systematic study in this field using polysomnography has rarely been performed. The aim of this study is to investigate the association of sleep, neurocognitive function, and asthma.
Methods: Forty three children with well-controlled, stable asthma, and 31 controls (age range: 6 to 12 years) were enrolled in the study. All subjects were questioned for sleep quality and daytime sleepiness using pediatric sleep questionnaire(PSQ) and pediatric daytime sleepiness scale(PDSS). Complete overnight polysomnography and neurocognitive function test were performed for the participants.
Results: Of the 43 asthmatic children, 31 (72.1%) met the diagnostic criteria of the pediatric sleep apnea. Total PDSS score and the indices related to snoring, apnea, hyponea, and arousal were higher in asthmatic children. In the vigilance test, the mean number of correct answer was lower, and the mean reaction time is slower in asthmatic children. In the asthmatic group, only apnea-hyponea related arousal index was significantly related with vigilance.
Conclusion: These results suggest that the prevalence of the pediatric sleep-disordered breathing could be very high among the asthmatic children. Moreover, sleep apnea and hyponea in addition to asthma may cause further impairment in vigilance function. Asthma may exacerbate sleep apnea via nocturnal dyspnea, wheezing, or cough, resulting in sleep disruption, altered ventilatory control, and diffuse airway edema, increasing susceptibility to upper airway narrowing or collapse. Sleep-disordered breathing should be checked in asthmatic children, since these children are at risk for developing neurobehavioral deficits associated with frequent arousals during sleep.

1117
SLEEP- RELATED SYMPTOMS AND SLEEP RELATED BREATHING DISORDER BY POLYSOMNOGRAPHY IN CHILDREN WITH CRANIOFACIAL MALFORMATION
Perez I[1], Haynes K[2], Davidson Ward SL[1]
[1]Pediatrics, Children's Hospital Los Angeles, Los Angeles, CA, USA, [2]Plastic Surgery, Children's Hospital Los Angeles, Los Angeles, CA, USA

Introduction: Sleep-related symptoms have been shown to be imperfect predictors of sleep related breathing disorders, mandating polysomnography as the "gold standard" for making the diagnosis of Obstructive Sleep Apnea Syndrome . The objective of the study is to evaluate the role of symptoms in predicting sleep disordered breathing in patients with craniofacial malformations, and whether it is in accordance to what previous studies have shown in normal children.
Methods: We performed a retrospective review of patients seen in the craniofacial clinic at Children's Hospital Los Angeles between 1/2007 -5/2010. Patients with the following diagnoses: Craniosynostosis, isolated cleft lip/palate, micrognathia/ Pierre Robin syndrome and hemifacial microsomia who have undergone were included. Data collected are age at polysomnography, weight, diagnosis, symptoms of snoring, gasping, choking, arousal, daytime sleepiness, and abnormal sleep positions . Polysomnography data collected are Obstructive apnea - hypopnea Index (AHI), central apneas, lowest O2 saturations, and % sleep time at PCO2 > 50 mm Hg. OSA was defined as AHI ≤1.5.
Results: 12 patients, mean age 5.6± 4.4. years were studied. Patients had the following diagnosis: Apert syndrome, hemifacial microsomia, and cleft lip and palate, and Pierre Robin sequence. Mean weight was 30kg. Snoring (10/12) and arousals (8/12) were the commonest manifestations. 50% had a diagnosis of OSA. 50% had central apneas. None had hypoventilation. There was no difference between number of symptoms between the OSA and non-OSA groups (mean = 2 ± 0.89 vs. 3 ± 1.26). There was no difference between number of symptoms between those with sPo2 < 92% and those with sPO2 ≥ 92% (2.8 ±1.3 vs. 2.3 ± 1.1; p 0.48). In patients with ≥ 3 symptoms, 4/6 (67%) did not have OSA vs. 2 (33%) who had OSA.
Conclusion: In children with craniofacial malformations, symptoms do not predict the presence of OSA or oxygen desaturation during sleep.

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SLEEP IN MIGRAINE AND TENSION TYPE HEADACHE IN CHILDREN

Zarowski M[2,1], Sieslik M[2], Vendrame M[3], Steinborn B[2], Kothare SV[1]
[1]Neurology, Children's Hospital, Harvard Medical School, Boston, MA, USA, [2]Neurology, Poznan University, Poznan, Poland, [3]Neurology, Boston University, Boston, MA, USA

Introduction: There is a paucity of research examining the relationship between headache and sleep in children. The aim of the study was to evaluate sleep disturbances in children with migraine and tension type headache (TTH).
Methods: Parents completed a standardized sleep-questionnaire and a headache-questionnaire. Appropriate patients also underwent nocturnal polysomnography.
Results: Four-hundred-and-fifty children with headaches (16% migraine, 84% of TTH) were screening for sleep problems. Ages ranged from 2 to 18years old (mean 12.3+/-4.1) and 57.6% were girls. There were no significant differences in sleep habits between children with TTH and migraine. Snoring was reported more frequently in children with TTH (24.9%) than in migraine patients (13.7%) (p=0.037). The parents of children with migraine reported more frequent daytime sleepiness 26% vs. 11.7% (p=0.001); day time naps: 37% vs. 24.4% (p=0.026); and learning difficulties 30.1% vs. 19.6% (p=0.045) than those with TTH. Twenty-nine patients underwent polysomnography (21 Migraine, 8 TTH). Slow-wave-sleep (N3) was lower in migraine (20.6%) than in TTH (24.6%)(p=0.03), more REM time: 122.3min in migraine vs. 101.8min in TTH(p=0.03) with no significant difference in total sleep time (461min vs. 480min). The children with migraine had a mean of 5 REM periods vs. 4 periods in TTH.
Conclusion: The difference in sleep-architecture with reduced slow-wave sleep in migraine and REM in TTH may influence daytime performance in children with headache. Additional multi-centric studies, with effect of medications also included are needed to validate our observation.

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SLEEP DURATION AND NEGATIVE EMOTIONALITY/ BEHAVIOURAL REGULATION IN 36 MONTH-OLDS: AN ASSOCIATION MODERATED BY SLC6A4 GENOTYPE

Bouvette-Turcot A[1,2], Pennestri M[2], Steiner M[3], Kennedy J[3], Sokolowski M[3], Wazana A[2], Gruber R[2], Atkinson L[4], Meaney M[2], Gaudreau H[2]
[1]Psychology, Université de Montréal, Montréal, QC, Canada, [2]Psychiatry, McGill University, Montreal, QC, Canada, [3]Psychology, University of Toronto, Toronto, ON, Canada, [4]Psychology, Ryerson University, Toronto, ON, Canada

Introduction: Sleep problems are frequent in young children and more so among children with difficult temperament. Although temperament has a strong hereditary component, it is also affected by early life experiences. Relations between polymorphisms of monoamine transporter genes and temperament/personality traits are documented. Serotonin also relates to mood, mental health, and the sleep-wake cycle regulation. Carriers of the 5-HTTLPR short allele are known to be more permeable to their environments, either detrimental or enriched, than homozygous for the long allele. We believe that the 5-HTTLPR genotype modulates the effect of sleep duration on negative emotionality/behavioural regulation in 36 months-old children.
Methods: Our representative community sample consisted of mother-children dyads recruited in the prenatal period and that were part of a longitudinal study: the MAVAN. When children were aged 36 months, mothers were asked to complete questionnaires pertaining to their offspring sleep habits and temperament. Children were also genotyped. Multiple linear regressions were performed to investigate the influence of sleep duration and 5-HTTLPR genotype, alone or in interaction, on negative emotionality/behavioural regulation.
Results: Controlling for the effects of sample of origin, gender, and maternal depression at 36 months postpartum, there was a significant interaction effect of sleep duration and 5-HTTLPR genotype on negative emotionality/behavioural regulation increasing as sleep duration decreased for carriers of either one or two copies of the short allele (β = -0.308, t = -2.000, p = 0.048).
Conclusion: Our findings confirm an interaction between sleep duration and 5-HTTLPR genotype to predict negative emotionality/behavioural regulation scores in 36 month-olds children. The consolidation of the sleep-wake schedule serves as an early indicator for the development of infant's neurobehavioral maturation. It may be the increased sensibility and emotionality of children carrying the short allele of the 5-HTTLPR gene that make them more easily affected by sleep duration.
Support (If Any): MAVAN : CIHR Presenter/1st author : SSHRC.

1120

THE BIDIRECTIONAL ASSOCIATION BETWEEN SLEEP PROBLEMS AND ANXIETY SYMPTOMS IN ADOLESCENTS: THE TRAILS STUDY

Mathyssek C[1], Olino T[2], McMakin D[2], Verhulst FC[1], Van Oort F[1]
[1]Child and Adolescent Psychiatry/Psychology, Erasmus Medical Centre, Rotterdam, Netherlands, [2]Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Sleep problems and anxiety symptoms are strongly associated with each other; yet, the direction of this association remains unclear. In this study, we investigate the temporal relationships between sleep problems and anxiety symptoms across adolescence.
Methods: We used data from the Tracking Adolescents' Individual Lives Survey (TRAILS), a Dutch longitudinal population cohort study (n= 2,230; 51% girls). Subjects were assessed on three time points (age range at T1: 10-12; T2: 12-15; T3: 15-17 years). Anxiety symptoms were collected using the Revised Child Anxiety and Depression Scale. Sleep problems were assessed with items from the Youth Self Report and an additional self-report sleep quality item. Structural equation modelling was employed to examine panel models testing the directionality of the association between anxiety symptoms and sleep problems.
Results: All non-significant regression paths were trimmed from the initial SEM model with all homotypic and heterotypic paths specified. The model fit was good (CFI=.961; TLI=.954; RMSEA=.034), and showed homotypic continuity of anxiety symptoms (.61, p<.001) and sleep problems (.50, p<.001), both of which were constant over adolescence. Further, from T1 to T2, sleep problems predicted anxiety symptoms (.07, p=.004) and anxiety symptoms predicted sleep problems (.10, p<.001). From T2 to T3, anxiety symptoms predicted sleep problems (.10, p=.001), but sleep problems did not predict anxiety symptoms. Associations between sleep problems and anxiety symptoms did not differ by sex.
Conclusion: Our data suggests a potential developmental change in the relationship between anxiety and sleep problems. From early to mid adolescence, sleep problems predicts anxiety symptoms and vice versa. However, from mid to late adolescence, anxiety symptoms predict sleep problems, but sleep did not predict anxiety symptoms.

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THE PATTERNS OF SLEEP DISORDERS AND CIRCADIAN RHYTHM DISRUPTIONS IN CHILDREN AND ADOLESCENTS WITH FETAL ALCOHOL SPECTRUM DISORDERS

Goril S[1,2], Scott L[3], Shapiro CM[1,2,4]
[1]Youthdale Child and Adolescent Sleep Centre, Youthdale, Toronto, ON, Canada, [2]Collaborative Program in Neurosciences, University of Toronto, Toronto, ON, Canada, [3]Neurodevelopmental Services, Scott and Associates, Toronto, ON, Canada, [4]Department of Neuropsychiatry, Toronto Western Hospital, Toronto, ON, Canada

Introduction: Sleep disorders have been poorly described in children and adolescents diagnosed with FASD. The objective of this study is to describe the sleep and circadian rhythm characteristics of children with FASD using overnight polysomnography, sleep questionnaires, and the Dim Light Melatonin Onset (DLMO) test. To our knowledge, no comprehensive studies of this nature have been conducted.
Methods: Thirty six children children ages 6-18 years diagnosed with Fetal Alcohol Spectrum Disorder (FASD) were recruited from various FASD clinics to the Youthdale Child and Adolescent Sleep Centre in Toronto. After medical consultation, each participant had one night of overnight polysomnography, as well as an additional night of DLMO. Participants completed various sleep and FASD questionnaires. Data was analyzed using SPSS 19.
Results: Significant differences were found when comparing the sleep architecture of FASD participants to normative data. There was a high prevalence of sleep disorders in this sample. Most of the melatonin profiles of the FASD participants were found to be abnormal, suggesting hypothalamic-pituitary-adrenal (HPA) axis disturbances. The melatonin results are congruous with the brain pathology in studies of animals prenatally exposed to alcohol.
Conclusion: The high prevalence of sleep disorders and melatonin abnormalities in this population warrants sleep assessments, as part and/or in conjunction of the diagnostic process.

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SLEEP ARCHITECTURE AND EXECUTIVE FUNCTIONS IN CHILDREN DEPRESSION

Moo Estrella J[1], Valencia-Flores M[2,3], Castaño Meneses A[3], Ulloa Flores R[4], Ostrosky Shejet F[2], Reyes Lagunes I[2]
[1]Universidad Autonoma de Yucatan, Mérida, Mexico, [2]Universidad Nacional Autónoma de México, México, [3]Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, México, [4]Hospital Psiquiátrico Infantil Juan N. Navarro, México

Introduction: Sleep disturbance and cognitive dysfunction are common in depression. However, objective data regarding the relationship between sleep architecture and depression in childhood have been inconsistent. The objective of this study was to determine the differences in the sleep architecture and executive functions in children with and without depression.
Methods: The participants were 20 children with an average of 10.5 (SD = 1.5) years old, nine were girls. Ten met the diagnostic criteria for major depression and ten were control. There were no differences by sex and age between groups with and without depression. The instruments were: Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime version (K-SADS-PL), the Children Depression Inventory, and the Battery of Executive Frontal Functions. Also, there were two consecutive nights of polysomnographic.
Results: Sleep efficiency was greater than 90% in both groups, there were not statistically significant differences in the indices of initiation, sleep maintenance and percentage of sleep stage. The executive functions showed statistically significant differences in tasks involving: visual-motor and impulse control, working memory and identify the risk-benefit ratio.
Conclusion: The results suggest that prefrontal structures are more vulnerable to depression than the structures that regulate the circadian and homeostatic sleep.

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SLEEP DISORDERED BREATHING IN CHILDREN WITH CRANIOFACIAL ANOMALIES

Moraleda-Cibrian M[1], Buchman SR[3], Edwards SP[2], Kasten SJ[3], O'Brien LM[1,2]
[1]Neurology, University of Michigan, Ann Arbor, MI, USA, [2]Oral & Maxillofacial Surgery, University of Michigan, Ann Arbor, MI, USA, [3]Surgery, University of Michigan, Ann Arbor, MI, USA

Introduction: Sleep-disordered breathing (SDB) affects up to 12% of typically developing children. Small studies suggest that children with craniofacial anomalies may be at high risk for SDB. Craniofacial anomalies are highly prevalent congenital malformations which often affect the upper airway. The main goal of this study was to evaluate the frequency of SDB in children with craniofacial anomalies.
Methods: This prospective study was conducted between March 2007-May 2011. Families of children aged 1-18 years completed the Sleep-Related Breathing Disturbance Scale of the Pediatric Sleep Questionnaire during their annual visit to the multidiscplinary craniofacial anomalies program. A threshold score $\geq$0.33 on this scale identifies SDB risk.
Results: In total, 1116 questionnaires were completed which comprised 579 unique children. Out of 579 subjects, 56.5% were male and mean age was 8.9±4.7 years. In the sample 26% were syndromic, including hemifacial microsomia (n=20), Goldenhar (n=17), velocardiofacial (n=22), syndromic craniosynostosis (n=27), Treacher Collins (n=6), and CHARGE (n=6). Non-syndromic subjects included isolated cleft lip (n=76), isolated cleft palate (n=73), cleft lip/palate (n=229), Pierre-Robin (n=35) and non-syndromic craniosynostosis (n=18). A large proportion of syndromic children had high risk for SDB, ranging from 17-48%, with syndromic craniosynostosis and velocardiofacial syndromes having >45% of subjects at high risk of SDB. The lowest frequency of SDB in the syndromic group was subjects with CHARGE (17%) and those with hemifacial microsomia (20%). Of non-syndromic subjects, those with isolated cleft lip had the lowest frequency of SDB risk (16%) while 26-46% of children in all other non-syndromic groups had high SDB risk. The highest risk was found in children with Pierre-Robin.
Conclusion: A large proportion of children with craniofacial anomalies are at high risk for SDB. Given the known consequences of SDB in children, education for healthcare providers and routine screening of children in this population may be beneficial.
Support (If Any): NIH HLR2187819.

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SLEEP DISORDERED BREATHING AND SPEECH PATHOLOGY IN CHILDREN WITH CRANIOFACIAL ANOMALIES

Moraleda-Cibrian M[1,2], Berger M[3], Buchman SR[4], Edwards SP[2], Kasten SJ[4], O'Brien LM[1,2]
[1]Neurology, University of Michigan, Ann Arbor, MI, USA, [2]Oral & Maxillofacial Surgery, University of Michigan, Ann Arbor, MI, USA, [3]Speech-Language Pathology, University of Michigan, Ann Arbor, MI, USA, [4]Surgery, University of Michigan, Ann Arbor, MI, USA

Introduction: Children with craniofacial anomalies are potentially at high risk for Sleep Disordered Breathing (SDB) likely due to upper airway anatomy. Velopharyngeal insufficiency (VPI) is often observed in children with craniofacial anomalies and is a significant contributor to speech difficulties in this population. However, the relationship between SDB and speech has not been studied.
Methods: Families of children aged 1-18 years with craniofacial anomalies, with and without cleft palate, were invited to participate in this study between March 2007-April 2011. Children with developmental

delay were excluded. Parents completed the Sleep-Related Breathing Disturbance Scale of the Pediatric Sleep Questionnaire. A threshold score ≥0.33 identified SDB risk. The speech evaluation was performed as part of clinical evaluation. The Pittsburgh Weighted Speech Scale was used to assess for VPI and other speech features including nasal emission and phonation.
Results: A total of 529 children with syndromic and non-syndromic craniofacial anomalies were recruited. Overall 56% were male and the mean age was 8.9±4.7 years. Cleft palate was present in 71% of children, while 28% screened positive for SDB. Speech evaluations found that VPI was present in 32% of the total sample, with 30% having hypernasality and 12% having hyponasality. Children with VPI were no more likely to have SDB risk than children without VPI (29% vs. 28%, p=0.85). However, children with hyponasal speech, compared to those without, were more likely to have SDB (58% vs. 26%, p=0.003). In a logistic regression model controlling for age, gender, presence of a cleft palate, presence of a syndrome, and previous pharyngoplasty, hyponasal speech was found to be independently associated with SDB, adjusted odds ratio 2.6 (95%CI 1.3-5.2, p=0.007).
Conclusion: In children with craniofacial anomalies and documented hyponasal speech it may be pertinent to evaluate for SDB.
Support (If Any): NIH R21HL87819, R21HL089918, and K23HL095739.

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ORAL AND NASAL SYMPTOMS ASSOCIATED WITH PEDIATRIC SLEEP DISORDERED BREATHING

Oka Y[1], Takahashi N[2], Kawasaki Y[3], Horiuchi F[4], Tanno S[3], Takata N[3], Tanigawa T[3]
[1]Department of Sleep Medicine, Ehime University Graduate School of Medicine, Ehime, Japan, [2]Iyo Dental Association, Ehime, Japan, [3]Department of Public Health, Ehime University Graduate School of Medicine, Ehime, Japan, [4]Department of Neuropsychiatry, Ehime University Graduate School of Medicine, Ehime, Japan

Introduction: Oral or nasal symptoms are often seen in sleep disordered breathing (SDB) in children. These symptoms could either be causal factor or result of SDB. The aim of the study was to identify the oral or nasal symptom associated with SDB among the community children.
Methods: 1108 elementary school children recruited from the community pediatric sleep survey were included in the study. A questionnaire asking about the oral or nasal symptoms and SDB symptoms were given to the caregivers. Questions include habitual snoring, witnessed sleep apnea, oral breathing during daytime or sleep, nasal congestion, flu, adenoiditis, foul breath, and history of orthodontic treatment. Presence of each oral or nasal symptom was compared between children with and without SDB (habitual snoring or witnessed sleep apnea).
Results: Oral breathing both during daytime (74% vs 30%) and sleep (77% vs 32%), and frequent flu symptom (32% vs 15%) were significantly more prevalent in children with SDB than in children without SDB.
Conclusion: Oral breathing and frequent flu symptom were associated with SDB in children and thus could be additional markers for identifying SDB children who requires treatment.

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COGNITION AND DENTAL MALOCCLUSION IN CHILDREN WITH SLEEP DISORDERED BREATHING

Carvalho FR, Carvalho LB, Carvalho G, Zanatta CR, Gouveia TS, Fernandes JT, Kulhmann CC, Oliveira SS, Prado LB, Prado GF
Neurology Neuro-Sono, UNIFESP, São Paulo, Brazil

Introduction: This study aimed to determine the impact of individual and combined dental malocclusion variables, cognitive impairment, and gender in SDB children.
Methods: We enrolled 1,600 children aged 7 to 9 years old, from elementary public schools of Osasco City, São Paulo, Brazil. We excluded children with neurologic diseases or genetic syndrome. We studied 1,401 children (53% girls) that answered the Sleep Disturbance Scale for Children validated for Brazilian Portuguese. We evaluated cognition (Bender test) and oral-facial features. We analyzed children with or without SBD, considering cognitive dysfunction and dental malocclusion.
Results: We observed 417 (29%) children with SDB, that was more prevalent in boys (32.7%) than in girls (27.2%; p<0.021). Hyperhydrosis was present in 170 (12%) children (boys: 16.9%; girls: 8.6%; p<0.00001). Twenty two (1%) children presented disorder of arousal, 41 (2%) presented disorder of sleep-wake transition, 46 (3%) presented excessive somnolence, and 67 (4%) presented disorder of initiation and maintaining sleep. There was no difference of these disorders by gender. Children with SDB showed a trend to present more cognitive dysfunction (18%) than children without SDB (14.2%; p=0.08). There was no association related to dental variables for SDB children.
Conclusion: This preliminary study in a considerable number of children showed that SDB and Hyperhydrosis are more prevalent in boys. Malocclusion in general was not predictive of SDB, but we detected a trend for a worse cognition among children with SDB.
Support (If Any): Supported by FAPESP 10/02633-2.

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OBSTRUCTIVE SLEEP APNEA IN DOWN SYNDROME: OBESITY CORRELATES

Spanò G, Anand P, Breslin JH, Bootzin R, Nadel L, Edgin JO
Psychology, University of Arizona, Tucson, AZ, USA

Introduction: Past studies have demonstrated high rates of sleep disruption, including Obstructive Sleep Apnea Syndrome (OSAS) in individuals with Down Syndrome (DS). Several factors contribute to the high incidence of OSAS in children with DS, including obesity, generalized hypotonia, and respiratory tract infections. Understanding the factors that may predict the development of OSAS in this population is important for determining treatment options. Shires et al. (2010) have shown that body mass index (BMI) related to the presence of OSAS in retrospective medical record review of a sample of children with DS (n = 52, ages 9.3 ± 4.5 years).
Methods: In the present study we performed unattended home polysomnography on a sample of 28 children with DS aged 7-18 years (M age: 11.74, SD: 3.52). The presence of OSAS and sleep architecture was scored by a certified polysomnography technician. Height and weight were collected by parent report, which was verified by concurrent medical records when available.
Results: Seventy-eight percent (n = 22) of our sample met criteria for OSAS (AHI > 1.5). When adjusted by age and sex, the mean BMI percentile was 70.75 (SD: 30.45). Higher BMI was related to a greater mean level of oxygen desaturation during sleep (r = 0.40, p < .05). Some aspects of sleep architecture also related, including the number of minutes in stage N3 (r = -0.45, p = 0.01), with those with higher BMI spending less time in slow wave sleep.
Conclusion: Despite the relatively small sample size, these results suggest that BMI reduction may be considered one treatment path for alleviating sleep disturbance in DS. Given the evidence for a correlation between slow wave sleep and memory consolidation, further investigations are needed to better understand the effects of reductions in these stages on cognition in individuals with DS.
Support (If Any): This research was funded by the Thrasher Research Fund, Down Syndrome Research and Treatment Foundation, and the Jerome Lejeune Foundation.

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CHIARI MALFORMATION-1 AND SLEEP RELATED BREATHING DISORDERS IN CHILDREN

Pai V, Zarowski M, Khatwa UA, Kothare SV
Sleep Medicine, Children's Hospital Boston, Boston, MA, USA

Introduction: Chiari malformation 1 (CM-1) is characterized by the caudal displacement of the cerebellar tonsils >5mm through the foramen magnum into the cervical spinal canal. Scant data is present on the clinical course, relationship to the extent of herniation on MRI, effect of decompressive-surgery and polysomnogram (PSG) findings in patients with CM-1. We present our experience in 11 children with CM-1.
Methods: Retrospective analysis was performed looking at PSG's of children diagnosed with CM-1. Details on how the diagnosis was reached, MRI findings, reason for obtaining PSG, data on children who had decompressive-surgery with available follow-up PSG findings and resolution of symptoms were reviewed.
Results: Of the 11 children identified, 6 were boys, ages 3-18 years (median 9 years). Seven/11 were pre-diagnosed with CM-1 and after decompressive surgery (2/7). They were referred for a PSG to r/o obstructive-sleep apnea (OSA) or central sleep apnea (CSA). Six of 7 were found to have normal PSG findings; 1 had moderate OSA. The other 4/11 children were referred to r/o OSA but were diagnosed on PSG to have CSA (median 30/hr, range 8-52/hr) and subsequently confirmed on MRI. All received surgical decompression and 3/4 children showed near complete resolution of CSA on a 6-month follow-up PSG; 1 child continued to be symptomatic and have CSA with bradypnea and was placed on bi-level ventilation. On MRI review, 4/7 children pre-diagnosed with negative PSG's were found to have cerebellar-tonsillar-herniation ranging between 6-10mm and with no syrinx. All children diagnosed with CM-1 on PSG had a herniation >20mm associated with syrinx in 2/4. Five/6 (83%) who underwent decompressive-surgery had no residual CSA on PSG.
Conclusion: Children with clinical symptoms and MRI findings with tonsillar-herniation >20mm and associated syrinx, were more likely to have CSA on their PSG. Eighty-three-percent had resolution of CSA after decompressive-surgery.

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CLINICAL USE OF TOPIRAMATE IN THE TREATMENT OF PRIMARY CENTRAL SLEEP APNEA IN A PEDIATRIC POPULATION

Suhrbier D[1], Dawkins R[1,2]
[1]Child Neurology Center, Gulf Breeze, FL, USA, [2]Practical Health Strategies, Pensacola, FL, USA

Introduction: The treatment of clinically significant primary central sleep apnea in a pediatric population is limited to pharmacological enhancement of the respiratory drive or to mechanical ventilation, usually bilevel PAP, with or without feedback servo-control, utilizing a backup rate. There is a long history of the use of acetazolamide, an inhibitor of the enzyme carbonic anhydrase, in the treatment of primary sleep apnea, but the tolerance is limited by unpleasant peripheral neurological symptoms. Topiramate is a newer carbonic anhydrase inhibitor with fewer of the unpleasant peripheral neurological side effects. We hypothesized that topiramate would be an effective treatment of primary central sleep apnea and that compliance would be less of a problem than with acetazolamide.
Methods: We did a chart review of 10 consecutive patients, 6 male and 4 female, with observed primary central sleep apnea in the pediatric sleep disorders center of the Child Neurology Center in the course of their regular, ongoing clinical care. All studies in the center are scored according to the current AASM guidelines. Patient were prescribed an initial dose of topiramate of 12.5 mg and increased to 25 mg as clinically indicated and tolerated.
Results: The patients ranged in age from 3y 3m to 12y 4m. Baseline central apnea indices ranged from 1.2 to 10.9 with a mean value of 3.4. On followup PSG the central apnea index ranged from 0.2 to 1.8 with a mean value of 0.8. Pairwise comparison showed that all patients experienced a reduction in the central apnea index ranging from 44% to 93% with a mean of 73%. The treatment was well tolerated by all.
Conclusion: These results suggest that topiramate is a promising alternative therapy for primary central sleep apnea and that controlled prospective studies are indicated.

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OBSTRUCTIVE SLEEP APNEA IN CHILDREN IS ASSOCIATED WITH A DOSE RESPONSE DETERIORATION OF OVERNIGHT ENDOTHELIAL FUNCTION

Etzioni T[1,2], Bussol Y[1], Pillar G[1,2]
[1]Sleep Lab, Rambam Medical Center and Technion, Haifa, Israel, [2]Pediatrics, Carmel Hospital and Technion, Haifa, Israel

Introduction: Restful sleep is expected to lead to better endothelial function in the morning compared to the evening. However, in adults with obstructive sleep apnea (OSA) endothelial function worsens during the night, probably due to the sympathetic activation and stress they experience during sleep. Data in pediatric OSA in this regard are sparse. We sought to examine the association between pediatric OSA and overnight changes in endothelial function.
Methods: 27 children with various degrees of sleep disordered breathing (average age, 10.7 years; range, 5 to 16.5 years) underwent endothelial function assessment (reactive hyperemia test by EndoPAT, Itamar Medical, ISRAEL) in the evening before and the morning after an overnight polysomnography. The correlation between the difference between evening and morning (E-M) endothelial functions and sleep disordered breathing indices (minimal oxygen saturation and RDI, respiratory disturbance index) were determined.
Results: E-M (deterioration of endothelial function during the night) correlated significantly positively with RDI ($r=0.31$, $p<0.05$) and negatively with lower minimal O2 saturation ($r=-0.32$, $p<0.05$).
Conclusion: In children, deterioration in endothelial function during the night significantly correlated with the severity of OSA. These findings support our hypothesis that similar to adults, sleep apnea in children results in endothelial dysfunction. We speculate that in children OSA is less commonly associated with cardiovascular (CVS) complications due to the shorter duration of the syndrome, and that if the syndrome would have been long enough, children with OSA would have developed CVS complications similarly like adults.

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INCIDENT SLEEP DISORDERED BREATHING IN THE PENN STATE CHILD COHORT: THE EFFECTS OF AGE AND BODY WEIGHT

Bixler EO[1], Vgontzas AN[1], Calhoun S[1], Fernandez-Mendoza J[1], Shaffer M[2], Criley C[1], Cain P[1], George S[1], Stewart R[1], Liao D[2]
[1]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA, [2]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA

Introduction: The epidemiology of sleep-disordered breathing (SDB) in children from general population samples has received little attention, with the incidence of SDB in adolescent children even less well studied.
Methods: The Penn State Child Cohort (PSCC) is a representative general population sample of 700 children aged 5-12 years. Our preliminary results are based on an average 8 year followup of the initial 169 prospective subjects (~24%) from this ongoing cohort study. Body fat distribution was assessed using a standardized Dual-emission X-ray Absorptiometry (DXA) system generating the percent of Android/Total Body fat. Linear regression was used to assess the association between potential risk factors and SDB.

Results: Incident SDB was observed to be 10.1%. This sample had a mean age of 17.1±2.0 years, an average BMIz of 0.50±1.03 (which corresponds to a BMI percentile of 64.4) and 56.2% were boys. At baseline 1.2% of this subsample had SDB, which corresponds to the prevalence of SDB at baseline, and surprisingly, there was no persistence of SDB. The average AHI in those with incident SDB was 14.1 with a maximum of 91.4. Incident SDB was similar for girls (10.8%) and boys (9.5%). Those with SDB were older than those without (17.0 vs 18.4 years, P = 0.004) and were more obese (BMIz=0.45 vs 1.01, P=0.033). There was also a significant association between SDB and both waist circumference (80.1 vs 90.2 cm, P=0.011) and abdominal fat as percentage of total body fat (27.8% vs 33.7%, P=0.047).
Conclusion: In this preliminary sample of an 8 year followup of children from The Penn State Child Cohort, the incidence of SDB is high in adolescents, whereas childhood SDB does not appear to persist into adolescence. Further, the results indicate that robust risk factors for SDB in adolescents are increasing age and abdominal obesity.
Support (If Any): NIH R01 HL603772, R01 HL97165, UL1 RR033184, C06 RR16499.

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UNDER-THE-MATTRESS MOVEMENT SENSOR (BABYSENSE*) VERSUS CARDIORESPIRATORY MONITOR TO ALARM IN APNEA OF INFANCY

Mordechai O[1], Etzioni T[2,3], Shehadeh N[1], Pillar G[2,3]
[1]Pediatrics Department A, Rambam Medical Center, Haifa, Israel, [2]Pediatrics Department, Carmel Hoapital, Haifa, Israel, [3]Sleep Lab, Rambam Medical Center and Technion, Haifa, Israel

Introduction: Infant home monitors are recommended in high risk infants. While direct monitoring of respiration and heart rate requires attaching surface electrodes to the infant, movement sensors may be placed under the mattress and detect respiratory cessations without touching the infant. Purpose: To study the accuracy of a movement sensor placed under the mattress in alarming for apnea and bradycardia in infants.
Methods: 53 high risk infants who presented to the emergency room with Apparent Life Threatening Event (ALTE) underwent a whole night simultaneous monitoring by both cardiorespiratory monitor (intellivue MP20 junior, Phillips) and under the mattress movement monitor (Babysense II, Hisense). The cardiorespiratory monitor was set to alarm when detecting no respiration for 20sec, heart rate below 90/min, and oxygen saturation below 90%. The Babysense was set to alarm when detecting no respiration (movement) for 20sec.
Results: 53 infants (age 43± 30 days) who presented to Rambam (n=50) or Carmel (n=3) emergency rooms after ALTE participated. During 74 nights of monitoring (19 infants were monitored for 2 nights, 2 infants were monitored for 3 nights) there were 7 events of alarming (9.3%), simultaneously in both systems. In all other cases there were no alarms in both systems.
Conclusion: Under the mattress movement sensing is accurate in alarming for apnea and bradycardia in infants. Since the usage of this system is simple and without direct contact with the infant, it may be a convenient useful method for certain infants.

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NOCTURNAL DIPPING OF BLOOD PRESSURE: IS IT PRESERVED IN PRESCHOOL CHILDREN WITH SLEEP DISORDERED BREATHING?

Nisbet LC[1], Walter LM[1], Yiallourou SR[1], Trinder JA[2], Nixon GM[1,3], Davey MJ[1,3], Horne RS[1]
[1]The Ritchie Centre, Monash University, Melbourne, VIC, Australia, [2]Discipline of Psychological Sciences, University of Melbourne, Melbourne, VIC, Australia, [3]Melbourne Children's Sleep Centre, Monash Medical Centre, Melbourne, VIC, Australia

Introduction: Blood pressure (BP) typically falls from wake to sleep, however this nocturnal dipping is lacking in adults with sleep disordered breathing (SDB). SDB incidence peaks in the preschool years, but to date, nocturnal dipping has not been studied in this age group.
Methods: 163 3-5yo children (59% M) were recruited: 128 for assessment of SDB and 35 non-snoring control children. All children underwent overnight polysomnography, with additional pulse transit time (PTT) measurement, which is non-invasive and inversely related to BP. PTT was calculated as the time delay between the ECG R-wave and the 50% point of the rise in the corresponding finger photoplethysmographic signal. PTT was averaged for each 30s epoch and mean values for wake (before sleep onset), sleep (average of entire night), and first periods of NREM1&2, NREM3&4 and REM were calculated for each child. Children were grouped according to their obstructive apnea hypopnea index (OAHI); control OAHI≤1 event/h (n=35); primary snoring (PS) OAHI≤1 event/h (n=66); Mild SDB 1-5 events/h (n=34); Moderate/Severe SDB (M/S) >5 events/h (n=28).
Results: Groups were similar for age and sex. PTT significantly increased from wake to sleep, wake to NREM1&2 and wake to NREM3&4 in both control and all SDB groups ($p<0.01$ for all). PTT during wake and REM were not significantly different. The magnitude of the change was not significantly different between groups, nor between sexes. Age was not correlated with increase in PTT.
Conclusion: Preschool aged children experience a significant rise in PTT from wake to sleep, indicative of a fall in BP. This reduction in BP occurs irrespective of SDB severity, indicating that nocturnal dipping is preserved. These findings suggest that the cardiovascular system of these young children may not as yet be adversely affected by SDB, however further research is needed to establish the long-term effects of SDB on the cardiovascular system.

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NOCTURNAL DIPPING OF BLOOD PRESSURE AND HEART RATE IS NOT ALTERED IN SCHOOL AGED CHILDREN WITH SLEEP DISORDERED BREATHING REGARDLESS OF SEVERITY

Horne RS[1], Yang JS[1], Walter LM[1], Richardson HL[1], O'Driscoll DM[1], Nixon GM[1,2], Jolley D[3], Walker AM[1], Anderson V[4], Davey MJ[1,2]
[1]The Ritchie Centre, Monash University, Melbourne, VIC, Australia, [2]Melbourne Children's Sleep Centre, Monash Medical Centre, Melbourne, VIC, Australia, [3]School of Public Health and Preventative Medicine, Monash University, Melbourne, VIC, Australia, [4]Critical Care and Neuroscience Research, University of Melbourne, Melbourne, VIC, Australia

Introduction: Sleep disordered breathing (SDB) in adults has been associated with loss of the nocturnal dipping in blood pressure (BP) and heart rate (HR), however, there have been limited studies in children. We measured BP non-invasively and continuously during overnight polysomnography in 105 children aged 7-12 with a range of severities of SDB and 36 non-snoring controls to examine nocturnal dipping profiles.
Methods: Children with SDB were divided into three severity groups according to the obstructive apnea hypopnea index (OAHI). BP and HR data were categorised into Wake (before sleep onset), total overnight Sleep, NREM 1/2, SWS and REM. Nocturnal dipping profiles were cal-

culated both as % of children exhibiting a ≥ 10% fall in systolic BP (SAP) and HR from Wake to Sleep and according to SAP Sleep / SAP Wake ratio as extreme dippers ratio ≤ 0.8, dippers < 0.8 ratio ≤ 0.9, non dippers < 0.9 ratio ≤1.0 and reverse dippers ratio > 1.0.
Results: Over the whole night BP dipped during Sleep, reaching statistical significance for SAP in the Control group ($p<0.05$). We also found that the fall in BP between wake before sleep onset and NREM 1/2, SWS and REM sleep was not different between the groups. In addition, when children were grouped according to their nocturnal dipping profile there were no differences between the proportions of children in each group across severities of SDB or between sleep states.
Conclusion: All severities of SDB were associated with similar nocturnal dipping patterns of BP and HR, a finding which may suggest that the cardiovascular system of these young children has not been significantly affected. However, further studies are required to determine if the elevated BP we have previously reported in this group will have long term effects on the cardiovascular system.

1135
LONG-TERM NEUROBEHAVIORAL OUTCOME OF INFANTILE OBSTRUCTIVE SLEEP APNEA

Rafaeli R[1], Goldbart AD[1,2], Roth G[3], Tal A[1,2]
[1]Pediatrics, Soroka University Medical Center, Beer Sheva, Israel, [2]Sleep-Wake Disorders Unit, Soroka University Medical Center, Beer Sheva, Israel, [3]Education, Ben-Gurion University, Beer Sheva, Israel

Introduction: Little is known about late neurobehavioral implications in children diagnosed with obstructive sleep apnea (OSA). The aim was to test the hypothesis that preschool age children diagnosed with OSA before age one present neurobehavioral disorders.
Methods: Otherwise healthy Children diagnosed as having OSA before one year of age were compared to age and socioeconomic matched healthy children (age 5 y). Parents completed a sleep questionnaire as well as Achenbach (CBCL) questionnaire. Out of 99 eligible children, 52 (65%) participated, as well as 28 healthy children as controls.
Results: Children with a history of OSA during infancy presented significantly more externalizing problems as compared to the controls (48.9 ± 10.9, vs 43.3 ± 10.6, $p<0.032$) with a tendency for impairment in total problems ($p<0.07$). There was no correlation between disordered behavior and OSA severity (AHI); there were no differences in behavior between children who did or did not undergo adenotonsillectomy or adenoidectomy (mean age at surgery 13 months). The risk for behavioral problems in all three categories (externalizing, internalizing and total problems) significantly correlated with report of at least one of three symptoms of OSA reported by parents at the age of five: snoring, difficulty in breathing during sleep, and witnessed apnea ($p<0.04$).
Conclusion: 1. preschool children with a history of infantile OSA present abnormal externalizing behavior four years later.; 2. The behavioral disturbance was mild, did not correlate with OSA severity, and was not influenced by surgical treatment; 3. Disturbed behavior at five years of age significantly correlated with clinical symptoms of OSA.
Support (If Any): Dr. Goldbart is suppoted by the Israel Science Foundation grant 753/11.

1136
SLEEP DISORDERED BREATHING IS ASSOCIATED WITH ABDOMINAL ADIPOSITY AND INSULIN RESISTANCE IN CHILDREN

Tsaoussoglou M, Kritikou I, Vgontzas AN, Calhoun S, Bixler EO
Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA

Introduction: In adults, sleep apnea is associated with excessive daytime sleepiness (EDS) and cardiometabolic comorbidity. In children on the other hand, sleep-disordered breathing (SDB) has been primarily associated with anatomic abnormalities and neurocognitive impairment, whereas studies on potential concurrent metabolic aberrations have been limited and inconsistent. In this study, we examined the joint effect of SDB and obesity on insulin resistance in a large sample of children.
Methods: One hundred forty children, aged 5-17 yr, were consecutively recruited from our Sleep Disorders Clinic and a subset of the Penn State Children's Cohort. Every child underwent a 9-h polysomnographic study for the assessment of SDB. BMI percentile, waist, hip and neck circumference were measured objectively. Single morning blood samples for the assessment of fasting glucose and insulin were obtained and the Homeostasis Model Assessment (HOMA) was calculated as an index of insulin resistance. Analysis of covariance was used for comparisons among four groups that were separated according to SDB severity and BMIpercentile. Waist circumference was used as a surrogate marker of intra-abdominal fat (i.e. visceral adiposity).
Results: There was a significant linear trend between HOMA and SDB with lowest levels observed in lean controls and highest in overweight/obese with moderate SDB (0.8, 3.1 respectively, $p<0.001$). Waist circumference increased significantly with SDB severity, independently of BMI. Simple correlation analysis revealed a positive correlation between waist, circumference and HOMA ($r=0.476$, $p < 0.001$).
Conclusion: This study suggests that in obese children, SDB, independent of obesity, is associated with increased insulin resistance. This association is probably mediated through increased amounts of visceral fat, as we have previously shown that is the case in obese and non-obese apneic adult patients. These findings point to an inflammatory/insulin resistance state suggesting that SDB in obese children shares many pathophysiological similarities with SDB in adults.
Support (If Any): R01 HL 63772, UL1RR33184, C06 RR16499.

1137
THE INFLUENCE OF OBESITY AND DECREASED TOTAL SLEEP TIME ON METABOLIC HORMONES IN ADOLESCENTS

Landis AM
School of Nursing, University of Washington, Seattle, WA, USA

Introduction: The prevalence of adolescent obesity has increased worldwide. One modifiable risk factor that has received little attention is quantity of sleep. Recent studies in children and adults have shown that total amount of sleep is inversely associated with body mass index (BMI), an observation not well characterized in adolescents. Reduced total sleep time is associated with appetite-regulating hormones alterations (e.g., ↑ ghrelin,↓ leptin) and changes in hunger in animal models and adults, possibly mediating weight gain. The purpose of this pilot study was to test and evaluate the feasibility of a study on sleep, obesity, appetite hormones, hunger/satiety, eating and physical activity habits, symptom experiences (e.g., sleepiness), and metabolic risk in a group of healthy adolescents 12-18 years old.
Methods: Subjects were recruited from the community. They completed study questionnaires; single fasting serum blood draw for ghrelin, leptin; BOD POD® measure; 24-hour diet recalls, sleep/hunger/satiety diary; and wore a wrist actigraph for 8-days. Ghrelin and leptin were determined by enzyme immunoassay (EIA) and enzyme-linked immunosorbent assay (ELISA), respectively.
Results: The sample (n=61) included 52.5% (32) females, 83.6% (51) White adolescents. The mean age was 15.6 ± 1.9 years. Mean BMI was 23.4 ± 4.9 kg/m^2. Mean nocturnal TST was 460 ± 46 minutes (7.6 hours) per night. Overweight/obese (based on CDC BMI-for-age and gender) short sleepers (≤ 7.5 hours/night) had increased % Fat intake ($t = 2.66$, $p = .02$); increased hunger after school ($t = 2.19$, $p = .04$) and evening ($t = 2.29$, $p = .04$); and increased ghrelin ($t = 2.09$, $p = .06$) levels compared to normal weight long (> 7.5 hours) sleepers. There was no difference in leptin levels between the overweight/obese short and normal weight long sleepers.
Conclusion: Collectively, the sample was sleep deprived. Similar to findings in adults, decreased total sleep time was associated with elevat-

ed ghrelin levels. Sleep loss may affect markers that potentially lead to obesity in adolescents. Future longitudinal studies, refining measures of diet, hunger, and biomarkers in a larger sample are needed to better understand the biological mechanisms underlying the association between sleep and obesity in adolescents.

Support (If Any): Biobehavioral Nursing Training Grant, T32 NR007106 NIH/NINR.

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CARDIOVASCULAR RISE AND FALL: OBSTRUCTIVE EVENTS IN 3-TO-5 YEAR OLD CHILDREN WITH SLEEP DISORDERED BREATHING

Nisbet LC[1], Walter LM[1], Yiallourou SR[1], Trinder JA[2], Nixon GM[1,3], Davey MJ[1,3], Horne RS[1]

[1]The Ritchie Centre, Monash University, Melbourne, VIC, Australia, [2]Discipline of Psychological Sciences, University of Melbourne, Melbourne, VIC, Australia, [3]Melbourne Children's Sleep Centre, Monash Medical Centre, Melbourne, VIC, Australia

Introduction: Surges in heart rate (HR) and blood pressure (BP) at obstructive apnea termination have been associated with adverse cardiovascular consequences of sleep disordered breathing (SDB) in adults and school aged children. The incidence of SDB peaks in the preschool years, but to date, acute cardiovascular changes have not been studied in this age group.

Methods: 3-5yo (n=36) referred for assessment of SDB were recruited and underwent overnight polysomnography with the additional measurement of pulse transit time (PTT), which provides a non-invasive, continuous measure of BP changes. Children were grouped according to their obstructive apnea hypopnea index (OAHI); primary snoring (PS) OAHI≤1 event/h; Mild SDB 1-5 events/h; Moderate/Severe SDB (M/S) >5 events/h (n=12 per group). Groups were age and sex matched. AASM criteria for respiratory event classification were used. PTT was calculated as the time delay between the ECG R wave and the 50% point of the rise in the corresponding finger photoplethysmographic signal. Beat-by-beat analysis of HR and PTT was performed surrounding each event; pre-event (mean of 10s preceding event) and post-event (mean 3 consecutive beats at HR peak/PTT trough within 15s).

Results: 176 obstructive events (22 apneas, 154 hypopneas) were analysed. Change in HR and PTT from pre- to post-event was 16%±0.8 and -6%±0.2, (mean±sem) respectively. Change in HR and PTT was not significantly different between SDB groups, event type or sleep states. Event length was not correlated with post-event change in HR or PTT.

Conclusion: Obstructive events in 3-5yo elicit an acute increase in HR and fall in PTT, indicative of a surge in BP, which is similar to that reported in adults and older children. Such perturbations are thought to be involved in the development of hypertension. Thus close monitoring of preschool children with SDB is imperative, as their cardiovascular system is still developing.

1139

THE EFFECT OF OBSTRUCTIVE SLEEP APNEA ON PEDIATRIC PEDESTRIAN INJURY RISK AND RISK TAKING BEHAVIOR

Avis K[1], Johnston A[2], Davis A[2], Schwebel DC[2]

[1]Pediatric Pulmonary, University of Alabama at Birmingham, Birmingham, AL, USA, [2]Department of Psychology, University of Alabama at Birmingham, Birmingham, AL, USA

Introduction: Pedestrian injury is the 2nd leading cause of pediatric unintentional injury. Crossing streets safely is a complex cognitive task that relies on: (a) judging approaching traffic speed; (b) recognizing safe traffic gaps; (c) selecting safe crossing locations; (d) scanning environments for dangers; (e) remembering safety rules; (f) controlling impulses to cross; and (g) accurately perceiving traffic movement. Characteristics influencing pedestrian safety are negatively influenced by sleep disorders. Sleep disorders put adults at high risk for sleepiness, mental inefficiency, motor vehicle crashes, and occupational injury. However, the effect of sleep disorders such as Obstructive Sleep Apnea (OSAS) on children's safety remains unknown. Pediatric OSAS causes significant daytime consequences, including impulsivity, impaired reaction time, inattention, and impaired decision making. However, little work addresses "real world" safety-related consequences of OSA. This study examined whether OSAS affects children's pedestrian safety using an interactive,virtual reality pedestrian environment (VR). We also examined the impact of OSAS on route selection choices during a tabletop task (risk taking pedestrian behavior).

Methods: 60 children with OSAS aged 8-16 participated in the validated VR to examine pedestrian injury risk. We examined the number of hits/close calls (when participants would have been struck by a vehicle in the real environment or were within 1/2 second of being hit) crossings as the dependent measure. Children completed measures of daytime sleepiness and a tabletop route selection task.

Results: Children with OSAS had significant daytime sleepiness. Daytime sleepiness significantly correlated with the number of hits/close calls in the VR (r=.29, p=.036) and was associated with choosing riskier routes in the tabletop route selection task (p<.05).

Conclusion: This study identifies "real-world" safety-relevant consequences of OSAS in children (pedestrian injury risk and risk taking pedestrian behavior). OSAS impacts pedestrian safety, which relies heavily on the same skillset negatively influenced by sleep deprivation, increasing risk taking pedestrian behavior.

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SLEEP DISORDERED BREATHING IN CHILDREN - THE EFFECT OF SEASONALITY

Greenfeld M, Sivan Y, Tauman R

Sleep Disorders Center, Dana Children's Hospital, Tel Aviv Medical Center, Tel Aviv, Israel

Introduction: Allergy and viral upper respiratory tract infections which are two risk factors for sleep-disordered breathing (SDB) in children, exhibit seasonal variability. A recent study in a school-age community based population from North America showed that pediatric SDB exhibits seasonal variation for SDB severity with a peak in the winter-spring time. We, therefore, aimed to examine the effect of seasonality on SDB severity in a clinical cohort of children of all ages who were referred for polysomnographic (PSG) evaluation for suspected SDB.

Methods: All children referred to our sleep center, between January 2008 and December 2010 for suspected SDB were included. Children with craniofacial anomalies, neuromuscular diseases, moderate-severe neurodevelopmental delay and chronic medical conditions were excluded. Medical records and PSG results were reviewed. PSG's with total sleep time less than 4 hours were excluded.

Results: 2179 children (65% male) were included. There was no difference in the number of children evaluated each year. The mean age was 59.4±41.9 months (1-216 m). 18% had history of allergy. Mean AHI was significantly increased in boys compared to girls (4.3±7.2 vs. 3.6±5.9, p=0.03). Mean apnea-hypopnea index (AHI) was significantly elevated during winter time (December-February) compared with summer time (June-August) (4.4±7.0 vs. 3.6±5.8; p=0.03). The percentage of AHI≥5h/TST was significantly increased in winter time compared with summer time (26.2% vs. 20.9%, p=0.04). These findings remained significant after excluding children with a history of allergy. No differences in the age and number of children evaluated every month were present.

Conclusion: The results suggest that children with SDB exhibit seasonal variability in disease severity which is unrelated to their allergy status.

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PREVALENCE OF SLEEP BREATHING DISORDER IN CHILDREN IN A BRAZILIAN EQUATORIAL AND TROPICAL ZONES

Carvalho LB[1], Figueiredo MB[1], Silva F[1], Carvalho NC[1], Silva NM[1], Lentini-Oliveira DA[1], Prado AF[2], Bertocco BP[1], Prado LB[1], Prado GF[1]
[1]Neurology, Neuro-Sono, Unifesp, São Paulo, Brazil, [2]Faculdade de Medicina, Universidade de São Paulo, São Paulo, Brazil

Introduction: It is estimated that between 10 and 12% of children snore habitually and that between 1 and 3% of children suffer from OSAS, with peak incidence between 2 and 5 years of age, when adenotonsillar hyperplasia is most common. Prevalence of OSAS is equal in boys and girls until adolescence, when a male preponderance becomes strikingly evident. Because full polysomnography in children is both costly and time-consuming, inexpensive and easily questionnaires has been used as a good predictor of sleep breathing disease (SBD). Objective. To verify the prevalence of SBD in children that live in an equatorial zone in Brazil compared to tropical zone.
Methods: This preliminary study was carried out in elementary public schools, in Sao Luis City, Maranhao State, north of Brazil. Parents of 6 to 10 years old children answered the Sleep Disturbance Scale for Children Questionnaire, adapted and validated for Brazilian Portuguese. We also analyzed questionnaires from elementary public schools, in Sao Paulo City, Sao Paulo State, south-east of Brazil. Parents of the same age children answered the same Questionnaire. We excluded children with genetic or neurological diseases in both studies.
Results: From Sao Paulo, we analyzed 3023 questionnaires (51% girls). Six forty hundred (21%) had sleep disorders and 79/3023 (2.6%) or 79/640 (12%) had SBD. From Sao Luis, until now, we analyzed 136 questionnaires (57% girls). Forty six (34%) had sleep disorders and 25/136 (18.4%) or 25/46 (54%) had SBD. There was no difference by gender in all groups.
Conclusion: The preliminary data showed a greater prevalence of SBD in Sao Luis (18.4%) compared to Sao Paulo (2.6%), a large city in the tropical zone. Economic and Social conditions, as poor health assistance and poor public health polices, may be more effective to impair sleep than the environmental features.
Support (If Any): Supported by FAPESP 2010/06188-3.

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ADENOTONSILLOTOMY; FIRST LINE TREATMENT FOR PEDIATRIC SLEEP DISORDERED BREATHING?

Sunnergren O[1], Ericsson E[2], Hemlin C[3], Hessén Söderman A[4], Hultcrantz E[5], Roos K[6], Stalfors J[7]
[1]Department of ENT, County Hospital Ryhov, Jönköping, Sweden, [2]Department of Medical and Health Sciences, Division of Nursing Science Linköping University, Linköping, Sweden, [3]Department of ENT, Aleris Sabbatsberg Hospital, Stockholm, Sweden, [4]Department of ENT, Karolinska University Hospital, Stockholm, Sweden, [5]Department of Experimental and Clinical Medicine, Division of Otolaryngology Linköping University Hospital, Linköping, Sweden, [6]Department of ENT, Capio Lundby Hospital, Göteborg, Sweden, [7]Department of ENT, Sahlgrenska University Hospital, Göteborg, Sweden

Introduction: In recent years there has been a shift in Sweden from tonsillectomy (TE) to tonsillotomy (TT), i.e. partial removal of tonsillar tissue, with or without simultaneous adenoidectomy (A) as primary treatment for children with sleep disordered breathing (SDB). This study compares the current prevalence of TE/ TE+A and TT/ TT+A and their respective rates of postoperative bleeding and self reported degree of symptom relief.
Methods: All children 1-15 years registered with the indication "upper airway obstruction" in the National Tonsil Surgery Register in Sweden (March 2009 - October 2011) were included. Surgical procedure and bleedings occurring during hospital stay were prospectively registered by the surgeon. Questionnaires were used to collect data on postoperative bleedings, occurring after discharge that required readmission to hospital (within 30 days post-surgery), and degree of symptom relief (6 months post-surgery).
Results: A total of 10508 tonsillar procedures were registered, whereof 1060 (10%) TE, 2753 (26%) TE+A, 1051 (10%) TT and 5644 (54%) TT+A were performed. Seventy-seven (77%) and 47% of the patients answered the 30 day and 6 month questionnaires respectively. Postoperative bleedings were all significantly more common after TE/TE+A than TT/TT+A: during hospital stay TE 1,8% TE+A 1,9% TT 0,3% TT+A 1,2% and at home requiring readmission to hospital TE 5,5% TE+A 3,7% TT 0,8% TT+A 0,8%. There was no significant difference in self-reported symptom relief, with 96% reporting "complete" or "almost complete" symptom relief, 6 months after surgery.
Conclusion: Despite that the objective efficacy (by polysomnography) of TT compared to TE remains to be established and the possible risk for reoperation after TT (due to regrowth of tonsillar tissue), it seems reasonable to recommend TT (with our without A) as the first option for treatment of children with SDB due to tonsillar hypertrophy.

1143

NEUROCOGNITIVE FUNCTION IMPROVEMENT AFTER ADENOTONSILLECTOMY IN PEDIATRIC OBSTRUCTIVE SLEEP APNEA SYNDROME

Chen K[1], Huang Y[1], Guilleminault C[2]
[1]Sleep Center and Child Psychiatry Department, Chang Gung Memorial Hospital and University, Taipei, Taiwan, [2]Sleep Medicine Division, Stanford University, Redwood, CA, USA

Introduction: Obstructive sleep apnea syndrome (OSA) is a common sleep disorder in children and adolescents. The consequences of OSA are not only tiredness, fatigue, but the syndrome lead to cardio-vascular and metabolic changes. Behavioral problems with daytime hyperactivity, inattention and neurocognitive function impairment are also common. The mechanism of neurocognitive impairment is still unclear. The relationship between age of treatment of OSAS and the improvement of different neurocognitive function in pediatric OSA is also unclear.
Methods: 56 children with OSA ie Apnea-Hypoapnea index (AHI) >5times/hr, were divided into two group, n=20, with age below 6 year and the other (n=36) with age above 6 years. All children had. PSG test and neurocognitive tests (such as the Wechsler intelligence test WPPSI, WCST, CCTT and CPT). Before adenotonsillectomy treatment and 1 year after treatment. Student's t-test was used to compare the data with SPSS version-16.
Results: After surgery, symptoms on all OSAS children are much relieved. Although, only 67% patients' AHI <1time/hr, both group have significant AHI decrease on PSG ($p<0.01$). The study also revealed neurocognitive function improvement in omission of CPT ($p=0.035$) and WCST test ($p<0.001$) after surgery in >6y/o group. Results are significantly improvement in <6 y/o group is better than it in >6y/o group on intelligence test comparing to improvement of OSAS severity. It means that the more AHI improved, the more verbal IQ score increased was found.
Conclusion: This study indicated that the neurocognitive function improved further in younger group after adenotonsillectomy Age of recognition and treatment of pediatric OSA is an important variable.

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INVESTIGATING REASONS FOR SUBOPTIMAL CPAP ADHERENCE IN ADOLESCENTS

Prashad PS[1], Marcus CL[1], Cornaglia MA[1], Bradford R[1], Costa P[1], Puzino K[1], Xanthopoulos M[1], Maggs J[1], Moore M[1], Barg FK[2]
[1]Sleep Center, Children's Hospital of Philadelphia and University of Pennsylvania, Philadelphia, PA, USA, [2]Mixed-Methods Research Laboratory, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Adolescents with obstructive sleep apnea (OSA) represent an important but understudied subgroup of long-term Continuous Positive Airway Pressure (CPAP) users. Adolescents may have unique beliefs and perceptions regarding using CPAP. The purpose of this qualitative study was to identify factors related to adherence by interviewing adolescents and their family caregivers.
Methods: Individual open-ended, semi-structured interviews were conducted with adolescents (n=10) and caregivers (n=10). Adolescents were asked reasons for adhering to CPAP and caregivers were asked for their perspective. Objective adherence data from the adolescents' CPAP machines during the previous month was obtained. All interviews were audio recorded and transcribed verbatim. Using a modified grounded theory approach, common issues emerged through a close reading of the text and themes were identified. We developed theories to explain the adolescents' adherence patterns.
Results: Adolescent participants (n=10) were obese (body mass index [BMI] ≥ 95th percentile) aged 14-18 years, males (n=7), African-American (n=7), users of CPAP for at least one month. Caregivers included 7 biological mothers, 2 biological fathers, and 1 aunt. Eight adolescents had poor adherence (mean use 10.8 ± 12.4 minutes per night) and 2 had good adherence (mean use 422 ± 50.1 minutes per night) during the month prior to their interview. Adolescents with suboptimal adherence described having poor communication with their caregivers. The adolescents did not feel they could speak freely about problems in their lives including their CPAP use, but this was not recognized by their caregivers. Communication about use of the machine was perceived as nagging rather than caring, which was the caregivers' stated intent.
Conclusion: Qualitative analysis of the data leads to the emerging theory that poor adolescent-caregiver communication is an important reason for suboptimal CPAP adherence. As adolescent adherence is clearly multifactorial, future studies should examine this theory and others to investigate more differences between optimal and suboptimal adherers.
Support (If Any): T32-HL007713-19, RO1 HL58585.

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PARENTAL RATINGS OF EXECUTIVE FUNCTIONING IN SCHOOL-AGED CHILDREN PRIOR TO INITIATING CPAP TREATMENT

Sorensen ST[1], Wences M[2], Kim H[2], Archbold K[2]
[1]Department of Disability and Psychoeducational Studies, University of Arizona, Tucson, AZ, USA, [2]College of Nursing, University of Arizona, Tucson, AZ, USA

Introduction: Numerous studies have investigated the neurobehavioral consequences of obstructive sleep apnea (OSA) using parental report measures, however few studies have utilized measures specifically intended to assess executive functioning deficits. The current study describes sample characteristics, sleep parameters, and parental ratings of executive functioning using the parent report of the Behavior Rating Inventory of Executive Function (BRIEF), in school-aged children (aged 6 to 12) prior to initiating continuous positive airway pressure (CPAP) treatment for OSA.
Methods: Baseline data was obtained through demographic questionnaires and the BRIEF within one week of undergoing in-lab polysomnography (PSG) following an adaptation night. All children were without significant medical comorbidities, had not previously received treatment for a sleep disorder, and met criteria for OSA based on having a respiratory distress index (RDI)≥1.5. Data analysis includes descriptive and one-sample Wilcoxon signed rank nonparametric tests.
Results: As part of an ongoing study, data was analyzed from 10 participants(11.1% female; 55.5% Hispanic, 11.1% African American/Black, 11.1% Native American, 22.2% Caucasian/White;(mean±SD) (8.5±1.6) years. Compared to the normative sample, participants (N=9) were ranked to have significantly higher scores on all primary scales of the BRIEF compared to the normative sample (T=50±10); Behavior Regulation Index (BRI) (68.8±7.2),p=.011, Metacognition (MI) (67.3±12.8),p=.015, and the Global Executive Composite (GEC) (63.6±7.7) p=.007, with all ranked scores falling above the median for GEC and 1 rank below for BRI and MI. Sleep parameters were available for N=6 participants RDI(7.9±7.2).
Conclusion: Consistent with previous research on parental reports in youth with sleep disordered breathing; the current study found on average parental reports of executive functioning on the BRIEF were approximately 1.5 SD higher than the normative sample, with higher scores indicating increased behaviors associated with executive dysfunction. Additionally, a large percentage of the sample met clinically significant criteria (T>65) for clinical impairment on the BRIEF (BRI=44.4%, MI=77.8%, GEC=66.7%).
Support (If Any): HL 102151.

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USE OF AUTO-TITRATING CONTINUOUS POSITIVE AIRWAY PRESSURE (AUTOCPAP) IN CHILDREN WITH SLEEP-DISORDERED BREATHING (SDB)

Amos L[1], Baughn JM[1], Flint KL[3], Grekowicz M[1], Kuhn EM[2], Norins NA[1], Olstad JD[2], D'Andrea LA[1]
[1]Pediatrics, Medical College of Wisconsin, Milwaukee, WI, USA, [2]Outcomes, Children's Hospital and Health System, Milwaukee, WI, USA, [3]Children's Hospital of Wisconsin, Milwaukee, WI, USA

Introduction: It has been suggested that autoCPAP may be safely initiated in children with obstructive sleep apnea (OSA) awaiting an attended CPAP titration study, and may also benefit children with fluctuating pressure need due to sleep stage or position, anticipated weight loss, or changing upper airway patency (e.g. adenotonsillectomy). We describe children treated with autoCPAP due to the aforementioned conditions, symptom improvement, and adherence to therapy.
Methods: This is a retrospective study of 13 children on autoCPAP who were enrolled in our noninvasive PAP program between April 2006 and September 30, 2011. Statistical analysis was performed using SAS v9.1.
Results: Thirteen children (7 boys) with a mean age of 13.7 yrs. (range 9.1-17.7 yrs.) used autoCPAP. Twelve had OSA. One child had chronic respiratory insufficiency following a complicated pneumonia. Over 2/3 of children had ≥2 medical diagnoses: 10 were obese, 6 had asthma and 4 had acyanotic heart disease. Eight children (61.5%) underwent adenotonsillectomy; most had surgery before starting autoCPAP, but 1 was started on autoCPAP pre-operatively due to severe OSA and anticipated decreased pressure need after surgery. Other reasons for autoCPAP included long wait until titration study (N=3), variable pressure need based on sleep stage or position (N=2), obesity and anticipated weight loss (N=1), inability to sleep in the sleep lab (N=3) , and suboptimal titration during an attended titration study (N=3). At the 1st PAP clinic visit (N=11), 63.6% had improvement in nighttime symptoms, and 45.5% had improvement in daytime symptoms. Most (72.7%) were compliant with autoCPAP 6-7 nights/week; of these, 75% used the autoCPAP all night.
Conclusion: AutoCPAP effectively treats pediatric OSA, with good adherence and symptom management. Under certain circumstances, autoCPAP may be a cost-effective and medically necessary alternative to standard CPAP.

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PREVALENCE OF PLMS IN THE PEDIATRIC POPULATION AFTER INITIATION OF PAP THERAPY

Pai V, Khatwa UA, Fitzgerald R, Kothare SV
Sleep Medicine, Children's Hospital Boston, Boston, MA, USA

Introduction: Positive-airway-pressure (PAP) is a known treatment for obstructive-sleep-apnea (OSA). In adults, initiation of PAP-therapy has been shown to unmask periodic-limb-movements-of-sleep (PLMS); the exact mechanism of this remains unclear. We present our experience in assessing the prevalence of PLMS in the pediatric population after initiation of PAP-therapy.
Methods: Retrospective analysis was performed on children who had PAP-studies performed over the past 3-years. Children found to have mild-severe OSA without significant PLMS on baseline studies who then showed a periodic-limb-movement-index (PLMI) (>5/hr) during titration with PAP-therapy were identified. Data from previous and follow-up polysomnograms were reviewed from the electronic-medical-records for demographics, severity of OSA based on apnea hypopnea index (AHI), PLMI, PLM-arousal-index (PLMAI) and pressures titrated.
Results: Of the 214 PAP-titration studies (CPAP=151, BiPAP=63) performed over 3 years at our institution, 11 children (10 CPAP and 1 BiPAP) fulfilled the study criteria. Of these, 8 were boys and the median age was 12 years (range 6 months - 18 years). On baseline studies, the median AHI was 5/hour (range 1.5-32/hr) and the median PLMI was 1/hour (range 0-4/hour). On titration studies, pressures ranged from 4- 14 cm, median AHI was 0.5/hour (range 0-1), median PLMI 12/hr (range 5-55/hr) and median PLMAI 9/hr (range 0-25/hr). PLMS were seen predominantly during N1, 2 sleep and on PAP of > 7 cm. One patient was found to have resolution of PLMS on a one-year follow-up study.
Conclusion: PLMS were seen in 5.1 % of children after initiation of PAP. OSA may mask PLMS which appear during PAP-titration as breathing improves. Alternatively, PAP may unmask or induce PLMS. Habituation on PAP-therapy was seen to resolve PLMS in 1 patient. Clinicians should recognize PLMS as a potential cause of persistent daytime-sleepiness despite effective control of OSA with PAP.

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BASELINE CHARACTERISTICS OF GENERAL INTELLIGENCE, ACHIEVEMENT, AND SCHOOL COMPETENCE IN SCHOOL-AGED CHILDREN PRIOR TO INITIATING PAP TREATMENT

Sorensen ST, Wences M, Kim H, Archbold K
University of Arizona, Tucson, AZ, USA

Introduction: Obstructive sleep apnea (OSA) in school-aged children has been linked to reduced performance on measures of academic achievement, intelligence, and increased school problems. However baseline measures have not been described in children prior to undergoing PAP treatment. The present study describes general intelligence, academic achievement, and school problems in a sample of school-aged participants prior to initiation of PAP treatment.
Methods: Participants were administered a testing battery prior to initiating PAP treatment and within one week of full polysomnography. General intelligence was assessed using the Kaufman Brief Intelligence Test-Second Edition (KBIT-2), academic achievement with the Woodcock Johnson Test of Achievement-Third Edition (WJ-III ACH), and parent reported school competence with the Child Behavior Checklist (CBCL 6-18). All participants were free from significant medical condition, met criteria for OSA based on an RDI of 1.5 events or more per hour of sleep, and had not previously had CPAP treatment. Descriptive statistics are reported and one-sample Wilcoxon signed rank tests were used to compare participants (N=10) to normative samples.
Results: Compared to the normative sample (mean±SD)(100±15) participants(11.1% female; 55.5% Hispanic, 11.1% African American/Black, 11.1% Native American, 22.2% Caucasian/White; (8.5±1.6) years) ranked significantly lower on the WJ-III ACH test of Understanding Directions (82.7±21.3) (observed median=92, p=.006) with all scores falling below the hypothetical median(100). As part of the CBCL school competence measure, 40% of the sample (N=4) demonstrated elevated behavior problems in school. Ranks were not significantly lower on KBIT-2 Composite IQ (94.6±10.8). Significant differences in rank were not observed on additional WJ-III ACH, CBC-L measures or KBIT-2 indices.
Conclusion: Consistent with findings that frontal lobe-mediated tasks may be significantly lower in children with OSA, participants in the current study demonstrated significantly low ranks on a task requiring working memory and processing of complex linguistic directions prior to initiation of PAP therapy.
Support (If Any): HL 102151.

1149

MEDICALLY COMPLEX CHILDREN WITH SLEEP DISORDERED BREATHING CAN BE EFFECTIVELY TREATED WITH NONINVASIVE POSITIVE AIRWAY PRESSURE

Baughn JM[1], Amos L[1], Grekowicz M[1], Kuhn EM[2], Norins NA[1], Olstad JD[2], D'Andrea LA[1]
[1]Pediatric Pulmonary and Sleep Medicine, Medical College of Wisconsin, Milwaukee, WI, USA, [2]Outcomes Department, Children's Hospital of Wisconsin, Milwaukee, WI, USA

Introduction: Indications for noninvasive positive airway pressure (PAP) in pediatrics have broadened from treating obstructive sleep apnea (OSA) to managing various forms of sleep disordered breathing, often in children with complex medical conditions. We describe the patient population in a large noninvasive PAP program at a regional pediatric sleep center, treatment process, and outcomes (e.g. symptom improvement, PAP compliance).
Methods: This is a retrospective study of 22% (n=60) of 268 children enrolled in our noninvasive PAP program between April 2006 and September 30, 2011. Records were randomly selected for review. Statistical analysis was performed using SAS v9.1.
Results: Sixty children (27 boys) with a median age of 15 years (range 6 mo to 21 yr) were studied. Primary indication for PAP therapy included OSA (75%), altered respiratory mechanics (13%), or hypoventilation (12%). All children had a co-morbid medical (97% of children), mental health (58%), and/or non-respiratory sleep disorder diagnosis (30%). Of the children with a co-morbid medical diagnosis, 60% had two or more diagnoses; most common diagnoses included obesity, asthma, and neurologic disorders. Two thirds of children had prior airway surgery (e.g. T&A). In addition to CPAP, PAP modes included BIPAP (32%), and Auto CPAP (12%). At the first PAP clinic visit (N=51), 59% of children had improvement in nighttime symptoms; 49% had improvement in daytime symptoms. Over half the children were compliant with PAP 6 to 7 nights/week and of these, 72% used PAP the entire night. Overall, 81% of children who wore PAP the entire night most nights of the week had improvement in symptoms. Adherence to CPAP at the first clinic visit was associated with on-going adherence at the second visit ($p<0.05$). PAP therapy was started in either the inpatient (30%) or outpatient (70%) setting.
Conclusion: Medically complex children with sleep-disordered breathing can be successfully managed in a pediatric noninvasive multidisciplinary PAP program with good adherence to treatment and improvement of symptoms.

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BASELINE PERFORMANCE ON THE CAMBRIDGE AUTOMATED NEUROPSYCHOLOGICAL TESTING BATTERY (CANTAB) IN SCHOOL-AGED CHILDREN PRIOR TO INITIATION OF PAP THERAPY FOR OSA

Archbold K, Sorensen ST, Kim H, Wences M
College of Nursing, University of Arizona, Tucson, AZ, USA

Introduction: Obstructive sleep apnea (OSA) is known to negatively affect spatial planning, spatial working memory and working memory levels in school-aged children, but little is known about levels of impairment prior to initiation of PAP therapy for OSA. The purpose of this study was to describe patterns of neurocognition in school-aged children prior to initiation of PAP therapy for OSA.
Methods: Nine children ((mean ± SD) 8.5 ± 1.6 years, 2 females) from the on-going Children's Apnea Treatment Study (Sleep CATS) were administered the Kaufman Brief Intelligence Test, 2nd edition (KBIT-2), Cambridge Automated Neuropsychological Testing Battery (CANTAB) then subsequently underwent full in-lab polysomnography to determine percentage of time spent in N1, N2, N3 and REM sleep, respiratory distress index (RDI), arousal index (AI) and minimum percent oxygen saturation levels (MinO2). The CANTAB battery consisted of tests of spatial planning (Stockings of Cambridge (SOC)), spatial working memory (SWM), and working memory capacity (spatial span (SSP)). Z-scores were computed for all raw scores in the CANTAB battery.
Results: Children spent an average of 14% (±4) of total sleep time in N1, 36% (±8) in N2, 34% (±7) in N3 and 16% (±2) in REM sleep. Mean RDI, AI and MinO2 were 7.9 ± 7.2, 20.8 ± 8.9, and 85.5 ± 8.5, respectively. Average composite KBIT-2 score was 94.6 ± 10.8. For the CANTAB battery tests: raw SOC score (number of problems solved in minimum number of moves) 4.9 ± 1.4, z = -1.1 ± 0.6; raw SWM score (strategy) 40.8 ± 2.8, z = -1.1 ± 0.8; raw SSP score (span length) 4.6 ± 1.8, z = -0.45± 1.2.
Conclusion: Children with OSA who are preparing to undergo treatment for OSA demonstrate below average performance levels on computerized tests of spatial planning, spatial working memory and working memory capacity.
Support (If Any): HL 102151.

1151

CONTINUOUS POSITIVE AIRWAY PRESSURE REQUIREMENTS IN THREE GROUPS OF CHILDREN: OBESE, NON-OBESE AND CHILDREN WITH DOWN SYNDROME

Alajmi M[2,1], Schmalz L[1,2], Nettel-Aguirre A[2], Kirk V[2,1]
[1]Alberta Children's Hospital, Calgary, AB, Canada, [2]Pediatrics, University of Calgary, Calgary, AB, Canada

Introduction: Continuous positive airway pressure is becoming the mainstay of treatment of obese children and those with Down syndrome who have obstructive sleep apnea. However, no studies have looked into the most frequently prescribed pressure settings to treat these groups. This study is conducted to look into patient and polysomnographic variables that may predict required continuous positive airway pressure among obese and non-obese children as well as those with Down syndrome.
Methods: A retrospective study was performed in children, aged 1-18 years, prescribed continuous positive airway pressure to treat sleep apnea between 1997 and 2011. Children were categorized into one of three groups: obese, non-obese and Down syndrome. Children with confounding factors contributing to OSA were excluded from the study. Demographic and polysomnographic data were extracted from a computerized database and subject sleep files.
Results: A total of 1027 children were prescribed PAP therapy during the inclusion period. 251 met inclusion criteria and were divided into the three groups as follows: Obese (n = 49), Non-obese (n=91), Down syndrome (N=111). Mean positive airway pressure requirement identified by laboratory titration study in the three groups was 8.00, 7.00 and 8.00 centimeters of water respectively. ANOVA testing and Tukey Honest Significant Differences, confirmed a statistically significant difference between both the obese and Down syndrome groups and the non-obese group with less positive airway pressure requirement in the latter group. There were no other statistically significant differences between the three groups.
Conclusion: Continuous positive airway pressure requirements are similar among children with obesity or Down syndrome. Non-obese children require statistically significant lower pressure settings however, the clinical significance of one centimeter of water pressure is unlikely.

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A THEORETICAL MODEL OF PARENTAL COGNITIONS AND CHILDREN'S SLEEP

Coulombe A[1], Corkum PV[1,2], Reid GJ[3,4], Bessey MA[1]
[1]Psychology, Dalhousie University, Halifax, NS, Canada, [2]Pediatrics, IWK Health Centre, Halifax, NS, Canada, [3]Psychology, The University of Western Ontario, London, ON, Canada, [4]Family Medicine, The University of Western Ontario, London, ON, Canada

Introduction: Approximately 30% of children experience disrupted or inadequate sleep. Given the importance of sleep to development, physical and mental well-being, there is a need to identify factors that predispose children to inadequate sleep, factors that precipitate and perpetuate these problems, and factors that pose barriers to effective intervention. Because parents are primarily responsible for providing the environment in which children's sleep occurs, there is increasing interest in understanding the role of parenting in children's sleep. Although the role of parental cognitions in general parenting is well established, the role of parental cognitions in night-time parenting has been largely unexplored.
Methods: Literature from multiple research areas (i.e., general parenting, adult sleep and insomnia, and pediatric sleep) was reviewed and integrated to create a model of parental cognitions and children's sleep. In progress and recently published empirical and qualitative research conducted by the authors (Coulombe, Corkum, Reid, Bessey) was also incorporated into the model. A cognitive behavioral framework was used to guide model development from both a theoretical and applied perspective.
Results: A theoretical model of parental sleep-related cognitions as predisposing, precipitating, and perpetuating factors in children's sleep was created. In this model, multiple parental cognitions are explored, including knowledge and beliefs, agreement with common sleep strategies (e.g., co-sleeping vs. "crying it out"), and thoughts and feelings that occur to parents during night-time interactions with their child. Potential behavioural and affective implications of the model are highlighted, with a specific focus on the role of cognitive factors in determining parents' sleep-related parenting behaviours. Implications for prevention and intervention are discussed.
Conclusion: The proposed model requires empirical investigation. The role of parental cognitons in night-time parenting and in children's sleep is a promising area of research. Greater clarity and consistency in the operationalization of parents' sleep-related cognitive constructs is necessary to advance the field.

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LONGITUDINAL DEVELOPMENT OF NREM DELTA AND THETA POWER: AGES 6 - 18 YEARS

Feinberg I, de Bie E, Campbell IG
Psychiatry, University of California–Davis, Davis, CA, USA

Introduction: The slow (delta and theta) EEG frequencies of NREM sleep are remarkably sensitive to post-natal maturational changes in the human brain. Because these frequencies also behave recuperatively ("homeostatically") their age changes also bear importantly on sleep

theory. We therefore studied the changes in delta and theta power across childhood and adolescence.
Methods: Ambulatory recording of all-night sleep EEG in 3 overlapping cohorts (C): C6: 6-9.5 yrs; C9: 9-16 yrs; C12: 12-18 yrs; total N=95. Subjects were studied twice-yearly while sleeping at home on their school-night schedules. Digitized EEG was scored visually as NREM/REM/waking. Artifact-free NREM epochs were analyzed with FFT (PASS PLUS, St. Louis). Power in 1-4 and 4-8 Hz was summed for the first 5 h of NREM sleep.
Results: We previously reported that theta power begins its age decline before delta. Our C6 data, reported here for the first time, confirm this difference. Thus, theta power declined linearly ($p<0.0001$) across ages 6 - 9 yrs. In contrast, delta power increased and then declined, exhibiting a significant ($p=0.0040$) curvilinear age trend with a peak at age 7.9 years. As previously reported, power in both frequencies declined steeply between ages 12 and 16.5, defining this as a critical period for adolescent brain development.
Conclusion: Although delta and theta EEG both behave recuperatively with respect to waking, their developmental age patterns differ. We have proposed that delta power is proportional to cortical synaptic density. The increase in delta power until age 8 would indicate that cortical synaptic proliferation continues into mid-childhood. Subsequently, synaptic pruning decreases the size of the neuronal pools generating EEG waves and also reduces the intensity (CMRO2) of waking brain activity. Less intense waking brain activity decreases the need for sleep recuperation. A later decline in delta than theta power may indicate that delta reflects maturation of more plastic brain systems.
Support (If Any): PHS grant R01MH062521.

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A NEW INSTRUMENT FOR ADOLESCENT SLEEP ROUTINES EVALUATION

Pinto TR[1,2], Rebelo Pinto H[1], Paiva T[1,2]
[1]Sleep Medicine Center, CENC, Lisbon, Portugal, [2]Sleep Sciences, Lisbon Medical Faculty, Lisbon, Portugal

Introduction: Sleep deprivation and bad sleep habits in adolescence have become a preoccupying reality. The worries are nowadays world wide but efficient tools or strategies to modify the current status are lacking. What makes adolescents disregard the importance of sleep health, choosing instead activities incompatible with good sleep? The answer remains a work in progress, but this project may help, since it aimed to pre-validate a questionnaire to evaluate what's wrong about adolescents' sleep routines.
Methods: During the Sleep-Schools Project, a sample of 63 participants was selected to respond a pilot test: the Adolescent Sleep Routines Questionnaire (ASRQ). This instrument was based on the conceptual framework of the Project, regarding 3 major dimensions (Sleep Habits, Environmental Factors, Personal Factors) and 9 sub-dimensions (sleep duration, regularity, autonomy, room organization, meals, activities, emotions, sleep knowledge and sleep problems). Adolescents were asked to classify 27 items concerning the previous aspects, responding how frequently they occurred. Higher scores indicate worst sleep routines. Cleveland Adolescent Sleepiness Questionnaire was used to compare results. The participants were from 11th (39%) and 12th (61%) grade, with ages from 16 to 18 (35% male and 65% female).
Results: ASRQ proved to be an effective tool to evaluate adolescents' sleep routines. Worst sleep routines were correlated with greater daytime sleepiness ($Rs=0.447$, $p=0.01$), particularly in what concerns bad sleep habits ($Rs=0.436$; $p=0.01$). Correlations between items and sub-scales support the conceptual framework: items 1-9 were more correlated with Sleep Habits, items 10-18 with Environmental Factors and items 19-27 with Personal Factors.
Conclusion: The conceptual framework of the Sleep-Schools Project has been proving to be effective in sustaining the development of new instruments in Sleep field. ASRQ should be validated properly with a bigger sample.
Support (If Any): Sleep Medicine Center, CENC Students engaged in collecting data.

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DEVELOPMENT OF THE SLEEP ATTITUDES AND BELIEFS SCALE

Bessey MA[1], Corkum PV[1], Coulombe A[1], Smith I[2,1]
[1]Psychology, Dalhousie University, Halifax, NS, Canada, [2]Pediatrics, IWK Health Centre, Halifax, NS, Canada

Introduction: Sleep problems are common among typically developing (TD) school-aged children and children with special needs, including attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorders (ASD). Parents' beliefs and attitudes may contribute to children's sleep problems and affect treatment utilization and adherence. However, there is no measure of these cognitions for parents of school-aged children.
Methods: The sleep attitudes and beliefs scale (SABS) was developed and administered to parents of TD children ($n = 179$) and parents of children with ADHD and ASD (ADHD, $n = 84$; ASD, $n = 92$). Exploratory factor analyses were conducted to assess the factor structure of the SABS. Inter-item correlations and alpha values were computed to assess the reliability of the SABS subscales. Total scores on the extracted factors were calculated and compared among the three groups (TD, children with ADHD, children with ASD), providing an assessment of construct validity.
Results: The final SABS has four subscales: 'sleep impact', 'nature of sleep problem', 'responsiveness to treatment', and 'sleep modifiability', all demonstrating good reliability ($\alpha = 0.64$ to 0.84). Compared to parents of TD children, parents of children with special needs (ADHD and ASD combined) provided higher ratings on scales indicating the belief that sleep problems are more intrinsic ($t(352) = -5.46$, $p < .001$), less modifiable ($t(352) = -6.07$, $p < .001$), and not as responsive to treatment ($t(352) = -3.67$, $p < .001$). Moreover, parents of children with ASD reported a stronger belief that sleep problems were intrinsic, compared to parents of children with ADHD ($t(352) = 2.94$, $p = .003$).
Conclusion: The preliminary psychometric properties of the SABS are promising. The clinical utility of the SABS, including examining the potential role of beliefs and attitudes in the development, maintenance, and treatment of children's sleep problems, warrants further study.
Support (If Any): This research was funded by Dalhousie University.

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CONFIRMATORY FACTOR ANALYSIS OF THE ADOLESCENT SLEEP HYGIENE SCALE (ASHS)

Storfer-Isser A[1], LeBourgeois MK[2], Harsh J[3], Redline S[4,5,6]
[1]Psychology, Bowling Green State University, Bowling Green, OH, USA, [2]Department of Integrative Physiology, University of Colorado at Boulder, Boulder, CO, USA, [3]Department of Psychology, The University of Southern Mississippi, Hattiesburg, MS, USA, [4]Department of Medicine and Division of Sleep Medicine, Harvard Medical School, Brigham and Women's Hospital and Beth Israel Deaconess Medical Center, Boston, MA, USA, [5]Case Center for Transdisciplinary Research on Energetics and Cancer, Case Western Reserve University, Cleveland, OH, USA, [6]Center for Clinical Investigation, Case Western Reserve University, Cleveland, OH, USA

Introduction: Inadequate and/or poor quality sleep in adolescence is influenced by developmental changes in sleep and circadian physiology, social factors (e.g., early school start times) and behavioral practices (e.g., sleep hygiene). Methods for accurately and reliably measuring adolescent sleep hygiene may help characterize risk factors for sleep problems and assist with evaluating the impact of behavioral sleep inter-

ventions. This study examined the factor structure, internal consistency, and concurrent validity of the adolescent sleep hygiene scale (ASHS).
Methods: Data were collected on 514 adolescents (50% female) aged 16-19 (17.7+0.4 years) participating in a longitudinal study of sleep and health. Confirmatory Factor Analysis (CFA) was used to examine the conceptually-based factor structure of the ASHS. Concurrent validity with objective sleep measures from actigraphy, behavioral measures from the Child Behavioral Check List, and subjective self-reported sleepiness from the Epworth Sleep Scale were examined with Spearman correlations.
Results: CFA results were consistent with the original factor structure for 6 of the 8 domains (physiological, sleep environment, daytime sleep, substances, bedtime routine, and sleep stability). The factor structure of two other domains (cognitive and emotional) was revised. Three of six items on the cognitive factor loaded on a new behavioral arousal factor, while the remaining items loaded on a cognitive/emotional factor. Internal consistency reliability for the total score (Cronbach's α=0.82) and the 8 scales were adequate (α: 0.60-0.78). A better total sleep hygiene score was significantly associated with fewer internalizing (r=-0.16) and externalizing (r=-0.20) problems, greater school competence (r=0.26), longer weekday sleep duration (r=0.16), better sleep efficiency (r=0.11) and less sleepiness (r=-0.26; all p's <0.05).
Conclusion: The 8-factor ASHS has adequate reliability and validity for research instruments used to assess adolescent sleep hygiene and improve our understanding of factors that influence sleep quality, sleep quantity, and sleep/wake regulation during adolescence.

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MATURATIONAL CHANGES IN SLEEP SLOW WAVE ACTIVITY TOPOGRAPHY PRECEDE SKILL MATURATION AND CORTICAL THINNING

Kurth S[1,2], Ringli M[1], Geiger A[1], Buchmann A[3], Jenni OG[1], LeBourgeois MK[2,4], Huber R[1]
[1]Child Development Center, Children's Hospital Zurich, Zurich, Switzerland, [2]Department of Integrative Physiology, University of Colorado, Boulder, CO, USA, [3]Department of Psychiatry, University of Wisconsin-Madison, Madison, WI, USA, [4]Department of Psychiatry and Human Behavior, Brown University, Providence, RI, USA

Introduction: Slow wave activity (SWA), the major marker of the deep NREM sleep EEG (1-4.5 Hz), has been suggested to reflect cortical plasticity. It was recently shown that the topographical distribution of SWA undergoes pronounced changes across childhood that seem to parallel regional cortical thinning.
Methods: To investigate the temporal relationship of maturational changes in sleep SWA, cortical morphology and cortical function, we measured all-night high-density sleep EEG (128 electrodes), anatomical magnetic resonance images (MRI) and behavioural skills in subsets of developing subjects (n=63, 2-26y). Electrodes were co-registered with T1 MR images and Brodmann areas (BAs) underlying all electrodes were identified. Based on BAs, regions of interest were defined, e.g. 27 electrodes over the motor cortex, BAs 1-4,6). The maturational stage of SWA topography was determined based on the region exhibiting maximal SWA, and a maturation index was calculated (SWAMI). The maturation of cortical morphology was quantified as cortical thickness.
Results: In relation to the maturation of the motor cortex, a regression (quadratic: y=a*x2+b*x+c) was performed for SWAMI, gray matter thinning and motor skills (8-26y, z-scored data). SWA topography matured first (SWAMI reached a maximum at 21y), then skills (maximum at 24y), and cortical thickness matured last (maximum at 26y or later). Exponential curve fitting including a broader age range (2-26y) revealed that the maturation of SWAMI reached the maximum about 3y prior to the maturation of skills.
Conclusion: SWA maturation might reflect maturational processes involved in the refinement of cortical connectivity related to the improvement of cortical functioning. Our data reveals that SWA topography matures first, followed by skills, and cortical thickness matures last. In the future, SWA topography might thus be used as a prognostic tool.

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MEASUREMENTS OF NORMAL NASAL AIRWAY ASSESSED BY 3-DIMENSIONAL COMPUTED TOMOGRAPHY IN CHINESE CHILDREN AND ADOLESCENTS

Lu X[1], Li H[1], Sun H[1], Shi H[2]
[1]Oral & Maxillofacial Surgery, Affiliated Shanghai 9th People's Hospital, Shanghai Jiaotong University, Shanghai, China, [2]Radiology, Affiliated Shanghai 9th People's Hospital, Shanghai Jiaotong University, Shanghai, China

Introduction: To establish normative data of nasal airway dimensions in east Chinese children and adolescents by age and sex.
Methods: CT-scans of 281Chinese children and adolescents (140 girls, 141 boys) aged from 6 to 18 were selected among the patients who visited in Shanghai Ninth People's Hospital from September 2009 to August 2010. Child was defined as 6 to 12 years(yr), and adolescent as 13 to 18 yr. All the subjects were divided into 4 groups according to age as 6 to 9, 10 to 12, 13 to 15 and 16 to 18. Nasal parameters were as follow: nasal volume (NV), nasal depth (ND), minimal cross-section area (S1) and its location (D1), inferior turbinate head's location (D2) and its airway cross-section area (S2).
Results: There was no difference in parameters between genders in children (group 1 and group 2). In adolescents, male's nasal dimension were larger than female's. NV, ND, S1 and D1 were correlated with age in male and female respectively.
Conclusion: Volume, depth and minimal cross-section area of nasal airway were correlated with age. In children, nasal conformations of male and female are similar. In adolescents, significant sex dimorphism in nasal parameters were evident.

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PEDIATRIC CENTRAL SLEEP APNEA AND NEUROIMAGING

Foreman A, Hopkins B, Smith E
Children's Sleep Center, Texas Children's Hospital, Baylor College of Medicine, Houston, TX, USA

Introduction: Central sleep apnea (CSA) is thought to be related to abnormalities involving the central nervous system. Although neuroimaging is often recommended, data to guide when this imaging is necessary are lacking. This study evaluated the characteristics of CSA and their association with neuroimaging.
Methods: Diagnostic polysomnograms with a diagnosis of CSA and a CA index of at least 1.0 from July 1, 2010 to June 30, 2011 at Texas Children's Hospital were included. 170 patients (age 0-18 years) were identified and their medical records reviewed. Parameters evaluated included: CA index, arousal index, obstructive RDI, longest central apnea, posterior dominant rhythm, O2 nadir, highest ETCO2, periodic limb movement index, and comorbid neurological and cardiopulmonary diagnoses. These findings were compared to MRI findings (not done, normal, abnormal anterior fossa, and abnormal posterior fossa).
Results: Of 170 patients, 87 had a brain MRI performed. 17/87 (19.5%, 95% CI 12-29%) had an abnormal posterior fossa. Of these, the average CA index was 5 (95% CI 2.14-7.86) and for normal MRIs, the average CA index was 6.87 (95% CI 1.7-12). Additionally, CA index, CA duration, O2 nadir, and obstructive RDI were equally non-predictive for comorbid neurological diagnosis, abnormal MRI, or abnormal posterior fossa. There was a 6.6-fold increase in the odds of having an abnormal MRI in the presence of a neurological diagnosis (75%, 95% CI 65-86%, p = 0.001), but 32% of those without a neurological diagnosis had an abnormal MRI (95% CI 12-51%).
Conclusion: At this time, MRI should still be considered as part of the work-up for central sleep apnea in children. No indices of central sleep apnea can be used to predict whether an MRI will be normal or abnor-

mal. Prospective neuroimaging studies of children with sleep disordered breathing are necessary.

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SUBJECTIVE SLEEP QUALITY AND DURATION IS ASSOCIATED TO GREY MATTER VOLUME IN EARLY PUBERTAL ADOLESCENT: A VOXEL-BASED MORPHOMETRY STUDY

Massicotte-Marquez J[1,2,3], Artiges E[3], Miranda R[3], Gollier-Briant F[3], Paillere-Martinot M[3], Lemaitre H[3], Martinot J[3]
[1]Psychologie, Université de Montréal, Montréal, QC, Canada, [2]Laboratoire de recherche en neuropsychologie de la douleur, Centre de recherche de l'Institut universitaire de gériatrie de Montréal, Montreal, QC, Canada, [3]INSERM U-1000 Unité de recherche 'Imagerie & Psychiatrie', Université de Paris Sud et University Paris Descartes, Orsay, France

Introduction: Adults studies recently identified structural brain correlates of insomnia and their relation with insomnia severity. The present study evaluated relationships between subjective sleep quality and quantity, and cerebral grey matter volume in early pubertal adolescents.
Methods: 179 healthy adolescents, age range 13-15, completed the Pittsburgh Sleep Inventory Questionnaire (PSQI) and underwent structural magnetic resonance imaging scans using a 3 Tesla scanner. Using voxel-based morphometry, we examined relationships between regional volumes and PSQI scores and sleep duration. Additionally, we compared the regional volumes between sleep quality subgroups according to the PSQI (poor (≥ 6), moderate (3 - 5) and good (<3)), as well as between sleep duration subgroups (short (<7hrs), moderate (7hrs to <9hrs) and long (≥ 9hrs)). Statistical analyses were performed using SPM8 software. Voxel clusters within each structure of interest were compared by the surviving family-wise error (FWE) multiple comparison test and p level were set at 0.001.
Results: Lower score on the PSQI was associated with larger left precuneus whereas longer sleep duration was associated with larger left dorsolateral frontal region. Poor sleepers had reduced superior frontal region, precuneus and parahippocampic region compared to good sleepers, and smaller right insula than sleepers with moderate quality. Sleepers with moderate duration had larger medial orbitofrontal region and anterior cingulate region than short sleepers, and they had smaller superior prefrontal region, medial orbitofrontal region, dorsolateral frontal region, anterior cingulate region and left hippocampus than longer sleepers. No group differences were found for white matter volume.
Conclusion: As have been observed in adults with insomnia, sleep quality and duration in adolescents are associated with modifications in grey matter volume in key areas for emotion regulation, decision-making and stimulus processing. Future studies should investigate functional impact of these anatomical changes to better understand markers of susceptibility to insomnia and depression in youths.
Support (If Any): Study supported by Canadian Research Institutes of Health, Fonds de recherche en Santé du Québec, European Commission (Consortium IMAGEN project).

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SYMPTOMATIC SLEEP BRUXISM IN ADOLESCENTS: AN EXPERIMENTAL TRIAL WITH A MANDIBULAR ADVANCEMENT APPLIANCE

Carra M, Huynh N, Rompre PH, El Khatib H, Remise C, Lavigne G
Faculté de Médecine Dentaire, Universite de Montreal, Montreal, QC, Canada

Introduction: Sleep bruxism (SB) is a sleep-related movement disorder characterized by tooth grinding/clenching frequently associated with snoring, sleep-disordered breathing, and headaches. The study aimed at evaluating the efficacy of a mandibular advancement appliance (MAA) for the management of SB in symptomatic adolescents reporting frequent snoring and/or headache.
Methods: 16 adolescents (mean age 14.9±0.5) reporting SB, snoring and/or frequent headache (>1day/week) underwent 4 ambulatory polysomnographic recordings performed as baseline (1 night) and with the MAA worn during sleep (3 nights). The MAA was used in 3 different positions (FS-free splints; NP-neutral position; A50-advanced 50% of maximal protrusion) for a period of 1 week each in a randomized order (FS-NP-A50 or NP-A50-FS; to respect a titration order NP-A50). Headache complaints were evaluated by questionnaires the day of every PSG recordings.
Results: Overall, sleep variables were not different between the 4 nights. SB index (episodes/h of sleep) was decreased with the MAA, up to a 60% decrease when in the A50 position (p=0.004; ANOVA). Snoring (>3.5% of sleep time spent snoring) was observed in 9 subjects. This subgroup showed a significant improvement with the MAA, with a linear decrease of snoring reduction (-94%; p=0.01). Prior MAA, headache intensity was scored at 42.7±5 mm on a 0-100 visual analogue scale and was decreased by 57% in the 6 subjects reporting morning headache.
Conclusion: Short-term use of MAA appeared to reduce SB and improve snoring and headache complaints in adolescents. However, the interaction between SB, breathing during sleep and headache as well as the long-term efficacy and safety of MAA in adolescents need further investigations.
Support (If Any): Supported by CIHR, FRSQ-Oral Health and Bone Research Network; M.C. Carra receives a fellowship from Ministrere de l'Education, du Loisir et du Sport.

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RESISTIVE LOAD CORTICAL PROCESSING IN NORMAL CHILDREN

Tapia IE[1,4], Mcdonough J[1], Huang J[1], Davenport PW[2], Colrain IM[3], Marcus CL[1,4]
[1]Sleep Center, Division of Pulmonary Medicine, The Children's Hospital of Philadelphia, Philadelphia, PA, USA, [2]Department of Physiological Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL, USA, [3]Human Sleep Research Laboratory, SRI International, Menlo Park, CA, USA, [4]Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Respiratory-related evoked potentials (RREPs) are an objective measure of respiratory afferent information cortical processing. We have previously shown that children with the obstructive sleep apnea syndrome (OSAS) have blunted RREPs to inspiratory occlusion during sleep. However, RREPs to resistive load are unknown in children. Therefore, we decided to test normal children in this pilot study before expanding our research to OSAS. We hypothesized that in normal children during wakefulness, Nf peak amplitude was directly proportional to the resistive load magnitude.
Methods: Surface EEG activity obtained from EEG electrodes Fz, Cz, Pz during wakefulness was averaged. Subjects breathed via an oronasal mask. RREPs were produced with multiple short occlusions of the upper airway randomly alternated with interruptions of inspiration with known resistors of 20 (R20) and 30 cm H2O/L/s (R30). RREP peaks were determined using Neuroscan. Statistics: ANOVA repeated measures.
Results: Four normal non-snoring children (3 male, 1 female) were tested (mean age [SD] = 11.9 ± 2.5 years, AHI 0.3 ± 0.3/hour, airway resistance 3.4 ± 1.3 cm H2O/L/s). Occlusion trials resulted in oronasal mask pressure drops of -2.9 ± 1 cm H2O and Nf peak amplitude of - 5.4 ± 1.8 mV. R30 and R20 trials resulted in oronasal mask pressure drops of -2.1 ± 0.3 and -1.9 ± 0.2 cm H2O respectively. Nf peak amplitudes were -4.1 ± 1.4, and -3.4 ± 0.8 mV respectively. Pressure drop (p = 0.03) and Nf amplitude (p = 0.04) were significantly different between the 3 challenges. Post-hoc analysis confirmed that Nf amplitude and oronasal mask pressure drop were significantly different between occlusion and R20 trials (p = 0.02 and 0.04 respectively).

Conclusion: In normal children, Nf peak amplitude is directly proportional to the resistive load. Children with OSAS have innate increased upper airway resistance. Therefore, we speculate that they have impaired resistive load cortical processing during wakefulness.
Support (If Any): AHA 10CRP3760011 and NIH UL1RR024134.

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SLEEP VARIABILITY AND CARDIAC AUTONOMIC MODULATION IN ADOLESCENTS: THE PENN STATE CHILD COHORT STUDY

Liao D[1], He F[1], Shaffer M[1], Vgontzas AN[2], Calhoun S[2], Rodriguez-Colon S[1], Bixler EO[2]
[1]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA, [2]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA

Introduction: Data on cardiac autonomic modulation (CAM) impairment due to sleep problems in adolescents are limited. We report preliminary findings associating actigraphy-based 6-night sleep and sleep variability and CAM in the Penn State Child Cohort (PSCC) follow-up examination.
Methods: We used available data from the first 169 adolescents who have completed the follow-up examinations for this preliminary report. Actigraphy was used to record total sleep time and total in-bed time on a nightly basis for 7 consecutive days at home. We calculated sleep efficiency as "total sleep time/total in-bed time" (%). We used a mixed-effects model to calculate the average within-subject sleep efficiency and the within-subject variability of sleep efficiency. CAM was assessed by heart rate variability (HRV) analysis of normal R-R intervals from a 39-hour high resolution Holter. The HRV indices in frequency domain [high frequency power (HF), low frequency power (LF), and LF/HF ratio] and time domain [standard deviation of normal RR intervals (SDNN), and the square root of the mean squared difference of successive normal RR intervals (RMSSD), and heart rate (HR)] were calculated on a 30-minute basis (78 repeated measures). Day- and night-time HRV and sleep variability were analyzed using mixed-effects models.
Results: The mean age was 17.1 years (SD=2.0), with 44% female and 75% white. After adjusting for age, gender, and ethnicity, individuals with higher within-subject variability of sleep efficiency have lower HRV indices and higher HR, indicative of lower parasympathetic and higher sympathetic modulation. For example, for one unit increase in the within-subject variability of sleep efficiency, the regression coefficients (SE, p-value) were -0.29 ms2 (0.15, 0.05), -9.62 ms (3.75, 0.01), and -7.76 ms (3.67, 0.04) for day-time HF, SDNN, and RMSSD respectively.
Conclusion: Our data suggested an adverse association between night-to-night variability of sleep efficiency and CAM in healthy adolescents.
Support (If Any): NIH R01 HL603772, R01 HL97165, UL1 RR033184, C06 RR16499.

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UTILITY OF THE MAINTENANCE OF WAKEFULNESS TEST (MWT) IN ASSESSING TREATMENT EFFICACY & OPTIMIZING MANAGEMENT IN CHILDREN WITH NARCOLEPSY

Zandieh S[1,2], Khatwa U[1,2], Zarowski M[1], Kothare SV[1]
[1]Neurology, Children's Hospital Boston, Boston, MA, USA, [2]Division of Respiratory Diseases, Children's Hospital Boston, Boston, MA, USA

Introduction: In adults, maintenance of wakefulness test (MWT) is often used to assess efficacy of treatment for hypersomnia secondary to narcolepsy, or OSA on CPAP therapy, but has not been adequately utilized in children.
Methods: Retrospective chart review of children with narcolepsy who had an MWT performed from Jan 2008 to October 2011 was performed. Appropriate demographic data on these patients was also reviewed.
Results: Nine MWTs performed on 7 children (3 boys) with narcolepsy (6/7 with cataplexy) were identified. Mean age at time of study was 14 .3 years (range: 9-20y). Co-morbid conditions included Prader-Willi syndrome, bipolar and seizures disorder (n=1 each). Medications included stimulants (modafinil, n=4), SSRIs/TCIs (sertraline, venlafaxine; n= 2), and sodium oxybate (n=3). Median sleep latency was 16 minutes (range: 5.8-40 minutes); SOREMs seen in (2 of 9 studies); 5 out of 9 MWTs resulted in changes in management after study results.
Conclusion: MWT may be a useful test for assessing efficacy and response to treatment in children with narcolepsy and is feasible beyond 8 years of age. Depending on the results, changes in management can be made more objectively (power naps at lunch/after school, increase in medications in morning, or additional doses at lunch-time).

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MODAFINIL FOR THE TREATMENT OF HYPERSOMNIA IN CHILDREN: ONE CENTER'S EXPERIENCE

Kiel S[1], Foshee H[2], Makris CM[1], Maddox M[1], Bowman C[2], Avis K[1], Lozano DJ[1]
[1]Pediatrics, Pulmonary Division, University of Alabama at Birmingham, Birmingham, AL, USA, [2]Children's of Alabama, Birmingham, AL, USA

Introduction: Modafinil is a wake-promoting agent approved by the Food and Drug Administration (FDA) for treatment of narcolepsy and other disorders associated with excessive daytime sleepiness (EDS) in patients 17 years of age and older, and it is first line treatment for disorders of EDS in adults. To date, there is a paucity of data regarding modafinil use in children resulting in reluctance of third party payers to cover its use in pediatrics. This abstract reports our experience using modafinil to treat EDS in children.
Methods: Electronic medical records were queried for "Provigil"; 255 charts were identified and reviewed. Charts were excluded if patients were not followed in Sleep Clinic or the duration of modafinil treatment was not established. Data collected include demographics, diagnosis, treatment duration, adverse effects and reported efficacy.
Results: 165 records met inclusion criteria. Demographics included 98 males, 67 females; 81 African American, 84 Caucasian. Age at hypersomnia onset ranged from 2-20 years of age (average 11.78 years). 41 patients had narcolepsy, 97 had idiopathic hypersomnia, 17 had hypersomnia due to other primary sleep disorders, and 10 had EDS secondary to non sleep-related medical disorders. 147 patients were less than 17 years of age at initial exposure to modafinil. Treatment duration ranged from 4 weeks to 118 months (mean 30.9 months); 107 patients had a treatment exposure greater than 12 months. 21 patients reported adverse effects including headaches (2), behavioral changes (8), GI upset (9), insomnia (2), and rash (2). Modafinil was discontinued in 7 patients secondary to adverse effects; none was deemed serious. The majority of patients reported improvement in EDS symptoms and quality of life.
Conclusion: Modafinil is well-tolerated and effective and should be considered a first line therapy in the treatment of hypersomnia in children under 17 years of age.

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USE OF ANTI-CATAPLECTIC DRUGS IN PEDIATRIC NARCOLEPSY CLOSE TO DISEASE ONSET

Lecendreux M[2], Lavault S[1], Benazzouz F[1], Konofal E[1,2], Franco P[4], Dauvilliers Y[3], Arnulf I[1]
[1]Sleep Disorders Unit, Pitié-Salpêtrière Hospital, Paris, France, [2]Child and Adolescent Psychopathology, Robert Debré Hospital, Paris, France, [3]Department of Neurology, Gui de Chauliac Hospital, Montpellier, France, [4]Pediatric Sleep Unit, Femme-Mère-Enfant Hospital, Lyon, France

Introduction: Narcolepsy is a lifelong disorder where occurrence during childhood is frequent. If cataplexy is highly specific and mostly dis-

abling it is usually not the first symptom to appear. We were interested in evaluating the proportion of children who required anti-cataplectic medication soon after disease onset in a large cohort of pediatric patients in France.

Methods: Pediatric data of 89 young patients (7-18 y.o.) have been extracted from a National French multicentric research program on narcolepsy (PHRC AOM07-138) that has enrolled a cohort of 400 narcoleptic patients between 2008 and 2011.

Results: 27 patients not yet treated had recently been diagnosed and 62 patients were already known to our reference centre and were in treatment. Most cataplectic occurred at the age of 11±3 years, 2±2 years after sleepiness symptoms. Clear-cut cataplexy were reported in 82% of the cases at the first evaluation. A total of 23 patients (52% men) were treated for both excessive daytime sleepiness and cataplexy, and 39 patients (54% men) for sleepiness only. Patients receiving both treatments were older (16±2 vs. 14±3 y., p=0.04), had more severe cataplexy (more than 1/week before treatment; 90 vs. 57%, p=0.02) and tended to have more total cataplexy (82% vs. 58%, p=0.08) than patients treated simply for sleepiness. However, the two groups did not differ for BMI (24±5 for both), weight gain at disease onset (59% vs. 41%), age at sleepiness onset (10±3 years for both) and presence of hallucinations (44 vs. 36%), sleep paralysis (44 vs. 21%) or sleep drunkenness (44 vs. 36%). Mean age at onset of anti-cataplectic treatment was 13±3 years (age range: 7-17 yo). First line treatment was venlafaxine (n=12), tricyclic antidepressant (n=6), sodium oxybate (n=2), selective serotonin reuptake inhibitor (SSRI, n=1) and mazindol (n=1). The mean estimated improvement was 4.2±2.4 (EVA self rating scale 0-10). Treatment was interrupted due to adverse effects (n=5) and/or to lack of efficacy (n=6). No habituation has been reported.

Conclusion: More than one third of the children required an anti-cataplectic soon after diagnosis was made. Anti-cataplectic treatments showed a positive benefit/risk ratio with a mean duration of use of 15 months in our pediatric cohort. No severe adverse effect occurred and most of the reported side effects were transient and benign.

Support (If Any): PHRC AOM07-138, French health Ministry; promotor: Assistance Publique - Hôpitaux de Paris.

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POST (A) H1N1 PEDIATRIC NARCOLEPSY WITH CATAPLEXY: DATA FROM THE FRENCH COHORT NARCOBANK

Lecendreux M[2], Lavault S[1], Benazzouz F[1], Franco P[4], Arnulf I[1], Konofal E[1,2], Dauvilliers Y[3]

[1]Sleep Disorders Unit, Pitié-Salpêtrière Hospital, Paris, France, [2]Child and Adolescent Psychopathology, Robert Debré Hospital, Paris, France, [3]Department of Neurology, Gui de Chauliac Hospital, Montpellier, France, [4]Pediatric Sleep Unit, Femme-Mère-Enfant Hospital, Lyon, France

Introduction: Narcolepsy is a disabling chronic sleep disorder affecting ~5 per 10,000 individuals, with an incidence of narcolepsy with cataplexy to be 0.74 per 100,000 person-years and the onset is most typically in adolescents. Since the signal on a potential association between H1N1 vaccination and narcolepsy was raised in Sweden and Finland, additional cases have been reported in different countries over Europe and particularly in France. France was exposed to a large vaccination campaign from October to December 2009 specifically orientated towards children.

Methods: Pediatric data have been extracted from a National French multicentric research program on narcolepsy (PHRC AOM07-138) that has enrolled a cohort of 400 narcoleptic patients. Post H1N1 pediatric patients have been investigated between December 2009 and December 2011.

Results: Symptoms developed in 20 pediatric patients between December 2009 and December 2011 in previously healthy children and were immediately and abruptly severe. Cataplexy onset was assessed by clinical interview. All patients had been vaccinated with one or two injections of Pandemrix® (n=16) or Panenza® (n=4). Other potential triggering factors had been excluded by history taking. All patients showed normal brain MRI. All children currently investigated were HLA DQB1*0602 positive and hypocretin deficient. Gender or Tanner stage had no influence.

Conclusion: A severe and complete form of narcolepsy with cataplexy occured in all 18 children and adolescents within a few weeks or months following (A) H1N1 vaccination. We show here that narcolepsy-cataplexy occurs mainly after injection of adjuvant-containing vaccine but it also occurred in the absence of adjuvant (20% of the reported cases). The role of the H1N1 vaccine in the occurrence of these cases still needs clarification. Two ongoing epidemiological studies VAESCO (Europe) and Narcoflu (France) should provide additional data in the suggested association.

Support (If Any): PHRC AOM07-138, French health Ministry; promotor: Assistance Publique - Hôpitaux de Paris.

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THE EFFECT OF PSYCHIATRIC MEDICATIONS AND DIAGNOSIS ON THE MSLT IN PEDIATRIC PATIENTS PRESENTING WITH EXCESSIVE DAYTIME SOMNOLENCE

Splaingard ML[2], Robert K[1], Splaingard D[2], Klima J[2], Gandhi B[1], Dzodzomenyo S[4], Aliling J[3]

[1]Department of Psychiatry, Ohio State University, Columbus, OH, USA, [2]Department of Pediatrics, Nationwide Children's Hospital. Ohio State University, Columbus, OH, USA, [3]Department of Pulmonary, Critical Care and Sleep Medicine, Ohio State University, Columbus, OH, USA, [4]Department of Pediatrics, Section of Sleep Medicine, Dayton Children's Hospital. Wright State University School of Medicine, Dayton, OH, USA

Introduction: Children and adolescents with psychiatric disorders often present with excessive daytime sleepiness and their psychiatric diagnosis and medications may complicate interpretation of the Multiple Sleep Latency Test (MSLT). Our aim was to study the effect of psychiatric medication and diagnosis on MSLT results in children and adolescents with developmental and psychiatric diagnoses who present with excessive daytime somnolence.

Methods: A retrospective analysis of MSLTs was performed in 321 subjects with a mean age 13.7 yr. (5-21y, 1%>21y); 9% diagnosed with ADD/ADHD/ODD: 7% diagnosed with bipolar/schizophrenia and 19% diagnosed with Depression/anxiety. Medications taken on the day of study included: 0.5% SSRIs/SNRI; 8% mood stabilizer: 7% antipsychotic agents; 4.5% stimulants; 3.5% antiseizure medications and 2% tricyclic antidepressants. Data was analyzed using two logistic regression models: 1) the first model contrasted subjects with an MSLT that met criteria for narcolepsy (MSLT<8 min and >2 SOREM) versus those that did not; the second model contrasted those subjects with a mean MSLT < 8 min versus those a mean MSLT > 8 min. Covariates in each model included age, psychiatric categorical diagnosis and medication class.

Results: The first model revealed that subjects who took anti-seizure medication on the day of the sleep study were 0.2 times as likely to have an abnormal MSLT, controlling for alpha-antagonist use. Similarly, patients who took alpha antagonist medication the day of the sleep study were 0.1 times as likely to have an abnormal MSLT, holding anti-seizure medication constant. The second model resulted in 'quasi-complete' separation of the data resulting in unreliable parameter and odds ratio estimates; therefore, this model was unusable.

Conclusion: Neither psychiatric medications or diagnosis differentiated between the group that met MSLT criteria for narcolepsy. This suggests that it may be reasonable to continue psychiatric medications on the day of MSLT without affecting the results.

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DAILY STRESS BETTER PREDICTS SLEEP QUALITY THAN STRESSFUL LIFE EVENTS IN CHILDREN AND ADOLESCENTS

Ly J, Jarrin DC, McGrath JJ
Department of Psychology, Concordia University, Montreal, QC, Canada

Introduction: There is a bi-directional relationship between stress and sleep, which is influenced by biological and psychosocial factors. Recent findings suggest that stress exposure negatively affects sleep quality in adults. Specifically, stressful life events (e.g., death, divorce) and daily stressors (e.g., daily strains and hassles) adversely affect sleep duration and subjective reports of sleep quality in adults. However, the relation between stress and sleep remains largely unexplored in children and adolescents. The purpose of this study was to investigate whether self-report of daily stress and stressful life events were associated with subjective sleep quality in children and adolescents.
Methods: Participants were children and adolescents aged 8-18 (N=238, M=12.67, SD=2.04, 46% female) taking part in the Healthy Heart Project at Concordia University. Children and adolescents rated their sleep quality on a 1-10 scale (1=poor, 10=excellent). Participants completed two measures of stress. On the Perceived Stress Scale, children and adolescents rated daily stressors and hassles over the past month. On the Stressful Life Events Schedule, participants provided the number of stressful life events they experienced over the past year (e.g., parental divorce, bullying) and rated how stressful each event was perceived to be (0=not at all stressful to 4=very stressful).
Results: Together, both daily stress and stressful life events accounted for 25% of the variability in children and adolescents' subjective sleep quality ($F=40.32$, $p<.001$). Results indicate that greater reports of daily stress significantly predicted poor sleep quality ($\beta=-0.54$, $t=-8.22$, $p<.001$), while stressful life events did not predict poor sleep quality ($\beta=0.08$, $t=1.22$, $p=.22$) among children and adolescents.
Conclusion: Daily stress better predicted subjective sleep quality than stressful life events. Children and adolescents who reported having more daily stressors and hassles reported poorer sleep quality than those with less daily stress. Stressors and hassles that occur on a daily basis may have a more immediate impact on sleep quality in comparison to stressful life events that occur less frequently. Future interventions should aim to incorporate stress management techniques, such as relaxation training, in order to improve sleep quality in children and adolescents.

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INSOMNIA SYMPTOMS AND CARDIAC AUTONOMIC MODULATION IN ADOLESCENTS: THE PENN STATE CHILD COHORT STUDY

Liao D[1], He F[1], Vgontzas AN[2], Shaffer M[1], Calhoun S[2], Rodriguez-Colon S[1], Bixler EO[2]
[1]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA, [2]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA

Introduction: Data on cardiac autonomic modulation impairment due to sleep problems in adolescents are very limited. We report preliminary findings associating insomnia symptoms and cardiac autonomic modulation in adolescents who participated in the population-based Penn State Child Cohort (PSCC) follow up examination.
Methods: We used available data from the first 169 adolescents who have completed the follow-up examinations in PSCC for this preliminary report. Insomnia symptoms were defined by self-reported "Often or very often having trouble falling asleep or waking up often in the night" using the Pediatric Behavior Scale. Cardiac autonomic modulation was assessed by heart rate variability (HRV) analysis of normal R-R interval data collected using a 39-hour high resolution Holter System. The HRV indices in frequency domain [high frequency power (HF), low frequency power (LF), and LF/HF ratio] and time domain [standard deviation of normal RR intervals (SDNN), and the square root of the mean squared difference of successive normal RR intervals (RMSSD), and heart rate (HR)] were calculated on a 30-minute basis, thus resulting in 78 repeated measures. Overall HRV, day-time, and night-time HRV were analyzed. Mixed-effects models were used to assess the insomnia and HRV relationships.
Results: The mean age of the study sample was 17.7 years (SD=2.0), with 44.3% female and 75.2% white. 8.1% were classified as having insomnia symptoms at the follow-up examination. The average PVC frequency was 0.43 per hour (ranging 0 - 133). After adjusting for age, gender, and ethnicity, individuals with insomnia symptoms have lower HRV indices and higher HR values, indicative of lower parasympathetic and high sympathetic modulation, for example, the regression coefficients (SE, p-value) were -0.31 ms2 (0.13, 0.02) and -5.62 ms (2.91, 0.05) for overall HF and SDNN, respectively.
Conclusion: Data from the ongoing PSCC suggested an adverse association between insomnia symptoms and cardiac autonomic modulation in adolescents.
Support (If Any): NIH R01 HL603772, R01 HL97165, UL1 RR033184, C06 RR16499.

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INSOMNIA SYMPTOMS AND CARDIAC ARRHYTHMIA IN ADOLESCENTS: THE PENN STATE CHILD COHORT STUDY

He F[1], Liao D[1], Vgontzas AN[2], Shaffer M[1], Calhoun S[2], Bixler EO[2]
[1]Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA, [2]Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA

Introduction: Cardiometabolic effects of chronic insomnia in adults have been examined. However, the data from adolescents are very limited. We report preliminary findings associating insomnia symptoms and cardiac arrhythmia in adolescents who participated in the Penn State Child Cohort (PSCC) follow up examination.
Methods: We used available data from the first 169 adolescents who have completed the follow up examinations in the population-based PSCC for this preliminary report. Insomnia symptoms were defined by self-reported "Often or very often having trouble falling asleep or waking up often in the night" using the Pediatric Behavior Scale. Cardiac arrhythmia, predominantly premature ventricular complex (PVC) was assessed using a 39-hour high resolution Holter system. The PVC data were analyzed on an hourly basis and scaled as number of PVC per hour, thus resulting in 39 hourly repeated measures. Negative binomial regression models were used to assess the insomnia and PVC relationship.
Results: The mean age of the study sample was 17.1 years (SD=2.0), with 44% female and 75% white. 8.1% were classified as having insomnia symptoms at the follow up examination. The average PVC frequency was 0.43 per hour (ranging 0 - 133). After adjusting for age, gender, and ethnicity, individuals with insomnia symptoms have a 9-fold increase in the PVC frequency as compared to individuals without insomnia symptoms (RR=9.65, 95% CI (1.55, 60.13), p = 0.02).
Conclusion: Data from a sample of the population-based PSCC study suggested an adverse association between insomnia symptoms and PVC frequency in healthy adolescents.
Support (If Any): NIH R01 HL603772, R01 HL97165, UL1 RR033184, C06 RR16499.

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INNOVATIONS IN SLEEP RESEARCH: DEVELOPMENT OF A CANADIAN, WEB-BASED PROJECT FOR THE TREATMENT OF BEHAVIOURAL INSOMNIAS IN 1- TO 10-YEAR OLD CHILDREN

Corkum PV[1,2], Coulombe A[1], Chambers C[1,3,4], Godbout R[5], Gruber R[6], Hall W[7], Reid GJ[8,9], Stremler R[10,11], Weiss S[12,13], Witmans MB[14,15]
[1]Psychology, Dalhousie University, Halifax, NS, Canada, [2]Pediatrics, IWK Health Centre, Halifax, NS, Canada, [3]Centre for Pediatric Pain Research, IWK Health Centre, Halifax, NS, Canada, [4]Pediatrics, Dalhousie University, Halifax, NS, Canada, [5]Psychiatry, Universite de Montreal, Montreal, QC, Canada, [6]Psychiatry, McGill University, Montreal, QC, Canada, [7]Graduate Studies, University of British Columbia, Vancouver, BC, Canada, [8]Psychology, University of Western Ontario, London, ON, Canada, [9]Family Medicine, University of Western Ontario, London, ON, Canada, [10]Nursing, University of Toronto, Toronto, ON, Canada, [11]Hospital for Sick Children, Toronto, ON, Canada, [12]Neurology, Hospital for Sick Children, Toronto, ON, Canada, [13]Pediatrics, University of Toronto, Toronto, ON, Canada, [14]Pediatrics, Stollery Children's Hospital, Edmonton, AB, Canada, [15]Respirology, Stollery Children's Hospital, Edmonton, AB, Canada

Introduction: Approximately 30% of children experience disturbed or inadequate sleep attributable primarily to behavioural factors (behavioural insomnias of childhood; BICs). Despite the prevalence of BICs and negative effects on children's health and development, only 1% of children receive evidence-based treatment for BICs. Web-based interventions can bridge the gap between knowledge and practice.
Methods: Evidence-based content and delivery modes were employed to develop a web-based BIC intervention aimed at parents of 1- to 10- year-olds. To develop the intervention content, key topics and activities were derived from four empirically-supported interventions (1 pamphlet-based intervention, 1 group-based intervention, and 2 booklet and telephone coaching-based interventions). The key topics and activities were translated for the web, following a literature review examining cognitive processing of electronic texts, expectations of web-based materials, and web-based behavioural tendencies.
Results: The five-session interactive web-based intervention covered: 1) general sleep information, 2) sleep hygiene and routines, 3) bedtime problems, 4) night-waking, and 5) difficulties with early morning awakenings and napping. Key information was conveyed in video format, minimizing the need for text-based information. Interactive activities, such as completing quizzes and sleep diaries online, were also included. The order in which parents view information and complete activities is controlled through the electronic medium. The electronic medium also provides immediate feedback to parents.
Conclusion: In addition to evidence-based practice from clinical sleep science, web-based interventions must consider cognitive processing of electronic media, expectations of web-based products, and rapid technological change. The next steps for this multi-phased Canadian study will be conducting usability studies followed by a national RCT to evaluate the efficacy of this web-based intervention. We aim to develop a sustainable evidence-based web intervention to treat BICs in 1- to 10-year old children.
Support (If Any): Canadian Institutes of Health Research TEAM Grant -Sleep & Circadian Rhythms "Better Nights/Better Days: Improving Psychosocial Health Outcomes in Children with Behavioural Insomnia".

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GABAPENTIN SHOWS PROMISE IN TREATING PEDIATRIC INSOMNIA

Robinson AA, Malow BA
Neurology, Vanderbilt University, Nashville, TN, USA

Introduction: Insomnia is prevalent and challenging to treat in pediatrics, particularly in those with neurodevelopmental disorders. Gabapentin is an attractive agent given its favorable side effect profile. We review our experience with gabapentin in children.
Methods: We reviewed the records of children seen by the authors in our Pediatric Sleep Clinic from January 2010 to July 2011 with insomnia (onset and/or maintenance) and were subsequently treated with gabapentin. We recorded age, gender, diagnosis, medications, type of insomnia and behavioral sleep intervention. In addition, the initial starting dose and final dose of gabapentin was recorded, effect of gabapentin, side effects of gabapentin and discontinuation.
Results: Fourteen subjects meeting inclusion criteria were found. The mean age was 7.8 years and 50% were male and 50% were female. The majority had a diagnosis of autism (50%), 36% had other neurodevelopmental disorders (epilepsy, developmental delay, ADHD) and 14% were typically developing. All children had sleep maintenance insomnia and 11 also had sleep onset insomnia. All parents received education in sleep behavioral interventions and 79% used melatonin as an initial medication intervention. Follow-up was available in 11 subjects, with improved sleep noted in 91% of children and adverse effects in only 18%. One subject had onset of parasomnias upon increasing gabapentin to 15mg/kg; the dose was then decreased to 10mg/kg and parasomnias stopped. One subject (9%) had agitation upon initiation of gabapentin and discontinued use of gabapentin. The average starting dose of gabapentin was 5mg/kg qhs (range 3mg/kg to 7.5mg/kg) and the average high dose was 15mg/kg qhs (range 6mg/kg to 15mg/kg).
Conclusion: Gabapentin is promising in the treatment of insomnia in children who did not respond to behavioral sleep education and melatonin. Larger controlled trials appear warranted.

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MEASURING DAYTIME SLEEPINESS IN A PEDIATRIC POPULATION: EPWORTH SLEEPINESS SCALE AND PEDIATRIC DAYTIME SLEEPINESS SCALE

Nash CO[1,2], Park G[3], Moore M[1], Mindell JA[1,3]
[1]Children's Hospital of Philadelphia, Philadelphia, PA, USA, [2]Drexel University, Philadelphia, PA, USA, [3]Saint Joseph's University, Philadelphia, PA, USA

Introduction: Daytime sleepiness significantly impacts children and adolescents, and subjective measures of daytime sleepiness are warranted. Though the Epworth Sleepiness Scale (ESS) has been studied in pediatric populations, most psychometric data has been gathered with adults. The Pediatric Daytime Sleepiness Scale (PDSS) was designed to assess sleepiness in adolescents, but further study of its psychometric properties is needed. The aims of this study were (1) to assess the psychometric properties of the ESS and PDSS and (2) to examine the relationships between these measures and demographic characteristics.
Methods: A retrospective chart review of 89 patients ages 5 to 18 years (M=10.8, SD=3.87) seen over the past year at a pediatric sleep center was conducted. The majority were boys (59.6%) and white (55.1%).
Results: The ESS yielded similar internal consistency scores for adolescents (α=.85) and school-aged children (α=.85). The PDSS yielded lower internal consistency for adolescents (α=.67) relative to school-aged children (α=.78), although removal of item #7 (need someone to awaken you in the morning) resulted in increased internal consistency (α=.75 adolescents; α=.81 school-aged). Sleepiness scores were higher for adolescents for the ESS (M=10.2, SD=5.6 adolescents; M=6.3, SD=5.6 school-aged) and the PDSS (M=10.9, SD=4.5 adolescents; M=14.2, SD=6.3 school-aged), $p<.01$. Girls scored higher on both measures ($p<.05$), with no differences across ethnicity. The ESS and PDSS were correlated ($r=.57$, $p < .01$) for school-aged children, as well as adolescents ($r=.45$, $p=.01$).
Conclusion: Both the ESS and the PDSS demonstrate good internal consistency for school-aged children and adolescents. Adolescents were found to be sleepier than school-aged children, and girls reported more sleepiness than boys. There was a moderate relationship between scores

on these measures. Future analyses comparing these measures with more objective measures of sleep are warranted.

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ARE PEDIATRIC INSOMNIA RESEARCHERS ASKING THE RIGHT QUESTIONS (OR EVEN ASKING AT ALL)?

Kuhn BR, Sanberg SA, McLey CM
Pediatric Psychology, University of Nebraska Medical Center, Omaha, NE, USA

Introduction: Until late childhood or adolescence, sleep complaints come from the parents rather than the child. In clinic settings, parents play a central role in setting treatment goals and defining outcomes.The purpose of this qualitative study is to identify parent-derived treatment goals for children presenting with symptoms of insomnia (difficulty initiating or maintaining sleep). A second goal of the study is to compare these treatment goals to the outcome measures selected for clinical trials; specifically medication trials for pediatric insomnia.
Methods: Subjects included 39 of 50 (11 excluded from analyses) children presenting to a behavioral sleep medicine clinic for symptoms of insomnia . A retrospective chart review was conducted to identify parent treatment goals obtained during the initial consultation appointment.
Results: Parents identified a total of 101 treatment outcome goals (range 1- 5 each). The findings revealed the following "top ten" outcome goals: 1.Improved sleep efficiency/reduced night waking (25%), 2.Fall to sleep independently (13%), 3.Alter sleep location or eliminate unwanted co-sleeping (13%), 4.Decrease sleep latency (10%), 5.Increase sleep duration (10%), 6.Fewer interruptions to parents' sleep (8%), 7.Problem daytime behavior (6%), 8.Problem bedtime/night-time behavior (4%), 9.Improved sleep-wake schedule (4%), 10. Improved nap pattern (4%). The literature review (PsychInfo & Medline) found thirty-six medication studies, which focused largely on three primary outcome variables; sleep duration (#5), sleep latency (#4), and night-time awakenings (#1). We could not identify a single study that obtained parent treatment goals or included them as an outcome measure.
Conclusion: Objective outcome measures will always serve as the backbone of well-designed clinical trials. Objective measures, however, do not necessarily correspond to what professionals are asked to achieve in clinical practice. For the results of intervention studies to generalize to the clinic setting, researchers are encouraged to begin including parent-derived, individualize treatment goals when evaluating pediatric insomnia treatments.

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INSOMNIA DIAGNOSTICS IN CHILDREN WITH NEURODEVELOPMENTAL DISORDERS (NDD): LOW-COST EQUIPMENT FOR VIDEO STUDIES IN THE HOME SETTING

Hung Y[1,2], Ipsiroglu OS[1,2], Barbosa AV[3], Vatikiotos-Bateson E[3]
[1]FASD & SLEEP Research Group, BC Children's Hospital/Sunny Hill Health Centre for Children, Vancouver, BC, Canada, [2]Dept. of Pediatrics, University of British Columbia, Vancouver, BC, Canada, [3]Dept.of Linguistics, University of British Columbia, Vancouver, BC, Canada

Introduction: Many children and adolescents with NDD have global developmental delay and/or intellectual disability, often causing difficulties in verbally expressing discomfort. Up to 90% of children with NDD suffer from chronic insomnia. Using home-based over-night-video-sleep-studies as a screening tool, we identified familial Restless Legs Syndrome/Willis Ekbom Disease (RLS/WED) as one main cause of insomnia and challenging behaviour. Advanced video technology is available for sleep-laboratories. However, low-cost equipment which can be sent out for screening and quantitative analyses has not been identified and tested.
Methods: Different combinations of hardware /software were tested and used for clinical purposes. Prerequisites for in-vitro testing were: 1) low cost/physical bulkiness/weight, durability for infrared-light camera and netbook; and 2) synchronized audio/video software with live time-stamp, constant frame-rates, automatic splitting of the recordings into multiple smaller files.
Results: We suggest an "ideal set of hardware/software" that is reliable, affordable (~$500) and portable (= 2.8kg) to conduct non-invasive home-based-overnight-video-sleep-studies. The equipment consists of a netbook, a camera with infra-red optics, and a video capture device. The recording software and video encoder provide consistent frame rate (>29 fps), are time-stamped for analysis, and allow standardized qualitative and automatic quantitative analyses. The equipment can be couriered to patient's home and since September 2011 we have had 14/15 successful recordings; problems occurred in one case due to software programming. In order to optimize results of clinical observations and to facilitate equipment setup at their homes, patients should have internet connection for remote access from the research lab.
Conclusion: Home-based-overnight-video-sleep-study videos allow us to observe the sleep patterns of patients in their normal sleep environment. The strategy of using sleep videos opens the floor for a new 'observational sleep medicine' that has been useful in describing discomfort/urge-to-move/pain-related behavioural movement patterns in patients with NDD and RLS/WED.

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SLEEPING THROUGH THE NIGHT: A COMMUNITY SURVEY OF PARENTS OPINIONS AND EXPECTATIONS

Henderson JM, Motoi G, Blampied NM
Psychology, University of Canterbury, Christchurch, New Zealand

Introduction: Evidence-based practise by health professionals providing advice to parents, and treating paediatric sleep disturbances, depends on empirical research. Effective communication and intervention also requires health professionals to understand parents' opinions and expectations around child development. There is a gap in knowledge between scientific research on infant sleep development and what is known about parents' opinions and expectations based on their own culture, context, and experience. This paper sought to address this imbalance.
Methods: Parents of children aged 2 years or younger, visiting different shopping malls were surveyed on their ideals for (1) infant's nocturnal sustained sleep durations, (2) the sleep duration and temporal location that defines "sleeping through the night", (3) the validity of an influential criterion for sleeping through the night, and (4) sources of advice sought for their infants sleep.
Results: Of the 412 analyzable surveys, mothers (mean age 30.8 years) considered infants should sustain sleep for a mean 9.6 hour duration. Sleeping through the night was defined as sleep onset beginning on average at 20:00 hours and cessing at 06:35 hours, a total duration of 10.35 hours. Over 80% of mothers did not consider a widely-used research criterion (sleeping from 24.00 to 05.00) valid. Over half of parents had sought advice regarding their infant's sleep, most commonly from child care nurses.
Conclusion: New Zealand parents hold realistic opinions and expectations regarding aspects of infants' nocturnal sleep. Their ideals for sustained sleep duration were congruent with empirical findings of infant's behavioural capabilities for sleep, and were within recommended clinical guidelines for sleep requirements. This study provides social and ecological validation for a criterion of sleeping through the night for infants and toddlers, viz sustained sleeping from 20:00 to 06.35 hours.

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SLEEP HYGIENE AND SOCIO-ECONOMICAL STATUS IN MINORITY CHILDREN

Spruyt K[1], Nwabara O[2], Britt T[2], Anguh I[2]
[1]Department of Pediatrics, The University of Chicago, Chicago, IL, USA, [2]Department of Health Sciences, Chicago State University, Chicago, IL, USA

Introduction: Children's sleep occurs in the socio-cultural context of the family. Little is known regarding sleep hygiene in minority children.
Methods: A de-identified questionnaire surveying sleep ecology and sleep-wake schedules of the child is being randomly distributed in local community centers. Preliminary data (n=92) was a posteriori stratified as Lower Class (LC; 57.6% of sample), Middle Class (MC; 16.3%) and Upper Class (UC; 26%) in comparison to Chicago's median Household Income ($38,625) and Below Poverty level (19.6%). The sample comprised 84.5% African Americans, 10.3% Mixed Ethnicity, 3.1% Hispanic and 2.1% African Ethnicity.
Results: Questionnaires' respondent was the mother (65.5%) and reflected sleep of 7.6±4.5 year old children of which 52.8% were girls. More African Americans (58.3%) belonged to the LC and Mixed Ethnicity to UC (15.5%)(Chi-square(6)=19, p=0.004). Bed- or room-sharing was not associated with classes (Chi-square(8)=1.5, p=0.99) such that 92.3% shared the sleep ecology; 20.9% bed-shared, 57.1% room-shared and in 5.3% the sleep environment often changed. No association with classes was found regarding the presence of TV (72.5%), media (10%) or intruding noise (13.8%)/light (25%). Sleep-wake schedules were similar; schoolday bedtime 20:59±0:46, risetime 6:44±0:39 and weekend bedtime 22:28±1:41, risetime 10:07±1:20 and 54.3% naps at least once a day. However, LC in comparison to UC children had a later bedtime (21:07±0:38 vs. 20:33±0:29) and shorter sleep duration (9.5±0.6hrs vs.10.4±0.8hrs) on schooldays when sleeping in their own bed while controlling for age. While LC that shared bed had an earlier risetime (6:45±0:29 vs. 7:37±0:51).
Conclusion: Preliminary data suggests that minority children living in a deprived social-cultural context might have less sleep.
Support (If Any): Comer Children's Hospital Research Award and Consortium to Lower Obesity in Chicago Children Fund.

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THE ASSOCIATION OF SOCIOECONOMIC STATUS WITH POLYSOMNOGRAPHIC FINDINGS IN NORMAL SLEEPERS FROM THE PENN STATE CHILD COHORT: EFFECTS OF RACE AND GENDER

Calhoun S, Vgontzas AN, Fernandez-Mendoza J, Basta M, Bixler EO
Sleep Research & Treatment Center, Psychiatry, Penn State College of Medicine, Hershey, PA, USA

Introduction: Recent research has yielded evidence of the association between obesity, male gender, low socioeconomic status, and minority race on sleep disordered breathing in children. No studies to date, however, have reported on the association of these factors on polysomnographic (PSG) markers of sleep disturbance in young school age children. In this study, we investigated the association of objective sleep disturbance with gender, race, and socioeconomic status in a large general population sample of children.
Methods: A population based study of 382 preadolescent children (6-12 years) from a subset of The Penn State Child Cohort, who did not have parent reported insomnia or an apnea/hyponea index ≥1, underwent a 9-hour polysomnogram, physical examination and parent completed health, sleep and psychological questionnaires.
Results: Minority race (African American or Hispanic) was significantly associated with increased stage 2 and decreased slow wave sleep (SWS) and low socioeconomic status (SES) with increased sleep latency and stage 2 and decreased total sleep time, sleep efficiency, and % REM sleep. Furthermore, there was a significant race by SES interaction on sleep latency, total sleep time, and sleep efficiency, even after controlling for body mass index, age, and gender. Interestingly, within the minority group, females had less SWS and more stage 2 sleep than males.
Conclusion: These preliminary data suggest that there is a strong association between children of minority race or low SES and objective markers of sleep disturbance. Additionally, minority females had less slow wave sleep than males. Thus, children who live in poor families of minority status are predisposed to impaired sleep that may be associated with vulnerability to cardiometabolic risks.
Support (If Any): R01 HL 63772, UL1RR33184, C06 RR16499.

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MATERNAL EMPLOYMENT IS ASSOCIATED WITH SHORTER SLEEP DURATION AMONG PRESCHOOL CHILDREN

Storfer-Isser A[1], Patel SR[2], Redline S[2], Musher-Eizenman D[1]
[1]Psychology, Bowling Green State University, Bowling Green, OH, USA, [2]Department of Medicine and Division of Sleep Medicine, Harvard Medical School, Brigham and Women's Hospital and Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Maternal employment has been identified as a risk factor for childhood obesity, but the mechanism for this association is unknown. We hypothesized that maternal work schedules may result in reduced child sleep duration, and reduced sleep duration is a risk factor for obesity.
Methods: Mothers of children aged 2-6 completed an on-line survey of maternal and child health. Results were analyzed from 208 married/partnered mothers; 103 mothers were employed full-time and 105 were homemakers. Sleep habits and child height and weight were obtained by maternal report.
Results: Mothers had a mean age of 34.8 [SD=4.8] years, 95% were Caucasian, 82% had a college degree, and 56% reported a household income ≥$100,000. Employed mothers had significantly more education, higher household income and fewer children in the home (p's<.01). Children of employed mothers slept 0.65 hours less on weeknights (10.30 vs. 10.95, p<.001) due to an earlier waketime on weekday mornings, and slept 0.42 hours less on weekends (10.46 vs. 10.88, p<.001) due to a trend for a later bedtime on weekends. Greater sleep deficiency among children of employed mothers is supported by their lower frequency of waking up in the morning on their own (49% vs. 78%, p<.001) and higher frequency of daytime napping (68% vs. 38%, p<.001). Overweight (≥ 85th percentile for age and sex) was more prevalent among children sleeping ≤10 hours on weekdays (35% vs. 23%, p=.07) and in children of employed mothers (35% vs. 20%, p=.02).
Conclusion: Children of employed mothers obtain 39 minutes less sleep on weeknights, 25 less minutes on weekends, and are more likely to be overweight compared to children of homemakers. Reduced weekday sleep is due to an earlier waketime on weekday mornings. Family-friendly workplace policies including flexible hours may improve sleep habits and potentially weight in children of working mothers.

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RESULTS OF SLEEP STUDIES IN CHILDREN BASED ON REFERRING PHYSICIANS

Khatwa UA[1], Zarowski M[3], Vendrame M[4], Loddenkemper T[2], Kothare SV[2]
[1]Respiratory Diseases, Children's Hospital Boston, Boston, MA, USA, [2]Neurology, Children's Hospital Boston, Boston, MA, USA, [3]Neurology, Poznan University of Medical Sciences, Poznan, Poland, [4]Neurology, Brigham and Women's Hospital, Boston, MA, USA

Introduction: Polysomnography (PSG) is the gold standard in diagnosis of sleep-disordered-breathing (SDB) and other sleep-disorders in children, but is labor intensive and expensive. In addition, it has become

increasingly challenging to obtain insurance approval for PSG. This study assesses results of PSGs based on specialty of referring physicians.
Methods: We retrospectively analyzed overnight-PSGs performed at a tertiary care pediatric hospital from June to December 2010. Patient demographics, indications, specialty of referring physicians, and results of PSG were analyzed. A PSG was considered abnormal if abnormal arousals, SDB (AHI > 1.5/hour, RDI >5/hr, hypoxemia, hypercapnia), abnormal EKG, or PLMS (index>5/hour) were noted.
Results: 488 PSGs were performed during this period (41% girls), mean age 8.3 years ±6.5. The most common indication was to rule out SDB (95%). The specialty of the referring physicians included sleep-medicine (30%), otolaryngology (25%), primary-care-physicians (PCP) (20%), pulmonary (9%), neurology (4%), genetics (4%) and others (8%). Forty-three percent of PSGs ordered by primary care providers (PCPs) were normal compared to only 22% by sleep-physicians (OR 2.27, CI 1.32-3.9). In addition, 51% of PSGs ordered by sleep-specialists showed SDB compared to 43% by PCPs (p=0.007).
Conclusion: PSGs ordered by PCPs were two times more likely to be normal than PSGs ordered by sleep-physicians. Due to the challenges associated with performing PSGs in children as well as the cost involved, we recommend initial evaluation in sleep-clinics to comprehensively assess any underlying sleep-disorders. Sleep clinic assessment prior to PSG will likely reduce unnecessary testing, and allow for application of individualized PSG montages for the suspected differential diagnoses. It will assist in appropriate utilization of services and also help cut healthcare costs.

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SLEEP PATTERNS IN ADOLESCENTS BEFORE ILLNESS VS. WELLNESS

Orzech K[1,2], Acebo C[1,2], Seifer R[1,2], Carskadon MA[1,2]
[1]Department of Psychiatry and Human Behavior, Brown University, Providence, RI, USA, [2]E.P. Bradley Hospital Sleep Research Laboratory, Providence, RI, USA

Introduction: Imposed sleep restriction has been linked to decreased immune function. Prospective naturalistic data may help determine how naturally-occurring sleep affects the occurrence of acute illnesses. We collected data from high school students using actigraphy and in-person interviews across 16 weeks (January to May) to assess nightly sleep duration and incident illness.
Methods: 56 adolescents were interviewed weekly in winter/spring (modal number = 13) using a structured protocol including 14 health event questions. Eighteen adolescents [7 male, ages 14-18] had usable matched ill and well events, 14 with one matched bout and 4 with two. Useable ill events were preceded by six well days not within one week after the daylight saving time (DST) shift. Matched well events were also preceded by six well days and matched for DST occurrence. Mean actigraphically estimated sleep durations 6 nights before illness/wellness events were compared, with sex as a between-subjects factor, using 2-way repeated measures ANOVA.
Results: A trend was found for shorter sleep duration before ill events (multivariate tests F (16) = 3.880, p = .066). Before ill events, mean nightly total sleep time (TST) was 411 minutes (standard error (SE) = 12.18). Before well events, mean nightly TST was 427 minutes (SE = 10.83). No main effect of night (F (12) = 1.681, p = .214) nor interactions of event type and night (F(12) = 1.109, p =.406), event type and sex (F(16) = .445, p = .514), or sex and night (F(12) = .452, p= .804) were found.
Conclusion: We found a trend in this small naturalistic sample that illness events in adolescents were associated with less sleep during the prior week than comparable periods before matched wellness. This naturalistic approach lends modest support to findings from experimental studies that better sleep is associated with better health.
Support (If Any): Support received from the National Institute of Mental Health (MH19927 and MH45945).

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PARENTAL COGNITIONS AND DEPRESSION IN INFANTS WITH BEHAVIORAL INSOMNIA AND FEEDING DISTURBANCES

Golik T, Avni H, Sivan Y, Greenfeld M, Tauman R
Sleep DIsorders Center, Tel Aviv Medical Center, Tel Aviv University, Tel Aviv, Israel

Introduction: Behavioral insomnia and feeding disturbances are two prevalent conditions in healthy young children. We have recently shown that problematic sleep and feeding behaviors tend to coexist in early childhood. The aim of the current study was to investigate parental cognitions about infant's sleep and feeding and parental depression in children with either behavioral insomnia or feeding disturbances in comparison to normal healthy controls.
Methods: Children 6-36 months of age with either behavioral insomnia or feeding disorders were recruited. Children 6-36 months of age who attended the well-care clinics were recruited and served as controls. Parental cognitions were evaluated using a validated parental questionnaire (MCISQ for sleep and BPFAS for feeding). Parental depression was evaluated using the Beck Depression Inventory (BDI-2).
Results: One-hundred and fifteen children (52% males) were recruited (25 with feeding disturbances; feeding group, 27 with behavioral insomnia; sleep group and 63 controls). The mean age was 15.8±7.4 months. No differences in parental cognitions regarding infant sleep were found. The BDI score was significantly elevated in parents of infants with behavioral insomnia compared to both children with feeding disturbances and controls (12.4±7.9 for sleep group, 8.7±5.9 for feeding group and 7.9±6.1 for controls, p=0.018). Parents of children with either feeding or sleep problems reported more frequently being frustrated and anxious while feeding their children compared to controls (32%, 19% and 1.6% respectively, p=0.0001), thought more frequently that their child's feeding pattern hurts his health (24%, 26% and 3.3% respectively, p=0.004) and felt more frequently angry while feeding their children (8.3%, 7.7% and 1.7% respectively, p=0.028).
Conclusion: Parents of children with behavioral insomnia exhibit higher depression scores compared to parents of children with feeding disturbances and controls. Parental anxiety, frustration and anger regarding infant's feeding are increased in both children with feeding disturbances and children with insomnia compared to controls.

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SLEEP PROBLEMS AND SOCIO-ECONOMICAL STATUS IN MINORITY CHILDREN

Spruyt K[1], Nwabara O[2], Britt T[2], Anguh I[2]
[1]Department of Pediatrics, The University of Chicago, Chicago, IL, USA, [2]Department of Health Sciences, Chicago State University, Chicago, IL, USA

Introduction: Socio-cultural circumstances may impose adverse effects on a child's sleep. Characterized by such circumstances sleep of minority children might be problematic.
Methods: A de-identified questionnaire surveying 34 sleep problems and sleep duration of the child is being randomly distributed in local community centers. Analyses were conducted on preliminary data (n=92) a posteriori stratified as Lower Class (LC; 57.6% of sample), Middle Class (MC; 16.3%) and Upper Class (UC; 26%) in comparison to Chicago's median Household Income ($38,625) and Below Poverty level (19.6%). The sample comprised 84.5% African Americans, 10.3% Mixed Ethnicity, 3.1% Hispanic and 2.1% African Ethnicity.
Results: Mothers' (65.5%) responses reflected sleep of 7.6±4.5 year old children of which 52.8% were girls. More African Americans (58.3%) belonged to the LC and Mixed Ethnicity to UC (15.5%)(Chi-square(6)=19, p=0.004). Sleep period time was not different across classes; LC: 8.1±3.6hrs, MC: 9.5±4.8hrs and UC: 9.5±2.4hrs. Highly prevalent problems were: difficulties waking up (55.2%), unwillingness

to go to bed (46%), difficulties falling asleep (49%). LC children had more difficulties waking up in the morning (H (2, N= 87) =8.7, p =.01), and had more frequent frightening dreams (H(2,N= 87) =6.7, p =.03). These children had a later wake-up time (β=0.51, p=.005). UC children grinded their teeth more often (H (2, N= 89) =6.9, p =.03). Nonetheless, respondents indicated on a scale of 1 to 10 that the child sleeps enough (4.05±2.3) and was not sleepy during the day (2.7±3.0).
Conclusion: Minority children exhibit disorders of initiating and maintaining sleep such that objective sleep quantification is advocated.
Support (If Any): Comer Children's Hospital Research Award and Consortium to Lower Obesity in Chicago Children Fund.

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SINGLE-PARENT STATUS IS AN INDEPENDENT RISK FACTOR FOR POOR SLEEP IN ADOLESCENTS

Troxel WM, Lee L, Hall MH, Matthews KA
Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Single-parent status may increase risk for adolescent sleep problems via multiple pathways, including increased family conflict and financial strain. However, scant research has examined the impact of family structure (single versus 2-parent households) on adolescent sleep. To address this gap, the current study examined the association between family structure and sleep in adolescents.
Methods: Participants were 242 (56% African Americans, 47% males) healthy adolescents (M age = 15.7 years). Sleep was measured via self-report and 7 days of wrist actigraphy. Outcomes included actigraphy-assessed Total Sleep Time (TST) and Sleep Efficiency (SE) and self-reported Sleep Delay (frequency of behaviors indicative of phase delay). Parental marital status and financial strain were assessed by parental report and family conflict by adolescent report. Analysis of covariance (ANCOVA) examined the relationship between family structure and adolescent sleep, after adjusting for age, sex, race, household income, and body mass index. All models included the family structure*race interaction to determine if the effects differed by race. Follow-up analyses included financial strain or family conflict to examine the degree to which these factors accounted for observed associations.
Results: African Americans were significantly more likely to come from single-parent households than Caucasians (69% versus 50%). Adolescents from single-parent households had poorer SE (p =.02). There was a significant race*family structure interaction for sleep delay, such that Caucasian children from single-parent households had the greatest sleep delay (p<.001). Family structure was not significantly associated with TST. Adjustment for financial strain or family conflict did not attenuate observed associations.
Conclusion: Findings suggest that disrupted sleep may play a key pathway in explaining the links between family structure and adverse mental and physical health outcomes in adolescents. Financial strain and family conflict do not play a major role in explaining these effects, at least in adolescence.
Support (If Any): Support for the current study was provided by HL25767. Support for the first author was provided by HL093220.

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RACIAL DISCREPANCIES IN SELF-REPORTED SLEEP AND COPING STRATEGIES IN ADOLESCENTS

Cousins JC[2], Matthews KA[1], Hall MH[1], Dahl R[3]
[1]Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA, [2]Psychology, University of Pittsburgh, Pittsburgh, PA, USA, [3]Public Health, University of California–Berkeley, Berkeley, CA, USA

Introduction: Daily stressors may negatively impact sleep. Differences in coping responses to stress have been observed across gender and racial sub-groups; therefore, gender and ethnicity may influence the relationship between coping and sleep. We examined whether coping styles in response to daily stressors predicted sleep characteristics in a diverse sample of adolescents.
Methods: Sample included 246 healthy adolescents (52.8% female, 56% black) enrolled in public high school (M=15.70 years; SD=1.30). Coping strategies were assessed with the Adolescent Coping Orientation for Problem Experiences Scale (Patterson & McCubbin, 1987) and sleep was assessed with actigraphy (7 days) and the sleep problem, sleep quality and daytime sleepiness subscales from the Carskadon Sleep Problems Scale. Based on prior factor analyses, two coping strategies emerged: positive coping (compromising, trying to improve oneself, talking or gaining support); and negative coping (avoidant and venting behaviors). Linear regressions were conducted with coping strategies and race predicting actigraphy-based sleep duration and sleep efficiency and the self-reported sleep scales, separately for males and females.
Results: Negative coping strategies were related to increased sleep problems in males (B = 1.03, p < .001) and females (B = 1.07, p < .001), with no moderation by race. Positive coping strategies were related to decreased sleep problems in white males, (race by gender interaction, B = -1.16, p = .035), and increased sleep quality for white females only (race by gender interaction, B = - .34, p = .046). No effects were found for actigraphy or daytime sleepiness.
Conclusion: Findings suggest positive coping strategies differentially benefit the sleep of black and white adolescents and negative coping strategies lead to increased sleep problems in both males and females. Further research is needed to better understand these racial discrepancies, including consideration of systemic factors, given that positive coping at the individual level seemed insufficient to benefit the black adolescents.

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AN EPIDEMIOLOGIC STUDY OF SLEEP-WAKE PATTERNS AND SLEEP DISTURBANCE AMONG JAPANESE SCHOOL-AGED CHILDREN

Kitamura S[1], Enomoto M[1], Tsukada E[1], Kamei Y[1], Koyama T[2], Moriwaki A[2], Kamio Y[2], Mishima K[1]
[1]Department of Psychophysiology, National Institute of Mental Health, National Center of Neurology and Psychiatry, Kodaira, Japan, [2]Department of Child and Adolescent Mental Health, National Institute of Mental Health, National Center of Neurology and Psychiatry, Kodaira, Japan

Introduction: Sleep problems are common in children and many studies have reported relationships among low sleep qualities or sleep disturbances and excessive daytime sleepiness, impaired daytime neurocognitive performance, obesity, incidence of psychiatric disorders or development disorders, however, few studies exist on large-scale school-aged children. In this study, we conducted a population survey to characterize sleep habits and sleep problems among school-aged children in Japan.
Methods: The participants were parents who raised children aged 6 to 15 belong to 148 elementary schools and 71 junior high schools in 10 areas across the country. They were requested to answer a self-reported questionnaire consisted of thirty-one items to evaluate sleep habits and sleep problems of their children for the past one month.
Results: Of the 25,211 children, mean bedtime and rise time were 21.9h and 6.6h, respectively. Approximately half of children (12,700/25,211) went to bed after 22 p.m. or later and 20.4% (5,144/25,211) went to bed after 23 p.m. or later. As grade shifted higher, bed time was significantly delayed, while rise time minimally changed across all grades. Consequently, a significant shortening in total sleep time for the higher grades relative to the lower grades was observed. The highest grade children slept an average of 126.5 min less than the lowest grades. Of all children in this study, approximately one thirds children usually experienced some kind of sleep problem, and two thirds experienced sometimes or more.

Conclusion: The present study has clearly shown that delayed bed time, short sleep duration, excessive daytime sleepiness and various difficulties in initiating, maintaining and terminating sleep were highly prevalent in school-aged children in Japan.

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ETHNIC DIFFERENCES IN TOTAL SLEEP TIME AND BEDTIME IN SINGAPOREAN INFANTS

Tan SS[1], Goh D[2], Teoh O[3], Utama DA[4], Gooley JJ[1]
[1]Program in Neuroscience and Behavioral Disorders, Duke-NUS Graduate Medical School Singapore, Singapore, [2]Department of Paediatrics, Division of Paediatric Pulmonary & Sleep, National University Hospital, Singapore, [3]Department of Paediatrics, Respiratory Medicine Service, KK Women's and Children's Hospital, Singapore, [4]National University of Singapore, Singapore

Introduction: Based on parental reports of infant sleep, total sleep time and bedtime differ across ethnic groups. Marked differences in sleep have been reported between countries or regions that are predominantly Caucasian versus Asian. However, relatively little is known about how infant sleep varies by ethnicity within countries. Here, we examined parent-reported sleep characteristics in Chinese, Indian, and Malay infants living in Singapore.
Methods: As part of the Growing Up in Singapore Towards healthy Outcomes (GUSTO) birth cohort study, we examined parent-reported sleep characteristics in 668 infants (57% Chinese, 26% Malay, 16% Indian) at age 6 months. Sleep was assessed using the Brief Infant Sleep Questionnaire (BISQ).
Results: Total sleep time was significantly greater in Chinese (mean ± SD = 12.3 ± 2.7 h) versus Malay (11.3 ± 3.2 h) and Indian (11.4 ± 2.9 h) infants ($p < 0.05$). This difference was due to longer nighttime sleep duration in Chinese infants; naps were similar across ethnic groups. Overall, 20% of parents reported that their child slept less than 10 h per day, and the majority of infants (55%) had a bedtime of 10 pm or later. On average, Indian infants had a bedtime that was an hour later than Chinese infants (10:24 pm ± 1 h 26 min versus 9:26 pm ± 1 h 13 min; $p < 0.05$).
Conclusion: Our findings suggest that in Singapore, Chinese infants had earlier bedtimes and more sleep than Malay and Indian infants. In all three Asian ethnic groups examined, however, parent-reported bedtimes were much later, and sleep duration was much shorter, than sleep characteristics typically reported in predominantly Caucasian countries. Additional research is needed to determine whether ethnic differences in parent-reported infant sleep are due to biological and/or cultural and socioeconomic factors, and whether such differences impact child development.

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ASSOCIATION BETWEEN EXPOSURE TO VIOLENCE AND OBJECTIVELY MEASURED SLEEP CHARACTERISTICS: A PILOT LONGITUDINAL STUDY

Spilsbury J[1], Frame J[1], Juhas K[2]
[1]Center for Clinical Investigation, Case School of Medicine, Cleveland, OH, USA, [2]Trauma Services, MHS, Cleveland, OH, USA

Introduction: Millions of children are exposed to violence each year. Although subjective reports of sleep disturbances following violence exposure are common, objective evidence is limited, especially for children. To better understand the association between violence exposure and sleep behavior, we studied the objectively-measured sleep of children with known exposure to community and/or family violence. We hypothesized that increased exposure to violence and posttraumatic stress symptoms measured at baseline would both be associated with lower sleep duration and poorer sleep quality both cross-sectionally (at baseline) and longitudinally (3-month follow-up point). Also, we investigated whether age moderated the relationship between exposure to violence and sleep outcomes, as well as between posttraumatic stress symptoms and sleep outcomes.
Methods: The study was longitudinal and home-based, consisting of assessments at baseline and at a 3-month follow-up. Participants were an ethnically mixed, largely disadvantaged, urban-based sample of 46 children (57% girls, 61% African-American) ages 8-16 years, participating in a community-based social-service program for children exposed to violence. Sleep data were obtained from 7-day actigraphy and a sleep journal. Main study predictors were children's recent (previous year) exposure to violence obtained from the Recent Exposure to Violence Scale and posttraumatic stress symptoms from the Trauma Symptoms Checklist for Children, both validated instruments. Sleep outcomes were mean nightly sleep duration, night-to-night variation in sleep duration, sleep efficiency, and bedtime.
Results: Adjusted analyses showed that greater exposure to violence at baseline was associated with decreased nightly sleep duration at the 3-month follow-up for younger children (8-11 years) only. Posttraumatic stress levels measured at baseline were associated with baseline exposure to violence but not to sleep outcomes at either baseline or 3-month follow-up.
Conclusion: Exposure to violence was associated with poorer sleep quantity among younger children, suggesting a developmental period (<11 yrs) of heightened susceptibility to some violence-induced sleep changes.
Support (If Any): This study was made possible by the Case Western Reserve University/Cleveland Clinic Multidisciplinary Clinical Research Training Program, CTSA Grant Number UL1 RR024989 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health and NIH roadmap for Medical Research.

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SLEEP, PHYSICAL ACTIVITY, AND WELL-BEING: AN EXPLORATORY STUDY OF U.S. ADOLESCENTS

Lee S[1], Swahn M[2], Yao H[2]
[1]Byrdine F. Lewis School of Nursing and Health Professions, Georgia State University, Atlanta, GA, USA, [2]Institute of Public Health, Georgia State University, Atlanta, GA, USA

Introduction: Sleep disturbance is a prevalent problem, particularly among depressed adolescents. Intriguingly, physical activity has been associated with increased activity in noradrenergic and serotonergic systems, both of which have been extensively linked to depression. This study explores the effect of sleep on overall well-being (school performance, sadness, and suicide attempt) which is mediated through physical activity for different racial/ethnic groups.
Methods: Three hypotheses were tested using secondary analyses of the nationally representative Youth Risk Behavior Survey conducted in 2009 of high school students (N = 16,410). Logistic regression models assessed the role of sleep and physical activity in school performance, sadness, and suicide attempt after controlling for age, gender, race, substances used, and BMI.
Results: Of the total sample, 69.2% slept less than 8 hours on school nights, which is 18% higher than the findings from the National Sleep Foundation's 2006 Sleep in American. Sleeping less than 8 hours or more than 9 hours were statistically significantly associated with less daily physical activity (Adj. OR=0.65; 95% CI: 0.56-0.76). Moreover, those who slept less than 8 hours or more than 9 hours were also more likely to report low grades (Adj. OR= 1.48; 95% CI: 1.22-1.80), sadness (Adj. OR= 1.58; 95% CI: 1.44-1.73), and suicide attempt (Adj. OR= 2.13; 95% CI: 1.75-2.58). The Sobel test indicates the physical activity mediate the relationship between sleep and sadness (p= .04).
Conclusion: Physical activity mediates the association between poor sleep and sadness among the adolescents in the U.S. As a gateway in regulating the effect of sleep and emotional status, physical activity may be a target for intervention. However, further research is needed to ex-

plore the underlying mechanisms that regulate sleep, physical activity, and depression.

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DIFFERENTIAL ASSOCIATION OF MATERNAL DEPRESSION AND ANXIETY WITH CHILDREN'S SLEEP

Pennestri M[1], Bouvette-Turcot A[1,2], Gruber R[1], Lydon J[3], Steiner M[4], Atkinson L[5], Meaney M[1], Gaudreau H[1]

[1]Department of Psychiatry, McGill University, Douglas Hospital, Montreal, QC, Canada, [2]Department of Psychology, Universite de Montreal, Montreal, QC, Canada, [3]Department of Psychology, McGill University, Montreal, QC, Canada, [4]McMaster University, St. Joseph's Hospital, Hamilton, ON, Canada, [5]Ryerson University, Toronto, ON, Canada

Introduction: Maternal depression and anxiety have been identified as contributors to children's sleep disruption. As depression and anxiety share common components, but also have distinct features, they could differentially be associated with specific sleep disturbances in children. The aim of the present study was to refine the association between mother's depression and anxiety with different measures of sleep disruption in children.

Methods: These data were part of a longitudinal study (MAVAN) aimed to measure the effects of the environment on infant development (n=316 mother and child dyads). Mother's levels of depression and anxiety were evaluated by questionnaires (CESD and STAI) when the child was 24 months. Bedtime, sleep latency, longer period of uninterrupted sleep and number of awakenings were assessed by maternal report at the same time-point. Partial correlations were used to assess the relationships between child's sleep variables and mothers' scores of depression and anxiety.

Results: Higher levels of mothers' depression and anxiety were associated with a shorter period of uninterrupted nocturnal sleep ($r = -0.17$, $p=0.002$; $r = -0.19$, $p=0.001$) and a higher number of awakenings in children ($r = 0.17$, $p=0.002$, $r = 0.20$, $p<0.001$). When controlling for depression, the association between anxiety and these sleep measures remained significant. However, when controlling for anxiety, the association between depression and these sleep measures was no longer significant. Moreover, a high level of depression was specifically associated with a later bedtime ($r=0.11$, $p<0.05$), whereas a high level of anxiety was specifically associated with longer sleep latency ($r = 0.13$; $p<0.05$).

Conclusion: These results suggest that mother's anxiety and depression show differential associations with specific sleep components in children. Whether children of anxious mothers present more sleep interruptions or if these mothers are more vigilant to their child's disruption remains to be determined with objective measures of sleep.

Support (If Any): Canadian Institutes of Health Research.

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CORRELATION OF PEDIATRIC QUALITY OF LIFE SCORES WITH SYMPTOMS AND POLYSOMNOGRAPHIC VARIABLES IN CHILDHOOD OBSTRUCTIVE SLEEP APNEA

Krishna J[1], Thompson N[2], Das P[1]

[1]Sleep Medicine, Cleveland Clinic, Cleveland, OH, USA, [2]NI Center for Outcomes, Research & Evaluation, Cleveland Clinic, Cleveland, OH, USA

Introduction: Poor health-related quality of life (QOL) has been reported in children with obstructive sleep apnea (OSA). Correlation between the polysomnographic (PSG) data and QOL in this population is not well established.

Methods: We hypothesized that QOL measured with PedsQL 4.0 (Varni et al., 1999) in children with OSA would diminish with OSA severity, measured both subjectively with 22-item Sleep-Related Breathing Disorder (SRBD) questionnaire (Chervin et al., 2000), and objectively with polysomnography (PSG). Records of patients aged 2-18 yrs with OSA (AHI>1) and without developmental or neurologic comorbidities presenting to Cleveland Clinic between July 2007 and July 2011 were retrospectively analyzed for polysomnographic variables like obstructive AHI, arousal index, mean SaO2 and SaO2 nadir. We calculated Pearson correlation coefficients and performed t-tests for correlation. We also tested associations after adjusting for age, gender and BMI, and PSG variables using multiple regression models.

Results: The correlation between PedsQL [parent and child] score and SRBD score was [0.35 ($p=0.0464$) and 0.0514 ($p=0.82$)]. After adjusting for the effects of age, gender and BMI, and polysomnographic variables, there was a significant positive association between SRBD and PedsQL parent score ($p=0.0048$) but not for PedsQL child score (0.2921). Neither unadjusted nor adjusted PedsQL scores had any significant association with polysomnographic variables ($p>0.05$).

Conclusion: Parent reported quality of life has possible association with symptom severity. Polysomnographic variables may not quantify the impact of OSA on the quality of life in children with sleep apnea.

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QUALITY OF LIFE IN OBESE YOUTH WITH AND WITHOUT SLEEP PROBLEMS: A MULTI-INFORMANT APPROACH

Janicke DM[1,2], McCrae C[1], Graef D[1]

[1]Department of Clinical and Health Psychology, University of Florida, Gainesville, FL, USA, [2]Department of Pediatrics, University of Florida, Gainesville, FL, USA

Introduction: The purpose of this study is to compare quality of life (QOL) and psychosocial functioning of overweight and obese youth with and without sleep troubles.

Methods: Participants were 92 overweight and obese youth, ages 8-17 years, and their parent or legal guardian attending an outpatient appointment at a Pediatric Obesity Clinic. In this cross -sectional study, child and parent participants completed a self-administered questionnaire packet assessing QOL, psychosocial functioning, and sleep.

Results: Approximately 1 in 4 children experienced sleep troubles. Children who reported experiencing sleep troubles exhibited poorer self-reported ($M = 71.1$; SD 13.0 vs. $M = 81.8$, $SD = 10.5$; $p < .001$) and parent-proxy report ($M = 68.5$; SD 10.5 vs. $M = 74.6$, $SD = 13.3$; $p < .035$) QOL relative to their peers who did not experience sleep trouble. Similar results were found when examining parent report of child sleep troubles relative to total QOL, as well as when examining domains of quality of life (physical, school, and emotional functioning). Children who experienced sleep troubles also exhibited more internalizing behaviors problems. There was no relationship between child sleep troubles and degree of overweight status.

Conclusion: These data suggest that clinicians working with overweight and obese children should assess for sleep troubles and symptoms associated with sleep disorders, as improvement in sleep may lead to subsequent gains in academic, behavioral, emotional, and social functioning in overweight and obese youth. Longitudinal research with a larger sample size, repeated measurement, and use of validated objective and subjective measures of sleep problems and sleep disorder symptoms is needed before firmer conclusions can be drawn as to the meditational role of sleep in these relationships. Future research is also need to determine if interventions to address sleep problems in these youth can positively impact psychosocial functioning and QOL.

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RELATIONSHIP BETWEEN COMPLIANCE WITH POSITIVE AIRWAY PRESSURE THERAPY (PAP) IN PEDIATRIC PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS), CAREGIVER CONCERN, AND CAREGIVER INVOLVEMENT: RESULTS OF A QUALITY IMPROVEMENT PROJECT

Kiel S, Avis K, Makris C, Foshee H, Lozano DJ
Pediatric Pulmonary, University of Alabama at Birmingham, Birmingham, AL, USA

Introduction: OSAS is a common sleep disorder, with estimated prevalence of 2-4% among non-obese children. Many pediatric patients are treated with PAP therapy to improve their OSAS. However, children often have difficulty tolerating the new and/or uncomfortable medical regimens. Compliance rates are often low; most range from 20-60%. Factors associated with compliance remain undetermined. Clinical observation indicated that caregiver involvement and concern regarding OSAS symptoms often related to how well the child initially tolerated PAP. In order to better understand this relationship and to identify those families that may benefit from further interventions to improve compliance, we implemented a quality improvement to determine what factors may be associated with compliance with PAP.
Methods: 113 children (63% males, 64% African-American, mean 11.7 years of age, mean AHI=15.4) with OSAS requiring PAP therapy were evaluated. Compliance at the first visit was assessed using Smart Card technology. Caregivers completed the OSA-18 to evaluate caregiver concerns of OSAS symptoms, sleep disturbance, and daytime functioning, and the Epworth Sleepiness Scale (ESS, modified for children) to evaluate parental perception of the child's sleepiness upon diagnosis of OSAS thus prior to treatment with PAP. We also tracked whether or not parents stayed for sleep study results the morning after the NPSG.
Results: Overall compliance data at the first visit significantly ($p<.05$ for all variables) correlated with how sleepy the parent perceived the child to be on the ESS, the level of caregiver concerns for OSAS assessed by the OSA-18, and whether or not the family stayed to hear NPSG study results. Compliance was not significantly correlated with machine type, mask type, or AHI.
Conclusion: Similar to other disease states, caregiver involvement and concern are related to success with medical regimens. Interventions targeted at identifying treatment barriers to improve compliance immediately upon diagnosis of OSAS and upon prescribing PAP are needed.

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QUALITY OF LIFE IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA AND COMMON NEUROLOGIC CONDITIONS

Das P[1], Thompson N[2], Krishna J[1]
[1]Sleep Medicine, Cleveland Clinic, Cleveland, OH, USA, [2]NI Center for Outcomes, Research & Evaluation, Cleveland Clinic, Cleveland, OH, USA

Introduction: Health-related quality of life (QOL) is lower in children with obstructive sleep apnea (OSA). There is paucity of literature comparing QOL in children with OSA and other medical conditions.
Methods: We hypothesized that QOL in children aged 2-18 yr with OSA (AHI>1, no neurologic disease) would be similar to QOL in children with common neurologic conditions presenting to Cleveland Clinic (CC) between July 2007 and July 2011. Electronic medical records were used to retrospectively review PedsQL 4.0 (Varni et al., 1999) scores. Children with OSA were compared to children with the 5 most commonly coded neurologic diagnoses at CC. Analysis of variance was used to compare PedsQL means for OSA and the neurologic diseases. Pairwise t-tests with Bonferonni-adjusted p-values were used to check which group means were significantly different. A multiple regression model was created to compare mean PedsQL scores, with adjustments made for age, gender, and BMI.
Results: 33 OSA and 2218 neurologic disease patients were studied. PedsQL scores [parent; child (N, mean, SD)] for each group were OSA [(33, 25.94, 15.99); (21, 21.05, 14.61)], ADHD [(330, 30.47, 13.11); (210, 25.87, 13.48)], Headache [(1270, 22.10, 14.02); (1035, 21.63, 14.01)], Seizure disorder [(347, 24.65, 17.21); (151, 20.06, 14.50)], Tourette's syndrome [(194, 22.87, 13.79); (161, 19.99, 12.12)] and ADD [(77, 26.29, 12.27); (59, 22.53, 11.99)]. There was a significant difference among group PedsQL score means for the neurologic disease groups ($p < 0.0001$) but the mean PedsQL scores for OSA patients was not significantly different from any of the other group means ($p > 0.1$).
Conclusion: Health related quality of life in children with OSA is similar to that in children with common neurologic diseases at our institution. This finding emphasizes the importance of recognizing and treating this condition in children to potentially improve their quality of life.

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SLEEP PROBLEMS IN A SWEDISH RURAL COLLEGE POPULATION

Bader G
[1]Sahlgren's Academy, Clinical Neuroscience, Gothenburg, Sweden, [2]SDS Kliniken, Gothenburg, Sweden

Introduction: Purpose of study: To characterize sleep patterns and life style in a well defined and homogeneous population of high school students in a middle-size urban and suburban milieu.
Methods: All the students from a costal city in the South West part of Sweden attending the last year at the different city's High Schools - theoretical and practical lines - were asked to complete a survey about sleep habits and life style. It included the Epworth Sleepiness Scale (ESS), the Hospital Anxiety and Depression scale (HAD), and a 77-item questionnaire about lifestyle, sleep-wake habits, sleep quality and disorders, stress and mood, social relation, use of computer, mobile phones and virtual networks, eating routines, interests, school performance, physical health, substance use/abuse and worries about the future. The age range was 18-20. About 65 % answered.
Results: Insomnia was very limited (3%) but 34 % have increased daytime sleepiness (ESS >=10) with 18 % moderate to severe (ESS >=12). While 14 % sleep < 6 hours and 1/3 have difficulty waking up in the morning and feel non refreshed, 25 % estimate to sleep too little. Most of them go to bed school days between 22-24, during the week-end 41 % go to bed after 2 am (11 % > 4 am) and 26% of the boys and 17 % of the girls wake up after 12 am. Most of them try to mask sleepiness by increased use of physical activity or caffeine. When possible up to 50 % try to take a nap during the day. Mild to moderate anxiety was found in 53 % with anxiety disorders in 21 %, 15 % had depressive mood, 4 % should be treated. Anxiety is associated with a decrease of sleep quality and quantity. Decreased sleep during weekdays and increased sleep during week-ends is associated to anxiety. 57 % of boys and 83 % of girls feel stressed (14 % and 28 % often) and feel that stress has negative impact on sleep. Though HAD showed increased anxiety only 4 % of boys and 8 % of girls feel anxious. Most of them never close their cell phones and 35 % send > 30 text messages/day, 78 % feel the need to be continuously reachable, 95 % are on facebook, 43 % being connected either continuously or many times a day.
Conclusion: Even in this rural community insufficient sleep with irregular sleep-wake patterns and anxiety-depression are present at alarming levels. Symptoms are masked by increased activity and connectivity among these college students. Intervention programs are considered.
Support (If Any): SDS kliniken Mats Paulsson Foundation.

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FUNCTIONAL OUTCOMES IN ELDERLY PATIENTS WITH OBSTRUCTIVE SLEEP APNEA(OSA) TREATED WITH POSITIVE AIRWAY PRESSURE THERAPY

Li Y[1], Andrews ND[2], Sam Z[3], Bena J[3], Foldvary-Schaefer N[2]
[1]Case Western Reserve University School of Medicine, Cleveland, OH, USA, [2]Sleep Disorders Center, Cleveland Clinic Foundation, Cleveland, OH, USA, [3]Quantitative Health Sciences, Cleveland Clinic Foundation, Cleveland, OH, USA

Introduction: Given the increasing population of aging patients and the significant impact OSA has on health outcomes, greater evidence is needed to understand improvements in functional outcome assessments in elderly adults in apnea-hypopnea index(AHI) severity categories.
Methods: This study evaluated OSA patients with AHI≥5 and complete functional outcomes assessments (Epworth Sleepiness Scale(ESS), Fatigue Severity Scale(FSS), Patient Health Questionnaire(PHQ-9), Functional Outcomes of Sleep Questionnaire(FOSQ), and Euroqol(EQ-5D)) at baseline(pre-OSA diagnosis) and within three to six months of PAP titration. Retrospective analyses compared changes in functional outcome measures in elderly(>60) versus young(18-<60) patients.
Results: Sample characteristics: Elderly patients (n=218, mean age=68.4±6.3, 62% male, 76% white, BMI=36.7±19.3kg/M^2, AHI=40.1±25.7); young patients (n=541, mean age=46.9±9.4, 67% male, 84% white, BMI=34.5±29.1kg/M^2, AHI=37.9±31.2). Baseline assessments show no difference in AHI(p=0.32), but significantly higher ESS(p=0.001), PHQ-9(p<0.001), FSS(p<0.001) and lower FOSQ(p<0.001) totals in the young than the elderly group. Baseline EQ-5D differences were non-significant (p=0.76). Outcomes for both age groups show significant changes at all time intervals in all outcomes except EQ-5D. Overall effect of age on functional outcomes changes was not significant (ESS,p=0.31;FSS,p=0.70;PHQ-9,p=0.10;FOSQ=0.57;EQ-5D,p=0.33). However, the effect of baseline AHI on ESS change was significantly different(p=0.014) between the two groups from baseline to 120 days post-titration. For every unit increase in AHI, ESS change was 0.017 less in elderly than young patients. Baseline AHI had no significant effect on ESS change during other time intervals or on change in FSS(p=0.12), PHQ-9(p=0.46), FOSQ(p=0.17), EQ-5D(p=0.29).
Conclusion: Elderly patients with OSA respond differently to functional outcomes assessments than younger patients at baseline but achieve comparable magnitude of improvement with PAP therapy. The effect of baseline AHI on functional outcomes change showed no difference between age groups except for the ESS, where elderly subjects showed less change. These results support treatment of OSA in older subjects and raise questions for future research addressing OSA outcomes in elderly patients.
Support (If Any): NIH T35 HL082544 Grant.

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ACTIGRAPHIC SLEEP PATTERNS AND OBESITY IN OLDER MEN AND WOMEN

Hayes AL[1], Patel SR[2], Blackwell T[3], Evans DS[3], Ancoli-Israel S[4,5], Wing YK[6], Stone KL[3]
[1]Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, OH, USA, [2]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [3]Research Institute, California Pacific Medical Center, San Francisco, CA, USA, [4]Department of Psychiatry, University of California at San Diego, San Diego, CA, USA, [5]Department of Medicine, University of California at San Diego, San Diego, CA, USA, [6]Department of Psychiatry, The Chinese University of Hong Kong, Sha Tin, China

Introduction: Short sleep duration has been associated with obesity, however, little is known about the association between obesity and other characteristics of sleep, such as sleep timing, sleep duration variability, and napping.
Methods: Sleep patterns were assessed for 3-5 days using actigraphy in cohorts of older men (from The Osteoporotic Fractures in Men Sleep Study- MrOS Sleep) and women (from the Study of Osteoporotic Fractures - SOF). Sleep timing was assessed using the midpoint of the main sleep period and sleep variability was assessed by the standard deviation of nocturnal sleep duration. Napping was assessed by self-report. Obesity was defined as body mass index (BMI) ≥30 kg/m2. All analyses were adjusted for age, race, education, alcohol and tobacco use, caffeine intake, physical activity, medication use, cognitive function and comorbidities.
Results: Men (n=3,132) had a mean age of 76.4 ± 5.6 years, sleep duration of 6.4 ± 1.2 hours and 20.4% were obese. Women (n=3,493) had a mean age of 83.6 ± 3.8 years, sleep duration of 6.8 ± 1.3 hours and 24.2% were obese. Greater sleep variability and later sleep timing were associated with obesity in both men and women [per 1 SD increase, variability: men OR (95% CI) = 1.25 (1.15-1.37), women 1.14 (1.04-1.25); timing: men 1.11 (1.01-1.22), women 1.17 (1.06-1.28)]. Napping regularly was also associated with an increased risk of obesity [men 1.24 (1.03-1.49), women 1.31 (1.10-1.57)]. After further adjustment for nocturnal sleep duration, all results remained significant in women while only sleep variability remained significant in men.
Conclusion: In both older men and women, greater variability in nightly sleep duration was associated with obesity independent of mean sleep duration. Later sleep timing and regular napping were also associated with obesity in older women. These findings suggest that characteristics of sleep beyond mean sleep duration may play a role in weight homeostasis.
Support (If Any): HL098297, HL071194, HL070848, HL070847, HL070842, HL070841, HL070837, HL070838, HL070839, AG005407, AR35582, AR35583, AR35584, AG005394, AG027574, and AG027576.

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BEDTIME-DELAYING ACTIVITIES IN MIDDLE-AGED AND OLDER ADULTS

Peppard PE[1], Hagen EW[1], Barnet JH[1], Hale L[2], Salzieder N[1], Nieto F[1]
[1]Population Health Sciences, University of Wisconsin-Madison, Madison, WI, USA, [2]Preventive Medicine, Stony Brook University, Stony Brook, NY, USA

Introduction: Many adults routinely experience insufficient sleep. Time-use surveys suggest that adults trade-off sleep with various activities (e.g., work, commuting). However, "competition" between sleep and other activities may be especially acute in the hours before intended bedtimes. We use data from the Retirement and Sleep Trajectories (REST) study to examine which activities adults identify as commonly causing delayed bedtimes, and how these activities vary by sociodemographic factors.
Methods: REST study participants were recruited from a working population of adults in 1988 (comprising the sampling frame of the ongoing Wisconsin Sleep Cohort Study). In 2010/2011, 1715 participants answered mailed surveys assessing sleep, health and sociodemographic factors. Participants indicated whether they regularly engaged in a list of specified activities within 2 hours of their "intended bedtimes," and, if so, how often each activity delayed bedtimes. For each activity, a binary outcome variable classified participants as delaying bedtimes by that activity either: 1) never/rarely or, 2) sometimes/often/always. Logistic regression estimated associations of these outcome variables with sociodemographic factors.
Results: Overall proportions (95% CI) of participants (52% female, ages 46-83) reporting selected activities as at least sometimes delaying bedtimes were: watching television, 62% (59-64%); leisure-related reading, 45% (42-47%); leisure-related computer use, 29% (27-31%); computer use for socializing, 26% (23-28%); employment-related ac-

tivities, 11% (9-12%); caring for others, 7% (6-8%); and, moderate-to-heavy physical activity, 4% (3-5%). For some activities, proportions varied significantly by sociodemographic factors. Examples include: women were more likely to delay bedtime caring for others (p=0.001); participants <65 years were more to delay bedtimes to use computers for socializing (p=0.002); and, participants with >high school education were more likely to delay bedtime reading for leisure (p=0.007).
Conclusion: A majority of middle-aged to older adults commonly stay awake past intended bedtimes. Leisure-related activities (television-watching, socializing, leisure-related reading and computer use) were most responsible for delayed bedtimes.
Support (If Any): NIH grants 1R01AG036838-01A1, R01HL62252, and 1UL1RR025011.

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SLEEP STRUCTURE AND SLEEP DISTURBANCES ACROSS LIFESPAN IN A GENERAL POPULATION

Moraes W, Poyares D, Bittencourt LA, Tufik S, de Mello M
Psychobiology, Universidade Federal de São Paulo, São Paulo, Brazil

Introduction: There is a need of studies evaluating the polysomnographic sleep structure of a representative sample of general population throughout lifespan. The objective of this study was to identify sleep patterns and disturbances across lifespan in the population of the city of Sao Paulo.
Methods: A population-based survey adopting a probabilistic three-stage cluster sample of Sao Paulo was used to represent the population according to gender and age (20-80 years). This sample included 1024 individuals who underwent full polysomnography and structured interviews. One-way ANOVA was performed considering insomnia syndrome and AHI>5 as covariates. Age ranges were set at five-year intervals.
Results: Total sleep time, REM and SWS percentage, and mean oxygen saturation showed a significant reduction while stage 1 was increased with age ($p<0.05$). There was a significant late tendency toward increment in PLM index ($p<0.05$). While insomnia complaints increased progressively across lifespan, insomnia syndrome peaked between 40-60 yrs in both genders ($p<0.05$). Both genders showed a significant progressive increment in AHI with age ($p<0.05$).
Conclusion: Not only sleep structure but also total sleep time were subject to continuous change throughout lifespan. Insomnia syndrome showed a different age distribution from insomnia complaints. As expected, OSA increased progressively with age.
Support (If Any): CEPID/FAPESP, AFIP.

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MEASURED SLEEP CHARACTERISTICS OF OLDER AMERICANS FROM A NATIONALLY REPRESENTATIVE SAMPLE

Lauderdale DS[1], Kurina LM[1], Schumm P[1], Chen J[2], Thisted RA[1,4], McClintock M[3], Waite L[2]
[1]Health Studies, University of Chicago, Chicago, IL, USA, [2]Sociology Department, University of Chicago, Chicago, IL, USA, [3]Psychology Department, University of Chicago, Chicago, IL, USA, [4]Statistics Department, University of Chicago, Chicago, IL, USA

Introduction: Actigraphy data have not been available from nationally-representative population samples, and previously reported sleep characteristics may not be normative. Here we report on actigraph-estimated sleep characteristics from a nationally-representative cohort of adults aged 60 to 90.
Methods: The National Social Life, Health and Aging Project obtained survey and biomarker data through in-home interviews in 2005-2006 from a national multistage probability sample of 3005 community-dwelling adults aged 57-85. Participants and spouses were re-interviewed in 2010-2011 and one-third were randomly selected and invited to participate in an ancillary study including actigraphy. Here we present 3-night averages of actigraph-estimated total sleep duration, percent sleep (percentage scored as sleep of time between first sleep and final awakening) and sleep fragmentation. Using multiple linear regression we examine how these sleep characteristics vary by sociodemographics: age, race/ethnicity, gender and three indicators of socioeconomic status (household assets, education and income). All analyses use sample weights.
Results: Actigraphy data were collected from 796 individuals. Mean sleep duration was 6.6 hours. Sleep percent averaged 84%. The correlation between duration and self-reported habitual sleep was < 0.2. Older age was significantly associated with decreased percent sleep (-0.45% per year, $p=0.001$) and increased fragmentation ($p<0.001$) but not duration. Women had longer duration (0.36 hours, $p=0.02$) and less fragmentation but not higher percent sleep. Race/ethnicity were not significantly related to duration or sleep percent, but there was a trend toward greater fragmentation among blacks ($p=0.06$). Greater household assets (in 5 levels) were strongly associated with longer duration (.24 hours per level, $p<0.001$), higher percent sleep (1.9% per level, $p<0.001$) and less fragmentation.
Conclusion: From ages 60 to 90, age was not associated with actigraph-estimated sleep duration, although sleep percent and fragmentation both worsened with age. Household wealth was the factor most strongly associated with all measured sleep parameters.
Support (If Any): This work was supported by NIH (1R01AG042164-01, 5R37AG030481-04 and 5R01AG033903-03). Phillips Respironics loaned Actiwatch Spectrums to the project for data collection.

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DAILY VERSUS OVERALL AROUSAL AS A PREDICTOR OF SLEEP OUTCOMES IN OLDER AND YOUNGER ADULTS

Douglas K[1], McCrae C[2], Dautovich ND[1]
[1]Psychology, University of Alabama, Tuscaloosa, AL, USA, [2]Clinical and Health Psychology, University of Florida, Gainesville, FL, USA

Introduction: The purpose of this study was to determine if there are differences in the predictive ability of daily versus overall levels of pre-sleep arousal for sleep outcomes. Given age differences in arousal and sleep outcomes, age differences in the arousal/sleep relationship were also examined.
Methods: 50 younger and 50 older community-dwelling adults completed 14 consecutive daily diaries of pre-sleep arousal and sleep outcomes. Two arousal (Pre-Sleep Arousal Scale [PSAS] cognitive and somatic) and five sleep (sleep onset latency [SOL], wake after sleep onset [WASO], total sleep time [TST], sleep efficiency [SE], and sleep quality rating [SQR]) variables were used in the analyses. Daily (within-persons) and overall (between-persons) arousal values were entered into multilevel models predicting sleep outcomes.
Results: In the MLM predicting SOL, overall ($\beta=2.25$, SE=0.63) and daily ($\beta=1.23$, SE=0.49) cognitive arousal were significant predictors. Overall ($\beta=2.81$, SE=0.77) and daily ($\beta=3.23$, SE=0.75) cognitive arousal and overall somatic arousal ($\beta=-2.65$, SE=0.84) were significant predictors of WASO. For TST, age ($\beta=-2.00$, SE=0.87) and daily cognitive arousal ($\beta=-4.07$, SE=1.78) were significant predictors. Overall ($\beta=-0.84$, SE=0.28) and daily ($\beta=-0.94$, SE=0.23) cognitive arousal were significant predictors of SE. For SQR, linear time ($\beta=-0.02$, SE=0.01), overall ($\beta=-0.07$, SE=0.02), and daily cognitive arousal ($\beta=-0.09$, SE = 0.01) were significant predictors. Finally, there was a significant age by daily somatic arousal interaction for SE and SQR, with daily somatic arousal predicting SE and SQR only in younger adults.
Conclusion: Overall, daily pre-sleep arousal does not seem to be a better predictor of sleep outcomes compared to average arousal. The sleep/arousal relationship remained remarkably similar for both age groups. However, daily and average values provide unique information about this relationship and both remain important constructs to examine. Implications for the similarity in daily versus weekly arousal measures,

age-group, and predictability of cognitive versus somatic arousal will be discussed.

Support (If Any): This research was supported by funding from the APA Science Directorate.

1203

RELATIONSHIP BETWEEN SLEEP AND PHYSICAL FUNCTION IN COMMUNITY-DWELLING ADULTS

Lorenz RA[1,4], Kalra G[3], Budhathoki C[1], Richards KC[2,3]
[1]Nursing, Saint Louis University, Saint Louis, MO, USA, [2]Nursing, George Mason University, Fairfax, VA, USA, [3]Polisher Research Institute, Horsham, PA, USA, [4]Nursing, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Over 50% of community-dwelling adults have sleep complaints. Because aging has been associated with decline in physical function, coexistent sleep difficulties may exacerbate loss of physical function, including mobility and ability to complete activities of daily living (ADLs) and instrumental activities of daily living (IADLs). This study examined the relationship between sleep and physical function.
Methods: Fifty-three community-dwelling adults (38 Females; Mean age=69.6 years; SD=8.9; Range 55-88 years) participated in an ongoing study (1R01AG027778, KC Richards PI) for one night of in-laboratory polysomnography (PSG) and completed the Functional Performance Survey, which identified difficulty in 24 daily tasks. ADL/IADL score (range 0-60; higher score indicated poorer physical function) was constructed by summing 6 items (bathing, dressing, getting in/out of bed, cooking, heavy housework, and shopping). Mobility score (range 0-20; higher score indicated poorer physical function) was assessed by summing 5 items (walking ½ mile, walking up stairs, walking down stairs, stooping/crouching/kneeling, and lifting/carrying 10 pounds). Backward stepwise regression analysis was used to test if sleep variables (mean total sleep time, sleep efficiency, and wake after sleep onset) significantly predicted participants' physical function, after controlling for age.
Results: Participants' sleep, measured by PSG was poor: (mean total sleep time=298.6 minutes, SD=78.7; sleep efficiency=70%, SD=16%; wake after sleep onset=101.2 minutes, SD=66.5). Mean ADL/IADL score was 4.1 (SD=4.3) and mean mobility score was 4.0 (SD=4.0) indicating a high level of physical function. Regression results indicated that short total sleep time explained 12.7% of the variance in ADL/IADL ($R2=0.127$, $F1,48=6.98$, $p=0.011$) and 13.4% of the variance in mobility ($R2=0.134$, $F2,47=3.65$, $p=0.03$).
Conclusion: Consistent with accumulating evidence provided by other researchers, older adults with short total sleep time have increased risk for loss of physical function. These findings suggest that interventions to improve total sleep time may improve physical function in community-dwelling adults.
Support (If Any): The trial was supported by grants from the National Institute of Health, National Institute of Nursing Research 1R01AG027778 (Richards) and T32NR009356 (Lorenz).

1204

RECOMMENDED LEVELS OF WALKING PREDICT SLEEP AND HEALTH OUTCOMES AMONG OLDER PEOPLE

Hartescu I[1], Morgan K[1], Stevinson CD[2]
[1]Clinical Sleep Research Unit, Loughborough University, Loughborough, United Kingdom, [2]School of Sport, Exercise and Health Sciences, Loughborough University, Loughborough, United Kingdom

Introduction: The minimum level of physical activity likely to improve or maintain both health and sleep outcomes among older people has not been explored. International physical activity guidelines indicate that at least 150 minutes of moderate activity per week can deliver cardiovascular and functional benefits. It is not known if this level of exercise can impact sleep quality or insomnia risk. The present analyses assess the contribution of physical activity, above and below the 150 minute threshold, to sleep and health outcomes reported at baseline.
Methods: Sleep, health, and physical activity profiles were obtained from a random community sample of 1042 older people (aged 65+), interviewed in 1985 for the Nottingham Longitudinal Study of Activity and Ageing. Baseline walking durations were categorized as below (<150 minutes/week) or above (≥150 minutes/week) international physical activity guidelines. In models adjusted for age, sex and health status at baseline, predictive relationships were examined between these activity categories and: prevalence of baseline insomnia symptoms "often or all the time" (logistic regression); self- reported time in bed (multiple regression); and 26-year all cause mortality (Cox regression). Mortality (cause/date of death) was monitored from baseline to May 2011.
Results: At baseline 441 (48%) and 485 (52%) respondents were categorised as walking below and equal to/above the walking guidelines threshold respectively. During 1985-2011 the project received notification of 981 deaths. In the adjusted multivariate models, the higher level of walking was significantly associated with lower levels of reported insomnia symptoms [OR =0.65 (95% CI =0.46-0.92) $p<0.05$]; shorter durations of 'time in bed' ($r2=.04$, $F(4, 908)=10.25$, $p<0.01$); and increased longevity [HR =0.78 (95% CI = 0.67-0.89) $p<0.01$].
Conclusion: Internationally recommended levels of physical activity provide a common threshold for superior health and sleep outcomes among older people. Results also suggest that time spent in bed may be an under-researched proxy for inactivity.

1205

THE RELATIONSHIP BETWEEN SELF-REPORTED PHYSICAL ACTIVITY AND SLEEP IN OLDER ADULT INSOMNIACS AND HEALTHY SLEEPERS

Lubinski LC, Kline CE, Hall MH, Buysse DJ
Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Although epidemiological studies report significant positive associations between self-reported exercise and better self-reported sleep, the majority of these studies have focused on normal sleepers. The aim of this study was to examine self-reported physical activity levels in older adults with insomnia versus good sleeper controls and to examine the association of physical activity with sleep parameters.
Methods: Older adults (aged ≥ 60 y) with insomnia (n=79) and age- and sex-matched good sleeper controls (n=40) participated in the study. Sleep was assessed via the Pittsburgh Sleep Quality Index (PSQI), Pittsburgh Insomnia Rating Scale (PIRS), and 2-week sleep diaries. Physical activity was assessed by daily diary report of the most vigorous physical activity performed each day. Among participants with at least 5 days of self-reported activity (n=110), participants were categorized into sedentary (≤ 1 day/wk of moderate/vigorous activity) or physically active (> 1 day/wk of moderate/vigorous activity) groups.
Results: Good sleeper controls were less likely to be sedentary (odds ratio [OR]=0.12, P=.05) compared to those with insomnia, although this relationship was attenuated after adjusting for age, marital status, and sex (OR=0.36, P=.06) and further attenuated after adjusting for number of medical conditions (OR=0.39, P=.09). Among the entire sample and following adjustment for age, marital status, and sex, physically active participants (n=81) had significantly lower PSQI and PIRS scores (P=.03 and P=.02, respectively) and higher diary sleep efficiency and total sleep time (TST) (P=.04 and P=.01, respectively) compared to sedentary participants (n=29). With the exception of TST (P=.03), these findings were reduced to marginal significance after adjusting for medical conditions (.05<P<.10).
Conclusion: The significant relationship between self-reported physical activity and subjective sleep in older adults may be linked to the presence of comorbid health conditions. Being active may promote good sleep quality, but comorbid health conditions appear to attenuate this effect.

Support (If Any): AG020677.

1206

SLEEP CHARACTERISTICS AMONG THE OLDEST ADULTS

Jung L, Richards KC, Kalra G
School of Nursing, George Mason University, Fairfax, VA, USA

Introduction: While sleep has been well studied in older adults, data are limited in those at the upper limits of the age spectrum. The aim of this study was to compare the self-reported sleep complaints and sleep characteristics from polysomnography (PSG) in older adults aged 70-76 years and >/= 77 years.
Methods: Eighty-six older adults (60 Females; Mean age = 76.9 years; SD=4.6; Range=70-89) participated in an observational study from 2008-2011 (1R01AG027778, KC Richards PI) to determine the sensitivity and specificity of objective measures of RLS. Inclusion criteria for the secondary analysis were: 1) age 70-89 years 2) cognitively intact 3) stable dosages of all medications for at least 4 weeks and 4) apnea-hypopnea index (AHI) <30 with or without continuous positive airway pressure (CPAP) during one night of PSG. Those aged 70-76 years (n=47) and those >/= 77 (n=39) were compared on self-reported sleep complaints (difficulty falling asleep, inadequate sleep, wake after sleep onset, interrupted sleep, and unrefreshing sleep) and one in laboratory night of PSG using t-tests and chi square analyses.
Results: The most frequent self-reported sleep complaints were difficulty falling asleep (12.9%), interrupted sleep (16.5%), and unrefreshing sleep (17.6%). PSG results were: total sleep time 281.2 minutes (SD= 79.7), sleep efficiency=69% (SD=18%), sleep onset latency=27.1 minutes (SD=30.1), number of awakenings=13.8 (SD=7.75), wake after sleep onset=102.6 minutes (SD=73.6), and AHI=6.7 (SD=6.8). There were no statistically significant differences between age groups.
Conclusion: Our findings provide evidence that self-reported sleep complaints are quite prevalent in the oldest adults and that their objectively measured sleep is short in duration and fragmented with wake. Interventions targeting etiologies for sleep disturbances, and the needs and preferences of the oldest adults may improve their sleep and quality of life.
Support (If Any): This research was supported by the National Institute on Aging, NIA Grant No. R01AG027778.

1207

CLINICAL CORRELATES FOR EXCESSIVE DAYTIME SLEEPINESS IN AN ELDERLY POPULATION IN KOREA

Yoon I[1], Lee S[1], Kang S[1], Ju G[2], Kim K[1]
[1]Neuropsychiatry, Seoul National University Bundang Hospital, Seongnam, Republic of Korea, [2]Neuropsychiatry, Chungbuk National University Hospital, Cheongju, Republic of Korea

Introduction: Excessive daytime sleepiness (EDS) is known to be related to various clinical conditions and to cause reduced cognitive functions and increased automobile accidents. However, only a few studies have been done on the relationship between sleep disorders and EDS, especially in elderly population. This study was carried out to investigate the prevalence and the clinical correlates of EDS in elderly population of Korea.
Methods: The subjects consisted of 848 representative elderly people aged 60-94 years from Osan area, Korea. Daytime sleepiness was evaluated by Epworth Sleepiness Scale (ESS). Insomnia and restless legs syndrome were diagnosed via face-to-face interview with sleep specialists. Cognitive function was assessed with mini-mental status exam-dementia screening (MMSE-DS) and subjective complaints of memory were assessed with subjective memory complaints questionnaire. Anthropometric and other clinical data were also collected.
Results: The prevalence of EDS was 13.0%. Subjects with BMI of 23.0-24.9, 25.0-29.9 and more than 30.0 had an excess risk of EDS by 2.99 (95% confidence interval [CI] = 1.70-5.27), 1.89 (95% CI = 1.08-3.33) and 2.96 (95% CI = 1.02-8.51) compared to subjects with BMI of less than 22.9. Subjects with occupation had an excess risk of EDS by 3.45 (95% CI = 2.00-3.94) compared to subjects without occupation. Insomnia and depression also increased risk of EDS by 1.96 (95% CI = 1.20-3.22) and 2.46 (95% CI = 1.53-3.94) respectively. There was no significant difference of MMSE-DS between groups, but there was significant difference of subjective complaints of memory between groups with EDS and without EDS.
Conclusion: Our finding showed that obesity, insomnia and depression increased the risk of EDS in the elderly, and EDS was related to subjective memory complaints. Clarifying causal relationship between these factors and intervention of EDS by modifying these factors need to be done.

1208

DEPRESSION AND SLEEP QUALITY IN OLDER ADULTS WITH NON-CANCER CHRONIC PAIN

Chang Y[1,2], Wray LO[2], Peng H[1], Maisto S[3]
[1]School of Nursing, The State University of New York, University at Buffalo, Buffalo, NY, USA, [2]Center for Integrated Healthcare, Veteran Health Affairs, Buffalo, NY, USA, [3]Department of Psychology, Syracuse University, Syracuse, NY, USA

Introduction: Older adults with non-cancer chronic pain often experience depressive symptoms and sleep disturbance due to decreased functionalities. Insufficient sleep may cause serious consequences that can affect older adults' psychological and physical health. This study aimed to describe depression and sleep quality in older adults with non-cancer chronic pain as well as to examine the associations between depression, sleep quality, and pain intensity.
Methods: This study used a cross-sectional design. Adults with non-cancer chronic pain aged 50 or above were recruited from Buffalo VA Medical Center, a pain management clinic, and senior centers in Buffalo area. Measures included the Pittsburgh Sleep Quality Index (PSQI), the Geriatric Depression Scale (GDS), Brief Pain Index (BPI), and a demographic questionnaire. Descriptive statistics and Pearson's correlation were utilized for data analysis.
Results: A total of 108 older adults with non-cancer chronic pain participated in the study. Preliminary findings indicated that 77.2% of participants reported poor sleep quality (PSQI > 5). Participants reported a moderate to high level of pain intensity. Significant associations were found between sleep quality total score and depression ($r = .476$; $p < .000$) as well as sleep quality total score and pain intensity ($r = -.332$; $p < .000$). Pain intensity was significantly associated with all of subscales in PSQI. In addition, depression was significantly associated with sleep latency and daytime functioning.
Conclusion: The findings revealed that poor sleep quality and depression are common problems among older adults with non-cancer chronic pain. Older adults who had a higher level of pain intensity and higher level of depression reported a poorer sleep quality. Clinicians should routinely evaluate depression and sleep quality in older adults with chronic pain. Findings indicated a need to develop interventions for older adults with chronic pain to improve their sleep quality.

1209

RHYTHMICITY OF OBJECTIVE SIGNS OF RLS IN THE ELDERLY. DOES RLS BECOME A DIFFERENT PHENOMENON WITH AGING?

Rogers V[1], Kalra G[2], Richards KC[2]
[1]Family and Community Health, University of Maryland, Baltimore, MD, USA, [2]College of Health and Human Services, George Mason University, Fairfax, VA, USA

Introduction: Restless legs syndrome (RLS) often remains undiagnosed in persons with cognitive impairment because self-reported sensory symptoms are beyond their communication skills. The Behavioral

Indicators Test-Restless Legs (BIT-RL) is an instrument under development to measure behavioral (objective) RLS indictors. We report circadian and exercise-related variations in the BIT-RL in a validation sample of cognitively intact older adults.

Methods: 87 adults aged 64.9±11.7 years, 62% female, who were not on RLS-attenuating medications underwent the Johns Hopkins Structured Diagnostic Interview of RLS Symptoms, as part of a larger study. 26 subjects (30%) had probable or definitive RLS. Subjects were scored on 15 BIT-RL indicators every 2 minutes for 20 minutes during 4 observation periods: evening pre- and post-exercise, bedtime, and awakening. Three indicators, fidgeting, flexing foot against a surface, and stretching/straightening legs, were the best individual predictors of RLS by univariate logistic regression (LR) across all observation periods. To derive a BIT-RL score, these 3 items were summed (double-weighting fidgeting, the strongest indicator), and averaged over the 10 scores within an observation period. Total score ranged from 0-1.0, with higher scores indicating more RLS behaviors.

Results: Pre-exercise evening BIT-RL scores produced the best RLS classification of the 4 observation periods (78.2% classified correctly by LR, $p<0.001$; area under the curve=0.738, $p<0.005$). RLS patients scored higher than non-RLS patients at each measurement period (pre-exercise 0.24±0.24 vs. 0.07±0.15, $p<0.005$; post-exercise 0.24±0.26 vs. 0.09±0.18, $p=0.008$; bedtime 0.11±0.14 vs. 0.04±0.09, $p<0.003$; awakening 0.17±0.23 vs. 0.08±0.15, $p=0.025$, respectively). There was a non-significant increase in BIT-RL scores between bedtime and awakening in both groups. Scores did not change from pre- to post-exercise in either group.

Conclusion: Behavioral RLS indicators are more common in older adults with than without RLS, but demonstrate few circadian and exercise-related changes reported subjectively. The 3-item evening BIT-RL demonstrated preliminary validity in predicting RLS.

Support (If Any): NIA Grant No. R01AG027778, Veterans Health Administration grant #NRI 01-077-01, and Department of Veterans Affairs 2002-2006 Research Career Development Award (Kathy C. Richards, PI); Ruth L. Kirschstein T32 Fellowship in Sleep and Sleep Disorders Research 5T32HL007953-10 and 2T32HL007953-11A1 (Valerie E. Rogers).

1210

INSTABILITY OF BEHAVIORAL CIRCADIAN RHYTHMS PREDICTS POOR SLEEP OUTCOMES IN YOUNGER NOT OLDER ADULTS: A MICROLONGITUDINAL DAILY PROCESS STUDY

Dautovich ND[1], McCrae C[2]
[1]Psychology, University of Alabama, Tuscaloosa, AL, USA, [2]Clinical and Health Psychology, University of Florida, Gainesville, FL, USA

Introduction: In a younger and older adult sample, the objectives of this study were to: 1) determine whether the mean timing versus the instability of daily activities better predicts sleep outcomes; and, 2) compare the relative potency of three daily activities for predicting sleep. Considerable research exists linking exposure to daylight, activity levels, and meals with sleep outcomes. Understanding the relative regulating effects of timing versus stability in these daily activities has implications for treatment interventions for sleep and mood dysregulation.

Methods: 50 younger and 50 older community-dwelling adults completed 14 consecutive daily diaries of daily activities (Social Rhythm Metric-17) and sleep. Three activity variables (going outside, starting work, and eating dinner) and three sleep variables (sleep onset latency, number of awakenings, and sleep quality rating) were used in the analyses.

Results: Variability in daily activities was calculated by determining the intra-individual standard deviation for each activity variable. Multiple hierarchical regression analyses indicated that dinnertime variability [$F(4, 45) = 4.32$, $p = 0.01$] and going outside variability [$F(4, 45) = 2.92$, $p = 0.03$] significantly positively predicted sleep onset latency and number of awakenings, respectively, beyond mean timing of these activities in younger adults. Dinnertime variability [$F(4, 45) = 4.28$, $p = 0.01$] significantly negatively predicted sleep quality ratings in older adults, beyond mean timing of dinner.

Conclusion: Instability, not mean timing of daily activities, best predicted sleep outcomes in younger and older adults. Greater instability was associated with negative sleep outcomes for younger but not older adults. Beginning work was less predictive of sleep outcomes than mealtimes for older adults and mealtimes and going outside for younger adults. Age differences and implications for treatment will be discussed.

Support (If Any): Research was supported by the APA Science Directorate.

1211

OBJECTIVE AND SUBJECTIVE SLEEP SENSITIVITY TO DIFFERENT CAFFEINE DOSES IN YOUNG AND MIDDLE AGE ADULTS

Robillard R[1,2], Cartier A[1], Bouchard M[1], Nicolau L[1], Carrier J[1,2,3]
[1]Center for Advanced Research in Sleep Medicine, Hopital du Sacre-Coeur de Montreal, Montreal, QC, Canada, [2]Département de Psychologie, Université de Montreal, Montreal, QC, Canada, [3]Institut Universitaire de Gériatrie de Montréal, Université de Montreal, Montreal, QC, Canada

Introduction: During the middle years of life, sleep becomes more fragile and its sensitivity to psychostimulants may increase. Few age differences have previously been found on sleep's response to 200mg of caffeine, but the effects of larger doses remain unknown. This study evaluates the effects of two doses of caffeine on objective and subjective sleep according to age.

Methods: The sleep of 22 young (mean(SD): 23.5(1.9) y.o.) and 24 middle age adults (51,7(11.5) y.o.) was recorded and subjectively rated in two conditions in a double blind cross-over design: after ingesting a placebo and a caffeine capsule. Subjects were randomly assigned to a dosage protocols (200mg or 400mg). Sleep stages were visually scored. Power spectral analysis of N-REM sleep was performed on C3. Interactions resulting from three-way ANOVAs (2age groups*2doses*2conditions) are reported.

Results: Compared to placebo, 400mg but not 200mg of caffeine reduced REM sleep and increased spectral power in the 14-17Hz frequency bins ($F>5.1$, $p<.020$). Both doses of caffeine decreased N3 sleep, but this effect was more significant with 400mg ($F=6.1$, $p=.018$). Similarly, both doses of caffeine increased sleep latency while reducing sleep length and efficiency, but these effects were more prominent with the 400mg dose, especially in middle age adults ($F>5.5$, $p<.024$). Caffeine significantly decreased REM sleep in middle age, but not in young adults ($F=4.2$, $p=.046$). Subjects from both age groups felt that caffeine reduced their sleep time and quality ($F>6.9$, $p<.012$). Middle age, but not young subjects felt that 400mg of caffeine increased their sleep latency ($F=4.3$, $p=.044$).

Conclusion: The adverse effects of caffeine on sleep quantity and quality increase with the ingested dose, especially in older adults. Despite this objective sensitivity to caffeine dosage, subjective measures suggest that both age groups were unable to discriminate the degree of sleep alteration caused by different doses of caffeine.

Support (If Any): This research was supported by scholarships and grants from the Canadian Institutes of Health Research (CIHR), the Fonds de Recherche en Santé du Québec (FRSQ) and the Natural Sciences and Engineering Research Council of Canada (NSERC).

1212

WHITE MATTER FRACTIONAL ANISOTROPY PREDICTS EVOKED DELTA AMPLITUDE DIFFERENCES IN NORMAL AGING

Colrain IM[1,2], Sullivan EV[3], Rohlfing T[1], Baker FC[1,4], Pfefferbaum A[1,3]
[1]Center for Health Sciences, SRI International, Menlo Park, CA, USA, [2]School of Psychological Sciences, The University of Melbourne, Parkville, VIC, Australia, [3]Department of Psychiatry and Behavioral Sciences, Stanford University, Stanford, CA, USA, [4]School of Physiology, University of the Witswatersrand, Johannesburg, South Africa

Introduction: K-complexes (KC) are single instances of delta EEG waveforms. The amplitude of the averaged evoked KC (N550) is a marker of the ability of the underlying cortex to produce a synchronized response, and is an indicator of cortical functional integrity. N550 amplitude decreases at all scalp sites as a function of normal aging in adults, but the slope of the age relationship is steepest at frontal sites. Cortical gray matter volume (GMV) explains a significant proportion of the variance at frontal sites, but other age-related brain changes are also likely partially responsible for the amplitude decrease. We hypothesized that the compromised integrity of frontal white matter tracts with normal aging would contribute to lower capacity to generate frontal delta.
Methods: Sleep evoked potential, structural MRI and diffusion tensor imaging (DTI) data were obtained from 22 normal healthy women and 19 normal healthy men age 35 to 71 years (mean of 51.6 ± 9.9 y). N550 amplitudes were calculated at Fz, FCz, Cz, CPz and Pz sites. GMV values were derived for 45 bilateral supratentorial regions defined in the SRI24 atlas (nitrc.org/projects/sri24), propagated to each subject via nonrigid registration and combined into 5 lobar volumes. DTI was performed with diffusion measured along 6 non-collinear directions. Quantitative fiber tracking was used to calculate mean fractional anisotropy (FA) of all fibers coursing though the corpus callosum (CC) divided into 7 sectors based on the cortical anatomical origins of the CC fibers. Stepwise linear regression models of N550 amplitude at different scalp sites were constructed using age, GMV from different cortical regions and FA from different CC segments.
Results: Lower FA was significantly correlated with older age in all 7 CC segments ($r = -0.270$ to -0.496, $p < .05$ to $< .001$). Regression models for N550 amplitude were significant with age at all sites ($r2 = 0.21$ to 0.32, $p < .001$ in all cases). Less frontal GMV and lower FA in the premotor CC segment led to significant r2 changes from the age model at anterior scalp sites ($r2 = 0.55$ at Fz and 0.54 at FCz).
Conclusion: Delta amplitude at anterior sites may be affected by the integrity of callosal fibers connecting cortical regions contributing to their generation, as well as the amount of gray matter in those regions.
Support (If Any): AA014211, AA012388, AG017919.

1213

SLEEP-DISORDERED BREATHING, COGNITIVE FUNCTION, AND WHITE MATTER LESIONS IN AN ELDERLY POPULATION

Taxin Z[1], Basireddy S[2], Osorio R[2], Randall C[2], Young L[1], Cummings M[2], Sadda R[2], De Leon M[2], Rapoport DM[1], Ayappa I[1]
[1]Division of Pulmonary Critical Care Medicine, New York University School of Medicine, New York, NY, USA, [2]Psychiatry, New York University School of Medicine, New York, NY, USA

Introduction: Sleep-disordered breathing (SDB) increases with age, as does evidence of White Matter Hyper-intensities (WMH) on brain MRI. Chronic long-term hypoxia may be a cause of CNS dysfunction and WMH, but the role of SDB-related intermittent hypoxia is less clear. In this study we explored the relationships between SDB, cognition and WMH in a population of elderly individuals.
Methods: 65 normal subjects (54-87 yrs) were recruited via advertisements and from controls used in a memory study, excluding those with significant dementia and global cognitive impairments. We did not screen for sleep complaints. Subjects were tested in attention, memory and executive function domains, and underwent MRI scans that were scored for total volume (cm3) of peri-ventricular and sub-cortical WMH. SDB was evaluated with 2 nights of home monitoring (ARES Unicorder); Total Sleep Time (TST) was estimated from actigraphy (2 wks). Five subjects were excluded because of poor data quality; 8 dropped out. Subjects were grouped using AHI4%: <5/hr=normal (n=20); 5-15/hr=mild (n=22); >15/hr=severe (n=12). Comparisons were performed between normal and severe groups. Correlations were performed using all data.
Results: Between normal and severe groups there were no differences in gender (62% vs 75% female). The severe group was older (68±5 vs 73±8 yrs, p=0.05) and had a larger BMI (25±4 vs 30±7 kg/m2 , p=0.02) than the normal group. Epworth Score did not differ between groups (4±3 vs 6±5). Only 1 subject had an Epworth Score>10. TST did not differ between groups (7.5±1.0 vs. 6.2±2.2). Hypoxia (%TST< 90% O2sat.) was higher in the severe group (12±11% vs. 4±6% , p=0.01). WMH volume did not differ between groups (5.0±4.6cm3 vs. 5.4±4.9cm3, p=0.49). Subjects with more WMH performed significantly worse on tests of Attention ("perceptual speed", r=0.37, p=0.03) and Working Memory ("WMS digits", r=0.35, p=0.05).
Conclusion: As in other elderly cohorts, SDB prevalence was high and severe SDB was associated with modest hypoxia. Despite this, subjects had low Epworth Scores. As expected, we found a relationship between cognitive dysfunction and WMH. We were not able to show a relationship between SDB and WMH or cognitive dysfunction. These data do not support the hypothesis that SDB-related intermittent hypoxia causes WMH, leading to cognitive dysfunction. The lack of correlation of SDB to sleepiness, cognitive dysfunction and brain pathology highlights the complexity of this disorder in the elderly.
Support (If Any): R01 Grant: HL081310, NYU COE Seed Grant, AG-12101, Foundation for Research in Sleep Disorders.

1214

BRIGHT LIGHT THERAPY AS PART OF A MULTICOMPONENT MANAGEMENT IMPROVES SLEEP, COGNITIVE AND FUNCTIONAL OUTCOMES IN DELIRIOUS OLDER HOSPITALIZED ADULTS

Chong MS[1], Tan K[2], Tay L[1], Chan M[1], Tan T[1], Ding Y[1], Ancoli-Israel S[3]
[1]Department of Geriatric Medicine, Tan Tock Seng Hospital, Singapore, [2]Department of Pharmacy, Tan Tock Seng Hospital, Singapore, [3]Department of Psychiatry, University of California, San Diego, San Diego, CA, USA

Introduction: Delirium is associated with poor outcomes following acute hospitalization. At Singapore's Tan Tock Seng Hospital, the Geriatric Monitoring Unit (GMU) was established to manage delirium. GMU was modeled after the Delirium Room (a specialized 5-bed unit incorporating specific elder-friendly room design with lower staff-patient ratio) and adoption of core interventions from Hospital Elder Life Program (standardized protocols for managing cognitive impairment, sleep deprivation, immobility, visual impairment, hearing impairment and dehydration). Evening bright light therapy (2000-3000 Lux; 6-10pm daily) was used to consolidate circadian rhythm and improve sleep. This study examined if this multicomponent GMU program improved sleep, cognitive and functional outcomes in delirious patients.
Methods: 98 patients (mean age=84.5y) were studied. Charlson comorbidity and severity of illness index (SII), delirium duration, delirium subtype, cognitive status (CMMSE) and functional status (modified Barthel Index; MBI) were obtained. Nurses completed hourly sleep logs and mean total sleep time (TST), number of awakenings (AWAKW) and sleep bouts (SB) were computed. Data from discharge were compared to admission using paired-sample t tests.
Results: Mean delirium duration=7.8± 5.2 days. 16.3% (n=44) had hypoactive delirium, 38.8% (n=16) mixed delirium and 44.9% (n=38)

hyperactive delirium. There were statistically significant improvements from admission to discharge in cognitive (CMMSE=8.7±6.9 from 5.5±5.6) and functional scores (MBI=48.7±27.2 from 30.5±25.4) ($p<0.05$). TST (8.1±2.7h from 7.4±2.8h, $p<0.05$) and length of 1st SB (6.3 compared to 5.4h, $p<0.05$) improved. Comparing delirium subtypes, the sleep improvements were mainly in hyperactive delirium with decremental benefit seen in mixed and hypoactive delirium respectively.
Conclusion: This study shows initial evidence for benefits of incorporating bright light therapy as part of a multicomponent delirium management program. Clinical benefits include improved TST and length of 1st sleep bout with improved cognition and functional gains. The benefits appear to be mainly in patients with hyperactive delirium, which merits further study.
Support (If Any): Ministry of Health (Singapore) Healthcare Quality Improvement Fund Ref:2010/17.

1215

SLEEP IN FAMILY CAREGIVERS OF INDIVIDUALS WITH DEMENTIA

Peng H[1], Chang Y[2], Wray LO[3]
[1]School of Nursing, The University of New York at Buffalo, Buffalo, NY, USA, [2]School of Nursing, The University of New York at Buffalo, Buffalo, NY, USA, [3]Veteran Health Affairs Center for Integrated Healthcare, Buffalo, NY, USA

Introduction: Family caregivers of individuals with dementia are engaged in a challenging and important role and must cope with the long-term disabling physical and behavioral problems associated with the care recipients' illness. In addition, family caregivers often experience sleep disturbances due to overwhelming caregiving task provided to their care recipient. Insufficient sleep may cause serious consequences that can affect caregivers' immune system and daily functioning. The purpose of this study is to describe sleep in family caregivers of individuals with dementia and to examine the influence of caregivers' depression, health status, caregiver burden, coping, and care recipients' sleep on caregivers' sleep.
Methods: This ongoing study uses a cross-sectional design. Participants are recruited from the Alzheimer's Association Western New York Chapter at Buffalo as well as the Home Based Primary Care, Adult day Care, and Geriatric Evaluation and Management Clinic at Buffalo VA Medical Center. Actigraphy (wore for 7 days) and self-report instruments are used to assess sleep and other related variables. Descriptive and regression statistics will be utilized for data analysis.
Results: We expect that a total of 60 family caregivers will participate in this study. Preliminary findings indicate that more than 50% of our participants experienced sleep disturbance. We hypothesize that caregiver depression, health status, caregiver burden, coping, and care recipients' sleep will moderately influence caregivers' sleep.
Conclusion: The findings will extend our understanding of sleep complains experienced by family caregivers of individuals with dementia as well as factors associated with sleep disturbance. Also, our findings will indicate a need to develop appropriate interventions to improve caregivers' sleep quality while they are performing their caregiving task.

1216

DOES COMORBID PTSD PREDICT SUBJECTIVE AND OBJECTIVE SLEEP DISTURBANCE AMONG WOMEN VETERANS?

Hughes JM[1], Jouldjian S[1], Washington D[3,2], Alessi CA[1,2], Martin JL[1,2]
[1]Geriatric Research, Education, & Clinical Center, VA Greater Los Angeles, North Hills, CA, USA, [2]David Geffen School of Medicine, UCLA, Los Angeles, CA, USA, [3]Center of Excellence for Healthcare Provider Behavior, VA Greater Los Angeles, Los Angeles, CA, USA

Introduction: Recent research has focused on high rates of sleep problems, psychological distress, and post-traumatic stress disorder (PTSD) in returning Veterans. However, this work has not focused specifically on women Veterans, a growing group that is expected to account for 10% of the Veteran population by 2020. Compared to men, women are at higher risk for both insomnia and PTSD, yet the relationship between the two has not been widely studied.
Methods: Within a larger study, 107 women Veterans (mean age=49 years, 44% non-Hispanic white) meeting all ICSD insomnia diagnostic criteria completed a one-hour, in-person sleep and health assessment which included the Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Brief Symptom Inventory-18 (BSI-18), and the PTSD Checklist - Civilian (PCL-C) . Women then wore an Actiwatch (Respironics, Inc.) wrist actigraph (with sleep diary) for 7 days to objectively estimate sleep. Women who met criteria for probable PTSD (n=55, PCL-C total score >33) were compared (independent samples t-tests) to those without probable PTSD (PCLC<33; n=52).
Results: Women with insomnia and probable PTSD had higher PSQI total scores (13.2 vs. 10.4), higher ISI scores (19.2 vs. 14.3), and higher BSI-18 scores (24.7 vs. 6.4) (p's<0.001). There were no significant differences between the two groups in actigraphically-estimated sleep percent (84% vs. 83%); bedtime (11:06pm vs. 10:58pm); rise time (7:38am vs. 7:25am), or time awake at night (86 vs. 87 minutes) (p's>0.05).
Conclusion: Women Veterans with insomnia and probable PTSD reported more sleep disruption and psychological distress; however, there were no differences in objectively-measured sleep. The discrepancy between objective and subjective markers suggests that women with probable PTSD may be bothered more by insomnia than those with insomnia alone. Research is needed to understand the relationship between PTSD and insomnia in women Veterans and how the presence of PTSD symptoms may impact insomnia treatment expectations and outcomes.
Support (If Any): VA Health Services Research and Development (PPO 09-282-1), VA Rehabilitation Research and Development (1RX000135-01), National Institute on Aging (K23 AG028452), and the VAGLAHS Geriatric Research, Education, and Clinical Center (GRECC).

1217

COMPLIANCE OF POSITIVE AIRWAY PRESSURE DURING PREGNANCY: A PILOT STUDY

O'Brien LM[1,2], Bullough AS[3], Shelgikar AV[1], Chames M[5], Armitage R[4], Johnson TR[5], Sullivan CE[6], Guilleminault C[7], Chervin R[1]
[1]Neurology, University of Michigan, Ann Arbor, MI, USA, [2]Oral & Maxillofacial Surgery, University of Michigan, Ann Arbor, MI, USA, [3]Anesthesiology, University of Michigan, Ann Arbor, MI, USA, [4]Psychiatry, University of Michigan, Ann Arbor, MI, USA, [5]Obstetrics and Gynecology, University of Michigan, Ann Arbor, MI, USA, [6]Medicine, University of Sydney, Sydney, NSW, Australia, [7]Psychiatry and Behavioral Science, Stanford University, Redwood City, CA, USA

Introduction: Recent data demonstrate that sleep-disordered breathing (SDB) is common during pregnancy, particularly in pre-eclampsia, and is associated with adverse pregnancy outcomes. Positive airway pressure (PAP) is the standard treatment for SDB although its use in pregnancy has not been well described. We examined the use and acceptability of PAP in pregnant women.
Methods: Pregnant women with hypertension were prospectively enrolled and underwent full home-based polysomnography (PSG), attended auto-titrating PAP trials, and home PAP therapy. Participants received intensive support from the study team to maximize PAP use. PAP compliance was defined as ≥4hrs/night for at least 3 nights/week on web-based patient compliance software.
Results: Mean gestational age at enrollment for n=21 participants was 25.4±8.8 weeks, mean maternal age was 31.7±3.8 years, and mean BMI was 40.4±12.6kg/m2. Eleven (52%) women were compliant with PAP. No demographic or baseline PSG differences existed between compliant and non-compliant subjects. Mean PAP use for compliant vs. non-complaint subjects was 67.9±49.5 vs. 30.1±38.5 days, respectively (p=0.06), and mean time between enrollment and delivery was 67.9±9 vs. 60.5±60.8 days (p=0.76). Among 10 non-compliant women, 3 discontinued therapy within 1 week. Reasons for non-compliance were: anxiety using mask (n=2); claustrophobia (n=3); face feeling hot and sticky/sweaty (n=2); too much to deal with when pregnant (n=2); air leak (n=1); multiple small children at home and chaotic schedules (n=1); and stopped use when had dizziness and struggled to re-start (n=1). Two of the 10 subjects denied being non-compliant, and one avoided all interactions with the study team.
Conclusion: Treatment with PAP is challenging in pregnant women with hypertension. Even with intensive interactions with study staff, almost half of the participants discontinued therapy despite the presence of SDB. Understanding barriers to compliance in this population may improve PAP use.
Support (If Any): Gilmore Fund for Sleep Research, University of Michigan Institute for Research on Women and Gender, NIH K23HL095739, R21HL089918, R21 HL87819, R01 HL08094 , R01 HL105999, UL1 RR024986, and M01 RR000042.

1218

OBJECTIVE INTERRUPTION OF SLEEP CONTINUITY BY HOT FLASHES: A GONADOTROPIN-RELEASING HORMONE AGONIST MODEL

Joffe H[1], Hall JE[2], Economou N[1], Kim S[1], Regan S[3], Crawford S[4], White D[5]
[1]Center for Women's Mental Health, Department of Psychiatry, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA, [2]Division of Reproductive Endocrinology, Department of Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA, [3]Division of General Medicine, Department of Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA, [4]Division of Preventive and Behavioral Medicine, Department of Medicine, University of Massachusetts Medical School, Worcester, MA, USA, [5]Division of Sleep Medicine, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

Introduction: Sleep interruption is a bothersome symptom commonly reported by women with hot flashes, the cardinal symptom of menopause. While women report that nocturnal hot flashes awaken them, PSG studies have not consistently found evidence that hot flashes interrupt sleep. We used a gonadotropin-releasing hormone agonist (GnRHa) that induces hypoestrogenism and mimics the menopause to investigate whether hot flashes increase the number of awakenings and wake after sleep onset (WASO).
Methods: Healthy premenopausal volunteers without hot flashes, sleep problems, PLMD or SDB (on screening PSG) received the depot GnRHa leuprolide 3.75-mg/day. Prior to and during 5 weeks on GnRHa, we measured hot flashes, serum estradiol, and conducted 2 pre-treatment and 2 post-treatment ambulatory PSG's (Safiro, Compumedics Ltd, Australia). Percent change from baseline in standard PSG parameters was compared between highly symptomatic and asymptomatic women using non-parametric Wilcoxon-rank-sum testing.

Results: Of 27 women receiving GnRHa (age 27.5 ± 7.4 years), 14 (51.9%) became highly symptomatic (1.9 ± 1.2 hot flashes per night), while 13 were asymptomatic or minimally symptomatic (4 without hot flashes, 9 with <5 nighttime hot flashes during 5 weeks). Estradiol was suppressed ≤20 pg/mL in 100% of symptomatic and 84.6% of asymptomatic women within 4 weeks on GnRHa. Hot flashes began after 11.1 ± 6.4 days on GnRHa. WASO increased in symptomatic women (median increase 10.9 minutes; 101.3% increase) but not in asymptomatic women (median decrease 1.5 minutes; 15% decrease, p=0.029). Similarly, awakenings increased only in symptomatic women (median increase 5/night, 53.6% increase, vs. median decrease 2/night, 8.9% decrease, p=0.012). Groups did not differ in age, race, BMI, or changes in sleep efficiency, sleep-onset latency, or sleep staging.
Conclusion: This GnRH agonist model of menopause demonstrates that frequent nighttime hot flashes increase awakenings and WASO. These results isolate a specific effect of hot flashes on PSG-measured sleep.
Support (If Any): 5 R01 MH082922.

1219

SELF-REPORTED SNORING AND CARDIOVASCULAR OUTCOMES AMONG POSTMENOPAUSAL WOMEN: THE WOMEN'S HEALTH INITIATIVE (WHI)

Sands M[1], Loucks EB[1], Lu B[2,3], Stefanick ML[4], Ockene JK[5], Shah N[6], Hairston KG[7], Limacher M[8], Hale L[9], Eaton CB[1,3]
[1]Department of Epidemiology, Division of BioMedicine, Brown University, Providence, RI, USA, [2]Brigham & Women's Hospital, Harvard Medical School, Boston, MA, USA, [3]Department of Family Medicine, Brown University, Providence, RI, USA, [4]Stanford Prevention Research Center, Stanford University School of Medicine, Palo Alto, CA, USA, [5]Department of Medicine, University of Massachusetts–Worcester, Worcester, MA, USA, [6]Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY, USA, [7]Department of Internal Medicine, Wake Forest University, Winston-Salem, NC, USA, [8]Division of Cardiovascular Medicine, University of Florida–Gainesville, Gainesville, FL, USA, [9]Preventive Medicine, State University of New York, Stony Brook Medical Center, Stony Brook, NY, USA

Introduction: Habitual snoring, a correlate and early symptom of sleep apnea, may be associated with hypertension, cardiovascular disease (CVD), stroke, type II diabetes and metabolic syndrome. Our understanding of these associations among postmenopausal women is limited. Our aim is to investigate the degree to which frequent snoring is a predictor of coronary heart disease (CHD) and CVD among postmenopausal women.
Methods: This cohort study was conducted among 42,244 postmenopausal women participating in the Women's Health Initiative observational study (WHI-OS) who reported data on snoring. Recruitment occurred at 40 clinical sites across the United States. Participants provided self-reported information regarding snoring habits at baseline (1993-1998) and were followed for first occurrence of coronary events (through August 2009). The CHD outcome included MI, CHD death, PTCA, CABG or hospitalized angina, and the CVD outcome included total CHD and ischemic stroke. Cox proportional hazards models evaluated whether snoring frequency is a significant predictor of CHD and CVD.
Results: We observed 2,401 incident cases of CHD and 3,247 incident cases of CVD over 320,241 person-years of follow up. At baseline, 47% of women reported no snoring, 33% reported moderate snoring and 20% reported frequent snoring. After adjusting for age and race, frequent snoring was significantly associated with CHD (HR=1.53, 95% CI 1.42-1.69), and CVD (HR=1.45, 95% CI 1.32-1.58). In models adjusting for sociodemographic and CHD risk factors, frequent snoring was significantly associated with a modest increase in incident CHD (HR=1.17, 95% CI 1.04-1.32) and CVD (HR=1.16, 95% CI 1.05-1.29). The largest attenuation resulted from adjustment for BMI, hypertension and diabetes.
Conclusion: Self-reported snoring is associated with a modest increased risk of incident CHD and CVD, independent of sociodemographic and CHD risk factors among postmenopausal women. Additional studies are needed to elucidate the mechanisms in which snoring, independent of sleep apnea, is associated with cardiovascular biomarkers and outcomes.

1220

EARLY GESTATIONAL SLEEP VARIES BY TIME AND PARITY

Okun ML, Wettlaufer B, Hall MH
Psychiatry, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Introduction: Sleep disturbance is considered a ubiquitous complaint of pregnancy. Yet the preponderance of evidence comes from women who are in late gestation. We have hypothesized that disturbed sleep in early gestation may establish an environment in which the risk for pregnancy complications, including preeclampsia and preterm birth, is increased. The extent to which parity influences sleep disturbance in early pregnancy and outcomes is also unknown. Data are presented to further the understanding of early gestational sleep, how it changes across time, and the role of parity.
Methods: Diary and actigraphy-assessed sleep were collected from pregnant women (N = 158) 10-12 weeks (T1), 14-16 weeks (T2), and 18-20 weeks (T3). Regression analyses with Bonferroni corrections tested main effects and interactions for time and parity.
Results: Significant effects for time were observed. Diary-assessed (D) average and variability of sleep onset latency (SOL), and average wake after sleep onset (WASO) significantly decreased from T1to T3 (p's < .01). Actigraphy-assessed (A) average and variability in WASO decreased from T1 to T3 (p's < .01). Average sleep efficiency (from D and A) significantly increased across time (p < .001). The sleep fragmentation index decreased from T1 to T3 (p = < .01). Actigraphy-assessed sleep duration (p < .001), and average and variability in percent time spent awake (p's < .01) also decreased across time. Multiparous women showed an indication of poorer sleep as depicted by greater SOL (average and variability), greater average WASO, and lower sleep efficiency (uncorrected p's < .02). There were no significant interactions.
Conclusion: Sleep in early gestation is inconsistent at best with rapid improvement in the second trimester. While there is significant variability, the impact of sleep in early gestation on morbidity is unclear. Therefore, further evaluation of the role of disturbed sleep on maternal and fetal outcomes is warranted.
Support (If Any): NIH NR010813.

1221

THE PREVALENCE AND CORRELATES OF HABITUAL SNORING DURING EARLY PREGNANCY

Frederick IO[1], Qiu C[1], Sorensen TK[1], Enquobahrie DA[1,2], Williams MA[1,3]
[1]Perinatal Studies, Swedish Medical Center, Seattle, WA, USA, [2]Department of Epidemiology, School of Public Health, University of Washington, Seattle, WA, USA, [3]Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA

Introduction: Mounting evidence implicates habitual snoring, a prominent symptom of sleep-disordered breathing, as an important risk factor for adverse pregnancy outcomes including preeclampsia and gestational diabetes. Little, however, is known about the determinants of habitual snoring among pregnant women. We sought to assess the prevalence of and to identify maternal characteristics associated with habitual snoring during pregnancy.
Methods: Pregnant women (n=1,303) receiving prenatal care at participating clinics provided information about habitual snoring before and

during pregnancy in in-person interviews completed in early pregnancy. We calculated adjusted odds ratios (aOR) and 95% confidence intervals (95% CI) from multivariable models designed to identify factors associated with snoring during pregnancy.
Results: Approximately 7.3% of pregnant women reported habitual snoring during early pregnancy. The odds of habitual snoring during pregnancy was strongly related with maternal reports of habitual snoring prior to the index pregnancy (aOR=24.32; 95% CI 14.30-41.51). Advanced maternal age (≥ 35 years) (aOR=2.02; 95% CI 1.11-3.68), history of pre-gestational diabetes (aOR=3.61; 95% CI 1.07-12.2), history of mood and anxiety disorders (aOR=1.81; 95% CI 1.02-3.20), pre-pregnancy overweight (25-29.9 kg/m2) (aOR=2.31; 95% CI 1.41-3.77) and obesity (≥ 30 kg/m2) (aOR=2.81; 95% CI 1.44-5.48) status, as well as maternal smoking during pregnancy (aOR=2.70; 95% CI 1.17-6.26) were also statistically significant risk factors for habitual snoring during pregnancy. In addition, maternal smoking during pregnancy was associated with snoring during pregnancy (aOR=2.70; 95% CI 1.17-6.26).
Conclusion: We identified several, potentially preventable, risk factors for habitual snoring during pregnancy. This may have important implications for developing strategies aimed at reducing the prevalence of sleep disordered breathing, promoting improved sleep hygiene, and improved pregnancy outcomes among reproductive age and pregnant women.

1222

A NOVEL ASSOCIATION BETWEEN SLEEP DISORDERED BREATHING AND RISK OF MISCARRIAGE IN PREMENOPAUSAL WOMEN

Lee E[1], Gutcher ST[2], Douglass AB[1]
[1]Psychiatry, Royal Ottawa Mental Health Center, Ottawa, ON, Canada, [2]Family Medicine, University of Ottawa Facutly of Medicine, Ottawa, ON, Canada

Introduction: Obstructive sleep apnea (OSA) is characterized by collapse of the upper airway in sleep. The respiratory disturbance index (RDI) is used to quantify OSA severity. Affecting 11% of premenopausal women, OSA may alter menstrual cycles, estradiol, progesterone and 17-hydoxyprogesterone and consequently, could affect fertility. Miscarriage, the abrupt spontaneous loss of a pregnancy, is estimated to occur in 12-24% of pregnancies. Obesity is a risk factor, though frequently no etiology is found. The aim of this study was to assess whether OSA would increase the risk of having a miscarriage.
Methods: 92 female patients (22-52 years) with ≥ 1 pregnancy referred to the Royal Ottawa Mental Health Center Sleep Disorders Clinic were assessed with a retrospective chart review. Demographic information and miscarriage history was obtained. All included women completed a Level I polysomnogram. Using logistic regression, data were analyzed to determine if RDI and body mass index (BMI) were associated with miscarriages.
Results: Given the binary nature of the variable "history of miscarriage" (i.e., "some" or "none"), this variable was coded "0" and "1" and set as the dependent variable in a multivariate logistic regression model. The two continuous independent variables were each categorized into 3 levels in order to be entered into the logistic model: 1) RDI, categorized as 0--9.99, 10--29.99, and >30, and 2.) BMI, categorized as <29.99, 30--39.99, and >40 The results showed a significant prediction of miscarriage by RDI (p = 0.029) but not by BMI (p = 0.550).
Conclusion: The study suggests that OSA may be strongly associated with miscarriages. Although correlated to RDI, BMI is not independently associated with miscarriages, suggesting that OSA may be the key factor in mediating miscarriage risk. The small sample size and the retrospective nature of the research, however, limit the generalizability of these findings.

1223

SHORT SLEEP DURATION, COMPLAINTS OF VITAL EXHAUSTION AND PERCEIVED STRESS ARE PREVALENT AMONG PREGNANT WOMEN WITH MOOD AND ANXIETY DISORDERS

Qiu C[1], Fida N[1,2], Gelaye B[2,3], Williams MA[1,3]
[1]Perinatal Studies, Swedish Medical Center, Seattle, WA, USA, [2]Department of Epidemiology, School of Public Health, University of Washington, Seattle, WA, USA, [3]Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA

Introduction: Psychiatric disorders have been associated with sleep disorders in men and non-pregnant women, but little is known about sleep complaints among pregnant women with psychiatric disorders.
Methods: A cohort of 1,332 women was interviewed during early pregnancy. At the time of interview we ascertained participants' psychiatric diagnosis status and collected information about sleep duration, daytime sleepiness, vital exhaustion and perceived stress during early pregnancy. Logistic regression procedures were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) of short/long sleep duration, excessive daytime sleepiness (EDS), vital exhaustion and elevated perceived stress associated with a history of mood or anxiety disorder. Analyses accounted for possible effect modification by pre-pregnancy lean or overweight/obesity (BMI <25 vs. ≥25 kg/m2) status.
Results: Approximately 5.1% of the cohort (n=68) reported having a diagnosis of depression or anxiety disorder before pregnancy. Compared with women without a psychiatric diagnosis, the multivariable-adjusted OR (95% CI) for short sleep duration in early pregnancy (≤6 hours) were 1.95 (1.03-3.69). The corresponding OR (95%CI) for long sleep duration (≥9 hours) during pregnancy was 1.13 (0.63-2.03). A modest, insignificant association between psychiatric disorder and EDS was noted (OR=1.32; 95%CI 0.61-2.86). Women with psychiatric disorders had an increased risk of vital exhaustion (OR=2.41; 95%CI 1.46-4.00) and elevated perceived stress (OR=3.33; 95%CI 1.89-5.88). Observed associations were more pronounced among overweight/obese women. Compared with lean women who had no psychiatric diagnoses, the odds of short sleep duration (OR=2.88; 95%CI 1.14-7.32) and perceived stress (5.58; 95% CI 2.40-12.96) were greatly elevated for overweight/obese women with a psychiatric diagnosis.
Conclusion: These data support earlier research documenting increased risks of sleep disorders and complaints among women with psychiatric disorders; and extends the literature to include pregnant women. Prospective studies are needed to more thoroughly explore factors that mediate the apparent mood/anxiety-sleep comorbidity among pregnant women.

1224

SLEEP DISTURBANCES IN EARLY GESTATION ARE ASSOCIATED WITH INCREASED BLOOD PRESSURE

Haney A, Okun ML
Psychiatry, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Introduction: High blood pressure (BP) and increased BMI are linked to increased morbidity in both pregnant and non-pregnant individuals. Disturbed sleep during later pregnancy is associated with increased BP and BMI, and subsequent maternal and fetal morbidity. The association between early pregnancy aberrations in sleep parameters, such as sleep fragmentation, with blood pressure and BMI are not well established and warrant further investigation.
Methods: Actigraphy-assessed sleep information was collected from pregnant women (N = 158) in early pregnancy: 10-12 weeks, 14-16 weeks and 18-20 weeks. Disturbed sleep was dichotomized as sleep duration < 7 hours, sleep efficiency (<75%), and a sleep fragmentation index > 35. Following each data collection period anthropomorphic measures, including blood pressure (systolic and diastolic) and

BMI, were collected. Regression analyses were conducted to determine whether disturbed sleep was associated with increased blood pressure or increased BMI.
Results: Women were approximately 29 years of age with an average BP = 107/67 and BMI = 26.5 at week 12. As expected BP and BMI significantly increased over time (p's < .05). Women with poor sleep efficiency from week 10-12 (<75%) had significantly elevated blood pressure at week 12 (p <.05). This difference disappeared at week 16 and 20 (p's > .05). Short sleep and sleep fragmentation via actigraphy were not associated with BP or BMI.
Conclusion: Gestational hypertension and diabetes are common disorders of pregnancy which can lead to both maternal and infant morbidity and mortality. Disturbed sleep in early pregnancy may play a role in the development of these harmful conditions via alterations in BP and weight gain. Sleep is a modifiable factor and quantifying its relation to these disorders may have important implications for clinical interventions. A more thorough evaluation of subjective and objective sleep indices and their associations with BP and BMI is needed to better understand these relationships.
Support (If Any): NIH NR010813.

1225

FIRST AND SECOND TRIMESTER SERUM MARKERS IN PREGNANT WOMEN WITH SLEEP DISORDERED BREATHING

Bourjeily G[1], Lambert-Messerlian G[2], Curran P[1], Martin S[2], He M[1]
[1]Medicine, Brown University, The Miriam Hospital, Providence, RI, USA, [2]Pathology and Laboratory Medicine, Brown University / Women and Infants Hospital, Providence, RI, USA

Introduction: Sleep disordered breathing has been associated with adverse pregnancy outcomes such as gestational hypertensive disorders, including preeclampsia. The exact mechanism underlying these adverse outcomes has not been elucidated. Maternal serum markers used routinely in prenatal screening for Down syndrome, in particular inhibin A (inhA) and pregnancy associated plasma protein A (PAPP-A) have been associated with the development of preeclampsia. Placental inhA is secreted in response to a hypoxc environment and low PAPP-A levels are associated with impaired trophoblastic invasion (a precursor of preeclampsia). Given the suggested association of sleep disordered breathing and preeclampsia, we hypothesized that Inhibin A and PAPP-A may be abnormal in women with sleep disordered breathing pointing toward a potential mechanism for this association.
Methods: Records of pregnant women diagnosed with sleep disordered breathing were identified by ICD-9 codes and then reviewed for confirmation of the diagnosis, demographic information and pregnancy outcomes. Records were also reviewed for prenatal Down syndrome screening tests. First trimester PAPP-A levels and second trimester inhA levels had been determined at the time of sample receipt using automated 2-site chemiluminescence immunometric assays on the DXI (Beckman Coulter Inc., Chaska, MN). Marker levels are expressed as multiples of median (MoM), after correction for gestation-specific normative data and maternal weight.
Results: A total of 35 pregnant women with a diagnosis of sleep disordered breathing have been identified by ICD-9 code and record review. Median age was 29 + 5.5 years and median BMI was 44.65 + 9.4. Median gestational age at delivery was 38.9 + 4.4 weeks. A total of 14.2% of patients were diagnosed with preeclampsia in this group. Fourteen patients had available inhibin A levels and 18 had PAPP-A levels. Median levels of Inhibin A (1.06 MoM) were not altered in women with sleep disorderd breathing. However, median levels of PAPP-A were significantly reduced at 0.55 MoM and remain low (0.55 MoM) even after excluding patients who later developed preeclampsia .
Conclusion: PAPP-A, a first trimester marker that has been suggested for screening for preeclampsia, is significantly reduced in pregnant women diagnosed with sleep disordered breathing.
Support (If Any): Perkins Charitable Foundation.

1226

DO PREGNANT WOMEN ACCURATELY REPORT THEIR SLEEP TIME? A COMPARISON BETWEEN SELF-REPORTED AND OBJECTIVE MEASURES OF SLEEP DURATION AMONG A SAMPLE OF URBAN MOTHERS

Herring SJ[1,2], Foster GD[1,2], Pien GW[3], Massa KW[1], Nelson DB[2], Davey A[2]
[1]Department of Medicine, Center for Obesity Research and Education, Temple University, Philadelphia, PA, USA, [2]Department of Public Health, Temple University, Philadelphia, PA, USA, [3]Department of Medicine, Division of Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Survey questions are commonly used to assess sleep duration because of their low-cost and convenience. Responses to these questions typically correlate moderately with objectively measured sleep durations in non-pregnant individuals, but little is known about the validity of self-reported sleep measures in pregnancy. As pregnancy is a time period associated with increased sleepiness and fatigue, women may be prone to misreport actual time spent sleeping. However, direction of bias and factors associated with bias are unknown.
Methods: We analyzed data from 87 mothers enrolled in Project MOMMIES, a longitudinal study of urban pregnant women. Sleep measurements were collected in mid-pregnancy (mean 21 weeks' gestation) and included 7-days of wrist actigraphy along with a standard survey question about usual sleep duration ("During the past month, how many hours of actual sleep did you get at night?"). Paired t-tests and linear regression assessed agreement between subjective and objective measures of nocturnal gestational sleep duration.
Results: The majority of participants were Black (84%), high school graduates (67%), low-income (100% Medicaid), and < 25 years old (74%). Average measured nocturnal sleep duration was 6.9 hours (standard deviation [SD] 0.9), while subjective reports averaged 7.3 hours (SD 2.1; 0.4 hours longer than measured sleep). Mothers who slept < 6 hours per night were more likely to over-report average sleep time than those who slept 7 or more hours. Bias did not significantly vary by age, race, body mass index, parity, education, or sleepiness. Overall, there was a correlation of -0.01 (95% confidence interval -0.22, 0.20) between subjective and objective measures of sleep duration in pregnancy, indicating the ranking of individuals was not well preserved.
Conclusion: Self-reports of usual sleep hours do not reflect objectively measured sleep time in urban pregnant women. Actigraphy is preferable to accurately assess gestational sleep duration for this population.
Support (If Any): K23 HL106231.

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HYPERTENSIVE DISORDERS OF PREGNANCY AND SLEEP-DISORDERED BREATHING

O'Brien LM[1,2], Bullough AS[3], Shelgikar AV[1], Chames M[4], Armitage R[5], Johnson TR[4], Sullivan CE[6], Guilleminault C[7], Chervin R[1]
[1]Neurology, University of Michigan, Ann Arbor, MI, USA, [2]Oral & Maxillofacial Surgery, University of Michigan, Ann Arbor, MI, USA, [3]Anesthesiology, University of Michigan, Ann Arbor, MI, USA, [4]Obstetrics & Gynecology, University of Michigan, Ann Arbor, MI, USA, [5]Psychiatry, University of Michigan, Ann Arbor, MI, USA, [6]Medicine, University of Sydney, Sydney, NSW, Australia, [7]Psychiatry & Behavioral Sciences, Stanford University, Redwood City, MI, USA

Introduction: Gestational hypertension and pre-eclampsia affect approximately 10% of pregnancies in the United States. Emerging data suggest that sleep-disordered breathing (SDB) may play a role in hypertension during pregnancy. The goal of this study was to investigate the frequency of habitual snoring and objective evidence of SDB in women with hypertensive disorders of pregnancy.

Methods: Pregnant women with gestational hypertension or pre-eclampsia were prospectively enrolled and completed self-report assessments of sleep. All women also underwent portable nocturnal polysomnography (PSG). Habitual snoring was defined as snoring at least 3 nights/week. PSGs were scored according to AASM 2007 guidelines.
Results: Thus far 29 women with gestational hypertension/pre-eclampsia have enrolled. Mean gestational age at enrollment was 26.7±8.2 weeks, mean maternal age was 31.4±4.3 years, and mean BMI was 41.1±12.1kg/m2. In total 68% of the women reported habitual snoring. Mean values for key PSG variables were: apnea/hypopnea index (AHI) 15.1±20.0, respiratory disturbance index (RDI) 15.7±19.8, oxygen saturation (SpO2) 95.0±1.4%, and SpO2 nadir 88.5±4.3%. All women had an AHI≥1, 50% had an AHI≥5, 32% had AHI≥15, and 20% had an AHI≥30 (range 1.0-75.1). Compared to non-habitual snorers, women with habitual snoring had higher AHI (19.3±21.8 vs. 2.2±1.1, p=0.021) and RDI (19.6±21.8 vs. 3.7±2.0, p=0.028), lower mean SpO2 (94.6±1.1 vs. 96.0±1.4%, p=0.04), and lower SpO2 nadir (86.8±4.2% vs. 91.8±2.6%, p=0.01).
Conclusion: Women with hypertensive disorders of pregnancy are at high risk for SDB, and a significant proportion may have moderate-to-severe SDB. Habitual snoring among hypertensive pregnant women appears to be an excellent marker for more severe SDB. Further research, identification of effective screening strategies, and targeted education for obstetric healthcare providers may well be warranted.
Support (If Any): Gilmore Fund for Sleep Research, University of Michigan Institute for Research on Women and Gender, NIH K23HL095739, R21HL089918, R21HL87819, R01HL08094, R01HL105999, UL1RR024986, and M01RR000042.

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SLEEP CHARACTERISTICS AND GESTATIONAL WEIGHT GAIN IN HEALTHY NULLIPAROUS WOMEN

Tsai S[1], Chang J[2], Pien GW[3]
[1]Department of Nursing, National Taiwan University, Taipei, Taiwan, [2]Department of Epidemiology, Saint Louis University, St. Louis, MO, USA, [3]Sleep Medicine Division, University of Pennsylvania School of Medicine, Philadelphia, PA, USA

Introduction: Recent evidence has documented a relationship between short sleep duration and weight gain in adults and children. Few studies have investigated the effect of sleep during pregnancy on gestational weight gain. This study aimed to determine the association between sleep characteristics and rate of gestational weight gain.
Methods: This study included 110 healthy nulliparous women at ≥ 29 weeks of gestational age recruited from a large university medical center in Taipei, Taiwan. Exclusion criteria included shift workers, current medical complications, diagnosis of sleep disorders or depression, family history of narcolepsy, or use of medications known to affect sleep. Participants wore wrist actigraphy monitors for seven continuous days to estimate sleep parameters. Sleep quality was derived from Pittsburgh Sleep Quality Index (PSQI). Rate of gestational weight gain was calculated as total gestational weight gain divided by completed weeks of gestation. Multiple linear regression models were used to examine the relation between sleep characteristics and rate of gestational weight gain.
Results: Participants' mean age was 31.58 ± 4.40 years old with a mean gestation of 32.41 ± 2.61 weeks. Majority of participants were employed with an average of 8.58 ± 1.73 daily work hours. Sixty-three (57.27%) women experienced poor sleep quality, defined by a PSQI global score >5. Mean nocturnal sleep duration was 389.87 ± 51.54 minutes, with average sleep efficiency 80.62 ± 5.93%. Sleeping < 7 hours per 24 hours was significantly associated with greater rate of gestational weight gain (β=0.049; p=0.03) after controlling for maternal age, education years, daily working hours, and pre-pregnancy BMI.
Conclusion: Findings from the present study suggest that short sleep duration in late pregnancy is associated with greater gestational weight gain. Prospective studies to examine the relationship between sleep duration and gestational weight gain and to understand the causal mechanisms are needed.
Support (If Any): This work was funded by National Science Council, Taiwan, NSC 99-2314-B-002-002.

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ASSOCIATIONS BETWEEN NAPPING, SLEEP, AND MOOD DURING THE THIRD TRIMESTER OF PREGNANCY: PRELIMINARY RESULTS

Hoepper AL[1,2], Machan JT[1,3], Mepham ER[2,3], Pearlstein TB[3,4], Sharkey KM[1,2,3]
[1]Rhode Island Hospital, Providence, RI, USA, [2]Sleep for Science Research Laboratory, Providence, RI, USA, [3]Brown University, Providence, RI, USA, [4]Lifespan Women's Health Collaborative, Providence, RI, USA

Introduction: Naps can improve alertness and mood in non-pregnant adults. In individuals with insomnia, however, naps can disrupt nighttime sleep. Pregnant women experience disturbed sleep, and napping is a common phenomenon during pregnancy. The purpose of this analysis was to examine associations between napping, daily ratings of mood and sleepiness, and objectively estimated nighttime sleep in pregnant women.
Methods: 14 pregnant women (ages 23-37, mean±SD=29.5±5.1 years) with a history of depression or bipolar disorder (but not in a current mood episode) wore wrist actigraphs and completed daily sleep diaries for one week during third trimester. Diary reported naps were verified by actigraphy. Naps observed on actigraphy but not reported on diaries were identified by interviews at the end of monitoring. Women also completed nightly mood and sleepiness scales. Nighttime sleep period (SPT), total nighttime sleep (TST), and nighttime sleep efficiencies (SLEFF) were estimated from actigraphy data using the Sadeh algorithm (1994) in Action-W software (AMI, Ardsley, NY). We used generalized estimating equations to compare sleep and mood measures on days participants did and did not nap. One participant's data was excluded due to movement artifact when she napped on the train.
Results: Data were available for a total of 88 days (mean=6.8 days/participant). Three diary-reported naps could not be verified by actigraphy; 8 actigraphy-identified naps not reported on diaries were confirmed by interview. A total of 28 naps were scored [mean±SD=3.3±2.6 naps per person, range=1-8 naps]. Average daily nap length was 50±40 mins (range=6-144 mins). We observed a marginally-significant difference in SPT on nights after naps compared to nights with no naps [F(1,9)=5.38, p=0.0455]. The mean SPT (95%CI) was 500 mins (95%CI 474-528 minutes) on no-nap days versus 459 mins (95%CI 421-502 minutes) on days with ≥ 1 nap. Napping was not related significantly to sleepiness or mood ratings, TST, or SLEFF.
Conclusion: In this small sample, we did not observe significant relationships between napping and TST, SLEFF, subjective sleepiness, or depressed mood. Women tended to spend less time in bed the night following a daytime nap, perhaps reflecting a partial dissipation of sleep homeostatic drive during the day. Future analyses will examine associations among naps, sleepiness, and mood in a larger sample and include the postpartum period.
Support (If Any): MH086689 (KMS).

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WOMEN'S WORK STATUS AND SLEEP DURING THE PERINATAL PERIOD: PRELIMINARY RESULTS

Mepham ER[1,2], Hoepper AL[2,3], Pearlstein TB[1,4], Sharkey KM[1,2,3]
[1]Brown University, Providence, RI, USA, [2]Sleep for Science Research Laboratory, Providence, RI, USA, [3]Medicine, Rhode Island Hospital, Providence, RI, USA, [4]Women's Behavioral Medicine, Women's Health Collaborative, Lifespan, Providence, RI, USA

Introduction: Work demands and work stress have been associated with poor sleep quality. Our objective was to examine the association of work status and sleep in women during the third trimester of pregnancy (3tdT) and 16 weeks postpartum (16PP).
Methods: As part of an ongoing study, women (n=14, ages 23-37, mean±SD=29.5±5.1 years) with a history of major depression or bipolar disorder (but not in a mood episode at 3rdT) wore wrist actigraphs and kept daily sleep diaries for one week at 3rdT and 16PP. Total sleep time (TST) and sleep efficiency (SLEFF) were estimated from actigraphy data using the Sadeh algorithm (1994) in Action-W software (AMI, NY). Full-time work was defined as working for pay at least 4 full days per week and part-time work was defined as work outside the home for pay < 4 full days. We used T-tests to compare mean TST and SLEFF between work status groups. Chi-square was used to determine whether workers were more likely to have lower sleep times than part-time or non-workers.
Results: Data were available for 13 women at 3rdT and 8 women at 16PP. At 3rdT, 5 women worked full time, 3 women worked part-time, and 5 women did not work. 3rdT median TST was 412 minutes. At 3rdT, 80% of full-time workers had TST below the median TST, compared to 37.5% of part-time/non-working women (Chi-Square (df=1)=2.24, p=.14). Mean 3rdT TST and SLEFF were 392±42 minutes and 82.5±8.3% for full-time workers and 417±77 minutes and 85.1±7.6% for part-time/non-workers. Neither 3rdT TST (t=.669, p=ns), nor SLEFF (t=.580, p=ns) differed statistically as a function of work status. At 16PP, zero women worked full time, 3 worked part-time, and 5 did not work. 16PP median TST was 383 minutes. At 16PP, 100% of part-time workers had TST below the median TST, compared to 20% of non-working women (Chi-Square (df=1)=4.80, p=.03). Average 16PP TST and SLEFF were 377±7 minutes and 78.0±8.4% for part-time workers and 401±59 minutes and 80.6±6.7% for non-workers. Neither 16PP TST (t=.682, p=ns), nor SLEFF (t=.488, p=ns) differed statistically as a function of work status.
Conclusion: Adequate sleep is key during the perinatal period because of the association of poor sleep with adverse health outcomes. We observed no statistically-significant differences in mean TST or SLEFF based on work status in this small sample. Future analyses will examine the association of work patterns and sleep in the perinatal period in a larger sample and will include other factors including parity, breastfeeding, and social support.
Support (If Any): K23-MH086689 to KMS. ERM is supported by the Helen Terry MacLeod Research Grant awarded by the Pembroke Center for Teaching and Research on Women at Brown University.

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THE RELATIONSHIP BETWEEN SNORING AND PREGNANCY OUTCOMES IN PREGNANT WOMEN AT KORLE BU TEACHING HOSPITAL, ACCRA, GHANA

Owusu JT[1], Anderson FJ[2], Coleman J[3], Oppong S[3], Seffah J[3], Obed S[3], Aikins A[3], O'Brien LM[1,4]
[1]Neurology, University of Michigan, Ann Arbor, MI, USA, [2]Obstetrics and Gynecology, University of Michigan, Ann Arbor, MI, USA, [3]Obstetrics and Gynecology, University of Ghana, Accra, Ghana, [4]Oral & Maxillofacial Surgery, University of Michigan, Ann Arbor, MI, USA

Introduction: Ghana has an overwhelming maternal mortality ratio of 450 per 100,000 live births with 12% attributable to hypertensive disorders of pregnancy, particularly pre-eclampsia. Research suggests that pregnant women who snore (a marker of sleep-disordered breathing) are at increased risk for gestational hypertension and pre-eclampsia as well as perinatal morbidity. However, this has not been previously studied in developing countries. Therefore, we hypothesized that snoring may contribute to the high prevalence of pre-eclampsia in Ghana.
Methods: As a part of a larger study, Ghanaian women were recruited from maternity wards within 48-hours of delivery and interviewed about their sleep quality. Snoring was defined as a positive response to: "Did you snore loudly in the past week?". Demographic data and pregnancy outcomes were obtained from medical records.
Results: Among the 234 women approached, 232 (99%) agreed to participate. Twelve participants were excluded due to missing data in medical records, thus the final sample size was 220. Mean age was 28.9±5.7 years, and mean parity was 1.35±1.38. Overall, 26 women (12%) had pre-eclampsia, and 53 women (24%) reported snoring. Women who snored, compared to those who did not, were significantly more likely to have pre-eclampsia (23% vs. 8%, p=0.005). We found no difference in gestational age at delivery (38.6±2.5 vs. 38.5±3.0 weeks; p n.s.) or birth weight (3083.27±629.56 vs. 3041.70±676.01 grams; p n.s.) of infants born to women with and without snoring. In a logistic regression, the presence of snoring was independently associated with preeclampsia, adjusted odds ratio 3.52 (95%CI 1.48-8.36, p=0.004).
Conclusion: Findings are consistent with similar studies in Western countries, suggesting that snoring during pregnancy may confer a risk to maternal morbidity in Ghana. Screening for snoring may improve maternal health outcomes in developing countries where maternal morbidity rates are high.
Support (If Any): University of Michigan Center for Human Growth and Development Minority Health and Health Disparities International Research Training Program (MHIRT).

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SHORT SLEEP DURATION AND ASSOCIATED PREGNANCY OUTCOMES AMONG OBESE WOMEN

Louis J[1], Auckley D[2], Mencin P[1], Shepherd A[1], Redline S[3]
[1]Division of Maternal Fetal Medicine and Department of Obstetrics & Gynecology, MetroHealth Medical Center, Case Western Reserve University, Cleveland, OH, USA, [2]Division of Pulmonary, Critical Care and Sleep Medicine, MetroHealth Medical Center, Case Western Reserve University, Cleveland, OH, USA, [3]Department of Medicine and Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Studies have indicated that short sleep duration may be associated with adverse pregnancy outcomes. We sought to investigate the impact of short sleep duration independent of obstructive sleep apnea (OSA) on pregnancy outcome among obese pregnant women.
Methods: Participants in an observational cohort of obese pregnant women (BMI >30 kg/m2) underwent overnight sleep studies for OSA at 8-20 weeks of gestation using a portable home monitor (ARES Unicoder; Carlsbad, CA). Subjects completed standardized sleep questionnaires: Epworth Sleepiness Scale (ESS) and Fatigue Severity Score (FSS) and self reported sleep duration during early pregnancy. Short sleep duration (SSD) was defined as the 1st quartile of sleep duration (< 5 hrs/night). Data were analyzed utilizing ANOVA, trend analysis, and chi square.
Results: Of the 170 participants, 24 (14%) had an apnea hypopnea index ≥5 and were excluded. Sleep duration quartiles were: 1st :< 5h, 2nd: 5-6.5h, 3rd:6.5-8h and 4th :> 8h. Women with SSD were older than other participants (29 vs. 27, 25 and 22 years, p<0.001) but had similar BMI (39 vs. 38, 38 and 37 kg/m2, p=0.29) and gestational weight gain (6 vs. 9, 10 and 9 kg, p=0.3). Women with SSD when compared to the other quartiles had a higher ESS score (10 vs. 9, 7, and 6; p=0.001) and FSS (37 vs. 30, 30, 26; p=0.02) and more frequent preterm birth (17 vs.

6, 8 and 5%, p=0.06) and lower birthweight (2937 vs. 3294, 3237, 3364 grams, p=0.08) but similar preeclampsia rates (10 vs. 15, 17, 17, p=0.8).
Conclusion: Shorter sleep duration was associated with increased sleepiness, and fatigue, with a trend for higher rates of preterm birth and lower birthweight. The high prevalence of short sleep among obese pregnant women supports the need for further research on the role of sleep on maternal and fetal outcomes.
Support (If Any): Robert Wood Johnson Foundation Physician Faculty Scholar Program Case Western Reserve University/Cleveland Clinic CTSA Grant Number UL1 RR024989 from the National Center for Research Resources (NCRR),.

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LACK OF ASSOCIATION BETWEEN OBJECTIVELY MEASURED SLEEP-DISORDERED BREATHING IN PREGNANT WOMEN AND GESTATIONAL HYPERTENSION OR PREECLAMPSIA

Pien GW[1], Pack A[1], Jackson NJ[1], Maislin G[1], Macones G[2], Schwab R[1]
[1]Center for Sleep and Circadian Neurobiology, University of Pennsylvania School of Medicine, Philadelphia, PA, USA, [2]Department of Obstetrics and Gynecology, Washington University, St. Louis, MO, USA

Introduction: Symptoms of sleep-disordered breathing (SDB) are common among pregnant women, and several studies have linked SDB symptoms with gestational hypertension and preeclampsia. However, few prospective studies or studies objectively measuring SDB during pregnancy have been performed. We performed a prospective cohort study in which we examined the relationship between objectively measured SDB and the hypertensive disorders of pregnancy (gestational hypertension and/or preeclampsia).
Methods: 105 pregnant women from the Hospital of the University of Pennsylvania obstetrics practices completed first and third trimester overnight polysomnography studies. After delivery, charts were abstracted for data on hypertensive disorders of pregnancy and other maternal-fetal outcomes. We performed logistic regression analyses using baseline and third trimester SDB variables in continuous and dichotomized form as predictors to examine the relationship between SDB and gestational hypertension and preeclampsia.
Results: Mean subject age was 26.7 (SD 7.2) years. 75% of all subjects were African-American. Mean first trimester BMI was 33.4 (SD 6.4) kg/m2. Women delivered at a median of 39.1 (SD 2.0) weeks gestation. 10.5% of women had OSA (AHI>=5 events/hour) in the first trimester. By the third trimester, 26.7% of women had OSA. Twenty subjects developed a hypertensive disorder of pregnancy (gestational hypertension, n=9; preeclampsia, n=10; both, n=1), including 1 with chronic hypertension who developed preeclampsia. In unadjusted analyses restricted to subjects without chronic hypertension (n=100), there were no significant associations between first or third trimester AHI, first or third trimester OSA, or change in AHI and the hypertensive disorders of pregnancy. There was a significant association between nulliparity (a known risk factor for preeclampsia) and the hypertensive disorders of pregnancy (p=0.04).
Conclusion: OSA, whether assessed either early or late in pregnancy, was not associated in this prospective study with the development of gestational hypertension or preeclampsia.
Support (If Any): National Institutes of Health (K23HD41465) and American Heart Association (0230190N).

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ADVERSE PREGNANCY OUTCOMES IN WOMEN WITH SLEEP DISORDERED BREATHING

Bourjeily G[1], Curran P[1], Lambert-Messerlian G[2], Martin S[1], He M[2]
[1]Medicine, Brown University, The Miriam Hospital, Providence, RI, USA, [2]Pathology and Laboratory Medicine, Brown University / Women and Infants Hospital, Providence, RI, USA

Introduction: Snoring has been associated with adverse outcomes including gestational hypertensive disorders, gestational diabetes, higher rates of cesarean deliveries as well as preterm labor. Data on outcomes of polysomnographically diagnosed sleep disordered breathing are scarce. The goal of this study was to compare outcomes of polysomnographically diagnosed sleep disordered breathing to those of pregnant women at low risk for the disorder.
Methods: A retrospective review of records of pregnant women diagnosed with sleep disordered breathing identified by ICD-9 codes was performed (Sample 1). Demographic information and outcomes were collected. Another cross sectional study systematically recruited women at the time of delivery and surveyed them for the presence of sleep disordered breathing symptoms using the multivariable apnea prediction index questions (Sample 2). Pregnancy outcomes of this sample were also collected. Two groups of controls were identified from Sample 2. Control group 1 had BMI <30 and no symptoms of sleep disordered breathing (no apnea, snoring or gasping). Control group 2 had BMI >30 and no symptoms of sleep disordered breathing.
Results: A total of 35 women with a confirmed diagnosis of sleep disordered breathing were identified (Sample 1). Out of Sample 2, 268 women were identified as control group 1 and 45 as control group 2. Median age in the case group was 29 + 5.5; 28.0 + 6.1 in Control group 1; 25 + 5.0 in Control group 2. Median BMI was 44.6+ 9.4 in the case group; 22.5 + 3.0 in control group 1; 34.8 + 4.04 in control group 2. There was a significantly higher likelihood of gestational diabetes in the case group compared to control group 1 (31.4% and 5.9% respectively, p=0.003) and to control group 2 (31.4% and 6.6% respectively, p=0.007). There was also a higher likelihood of gestational hypertensive disorders in the case group when compared to control group 1 (22.8% and 5.2%, p=0.02) and control group 2 (22.8% and 6.6%, p=0.05). There were no significant differences when control group 1 was compared to control group 2 for either gestational diabetes or gestational hypertensive disorders.
Conclusion: Pregnant women with sleep disordered breathing are more likely to have gestational hypertensive disorders and gestational diabetes than lean and obese pregnant women without symptoms of sleep disordered breathing.
Support (If Any): Perkins Charitable Foundation.

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EFFECTS OF A BEHAVIORAL SLEEP INTERVENTION ON POSTPARTUM SLEEP: A RANDOMIZED PILOT TRIAL

Stone KC
[1]Psychiatry & Human Behavior, The Warren Alpert Medical School of Brown University, Providence, RI, USA, [2]Pediatrics, Women & Infants Hospital, Providence, RI, USA

Introduction: Emerging research supports the efficacy of behavioral sleep interventions among postpartum women. We hypothesize that we can improve sleep duration and sleep consolidation of postpartum women with a history of smoking as a potential strategy for improving their ability to remain smoke-free. This study documents the sleep outcomes following 5 weeks of behavioral sleep intervention.
Methods: Twenty postpartum mothers (mean age 25.1 years [SD = 4.18], 25% minority, 85% low SES, 65% unmarried, 50% with other children at home) were enrolled in the hospital after the birth of their babies prior to discharge. Baseline sleep data was collected using wrist actigraphy (Octoganol Basic, AMI) and sleep diaries. These measures yielded values of Nocturnal Total Sleep Time (NTST), Night Wake Min-

utes (NWM), and Longest Sleep Bout (LB), which we used to compare the intervention group to the control group on sleep duration and consolidation. Post-treatment sleep data was collected around week 7.
Results: Independent t-tests revealed no significant baseline differences on any of the 3 sleep outcomes. Post-treatment, the intervention group had significantly more NTST (433.06 [68.96] mins) than the control group (373.77 [38.67]), t (18) = 2.294, p = .034; significantly less NWM (91.92 [29.53]) than the control group (124.72 [35.52]), t (18) = -2.257, p = .037; and longer LBs (M = 139.32 [38.12] mins) than the control group (M = 105.39 [32.84]), t (18) = 2.105, p = .050.
Conclusion: Consistent with preliminary results, our behavioral sleep intervention significantly lengthens and consolidated the sleep of new mothers during the first 7 weeks postpartum compared with controls. These results will be updated based on a larger sample size available by the meeting date. Better sleep may lead to better daytime functioning for postpartum women, which is particularly important for new mothers seeking to remain smoke-free.
Support (If Any): NIH - NIDA 1R21DA026448-01 (PI: K. Stone).

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EARLY TO BED, EARLY TO RISE… POSTPARTUM CHRONOTYPE AND REACTION TIME
McBean A, Montgomery-Downs H
Psychology, West Virginia University, Morgantown, WV, USA

Introduction: Postpartum women have highly fragmented sleep, which makes them vulnerable to daytime impairment. Little research has looked at relations between chronotype and performance among postpartum women. Our goal was to describe associations between sleep midpoint, morningness-eveningness, and performance throughout the first three postpartum months.
Methods: Seventy primiparous mothers (26.3 years, 94% white, $60,000 household income) wore an actigraph for 12 continuous weeks, beginning at postpartum week two. Nightly sleep midpoints were averaged across postpartum week two based on actigraphy and corroborative sleep diary reports. Mothers self-administered a psychomotor vigilance test within two hours after awakening and before drinking caffeine each morning during the study period. A morningness-eveningness survey was filled out at prenatal recruitment.
Results: After controlling for age, income, and total sleep time, partial correlations revealed that an earlier sleep midpoint at postpartum week 2 was associated with significantly faster reaction times on the psychomotor vigilance test at postpartum weeks 5-8 and fewer lapses at postpartum weeks 5-8,10-13 ($p<.05$ at each week). More morning-type women had significantly faster reaction times at postpartum weeks 2 and 13 and significantly fewer lapses at postpartum week 2. Morning-type women were also more likely to have an earlier sleep midpoint ($r=-.687$, $p<.001$).
Conclusion: Across the first three postpartum months, healthy postpartum women with an earlier chronotype had significantly faster reaction times and fewer lapses. These results suggest benefits of an earlier sleep period for postpartum women on daytime functioning including fewer micro-sleeps, which has direct implications on likelihood of falling asleep while driving. Due to the danger of micro-sleeps, postpartum interventions should consider including sleep scheduling.
Support (If Any): Funding provided by NIH grant R21HD053836 (HMD).

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POSTPARTUM SLEEP CHANGES IN WOMEN AT HIGH AND LOW RISK FOR DEPRESSION
Swanson L, Bertram H, Fordyce J, Hoffmann RF, Armitage R
Psychiatry, University of Michigan, Ann Arbor, MI, USA

Introduction: Major sleep changes are common during the postpartum period. Women are also at serious risk for depression around the childbearing period. The purpose of this study is to examine changes in sleep in women at high and low risk for postpartum depression (PPD) during the postpartum period.
Methods: Twenty-two women (33±4 years of age) at high (n=15) and low (n=7) risk for PPD completed 6-7 days of wrist actigraphy and a sleep diary at 2 weeks and 6 months postpartum. Women were classified as high risk if they scored > 10 on the Edinburgh Postnatal Depression Scale or had a past history of depression based on SCID-IV. Low risk women had no family or personal history of depression. Actigraphy-derived sleep measures included time in bed, total sleep time, sleep latency, sleep efficiency, and sleep fragmentation.
Results: T-tests indicated no differences between sleep measures in high and low risk women at 2 weeks postpartum. However, repeated measures ANOVA ($p=.03$) indicated that low risk women had a significantly greater increase in sleep efficiency between 2 weeks and 6 months postpartum (71%±1% to 85%±1%) relative to the high risk group (76%±1% to 81%±1%). A main effect for time was observed for sleep fragmentation; both groups experienced less fragmentation at 6 months relative to two weeks postpartum.
Conclusion: Our data indicate that sleep patterns immediately postpartum are relatively similar for women at high and low risk for PPD. However, by six months postpartum, low risk women have made significant gains in their sleep consolidation, whereas the sleep efficiency of women improved only slightly. This suggests that vulnerability to PPD may manifest in impaired recovery of sleep consolidation. We are continuing to explore how sleep patterns in the infants of these women affect maternal sleep.
Support (If Any): Berman Family Fund (Armitage).

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POSTPARTUM WEIGHT RETENTION AND POST-PARTUM SLEEP DURATION IN OBESE WOMEN
Louis J[1], Redline S[2], Shepherd A[1], Auckley D[3]
[1]Division of Maternal Fetal Medicine and Department of Obstetrics & Gynecology, MetroHealth Medical Center, Cleveland, OH, USA, [2]Division of Pulmonary, Critical Care and Sleep Medicine, MetroHealth Medical Center, Case Western Reserve University, Cleveland, OH, USA, [3]Department of Medicine and Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: We sought to investigate the impact of gestational weight retention on postpartum symptoms of abnormal sleep and sleep duration among obese pregnant women.
Methods: Participants in an observational cohort of obese pregnant women (BMI >30 kg/m2) were evaluated at two time points: at 8-20 weeks of gestation and 6-8 weeks postpartum. Evaluation for SDB included a portable home monitor (ARES Unicoder; Carlsbad, CA), completed standardized sleep surveys: Epworth Sleepiness Scale (ESS) and the Fatigue Severity Scale (FSS) and self-reported sleep duration. Electronic medical records were reviewed for clinical data. Data were analyzed utilizing paired t-test and Spearman's correlation.
Results: The sample consisted of 13 participants. On average these women were 27±7 years old, had a prepregnancy BMI of 36±5kg/m2. Thirty percent had chronic hypertension and 23% had pregestational diabetes. The median AHI was 0.15(range 0-2.69.), and overall the group reported a mean ESS of 9±4, FSS of 36±11 and 6.6±2 hours of sleep per night. Gestational weight gain was on average higher than the Institute of Medicine recommendations for this group (14±8kg). At the postpartum visit, three subjects had lost weight compared to their prepregnancy weight but the remaining women were heavier than their prepregnancy weight. The overall weight retention for the group was 9.6±16kg, $p=0.05$. During the postpartum period, there was no significant change in AHI (+.09±1.1, $p=0.78$) or ESS score (=+0.08±3, $p=0.92$) but there appeared to be a slight decrease in fatigue score (-6±12, $p=0.06$) despite a reported decrease in sleep duration (-1.3±2.3, $p=0.07$). Postpartum

change in weight was correlated with change in sleep duration (r=0.55, p=0.04) but not the change in AHI (r=-0.1, p=.74).
Conclusion: Obese pregnant women had high postpartum weight retention and decreased sleep sleep duration. Given other evidence implicating short sleep with obesity, these data suggest a potential utility for efforts to improve sleep during the post-partum period.
Support (If Any): Robert Wood Johnson Foundation Physician Faculty Scholar Program Case Western Reserve University/Cleveland Clinic CTSA Grant Number UL1 RR024989 from the National Center for Research Resources (NCRR),.

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LONG-TERM MATERNAL RECOVERY FROM POSTPARTUM SLEEP DISTURBANCE

Montgomery-Downs H, McBean A
Psychology, West Virginia University, Morgantown, WV, USA

Introduction: Our cumulative work shows moderate to severe maternal daytime sleepiness at postpartum week 6 and worsening neurocognitive performance through week 12. Although sleep improves across this period, it may not be sufficient to both meet sleep need and to reduce accumulated debt. The goal of this preliminary study was to assess when daytime sleepiness returns to normal.
Methods: Eleven primiparous women 8-32 months postpartum with no history or symptoms of sleep or mental health disorders participated. They were white non-Hispanic, cohabitating, 31(±6) years old, with 17.3(±3) years of education, and $63,300(±$26,700) household income; 64% were employed full-time. Their infants were all born full-term and healthy. Each woman wore an actigraph for 7 days, followed by standard 4-nap Multiple Sleep Latency Test (MSLT).
Results: Average Total Sleep Time (min) and Sleep Efficiency (%) by postpartum age were 440min and 90% at 8months (n=2); 446min and 92% at 12months (n=3); 412min and 90.2% at 15months (n=2); 405min and 89% at 18months (n=1); and 432min and 93% at 30months (n=3). The night preceding MSLT did not differ from the week average for total sleep time (p=.94) or sleep efficiency (p=.48). MSLT scores by age period were 6min at 8months, 12min at 12months, 17min at 15months, 8min at 18months, and 9min at 30months. Across this period, 18% of women fell asleep in the pathological range (<5min), 27% in the moderate range (5-10min), 36% in the mild range (10-15min) and only 18% in the normal range (15-20min).
Conclusion: Despite apparently normal sleep duration and efficiency, healthy women between 8 and 30 months postpartum with no diagnosis or symptoms of sleep or mental health disorders have significant daytime sleepiness. These preliminary data suggest potential long-term effects of postpartum sleep disturbance that should be further explored and may point to a healthcare and public policy concern.

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PARENT INFORMATION ON PARENT AND INFANT SLEEP: TRIAL OF A SLEEP INTERVENTION FOR FIRST TIME MOTHERS IN EARLY POSTPARTUM

Sweeney BM[1], Signal L[1], Babbage DR[2]
[1]Sleep/Wake Research Centre, Massey University, Wellington, New Zealand, [2]School of Psychology, Massey University, Wellington, New Zealand

Introduction: Alterations in usual sleep are universal among peripartum women. Prospective mothers receive little information about realistic sleep patterns or strategies for coping. Further, minimal evidence-based information is available on coping with and promoting infant sleep in the early postpartum. The aim of this study was to trial a behavioural-educational intervention to promote maternal and infant sleep in the first three months. Results for maternal sleep at six weeks are reported.
Methods: Forty primiparous women were assigned to either an intervention or control group. Intervention participants attended a 2-hour prenatal sleep education session, and received weekly postnatal support phone calls during weeks 1-6. Control participants attended a 1-hour prenatal general information session and received two contact-only phone calls in weeks 1-6. All mothers and babies completed 48-hours of actigraphy, sleep diaries and questionnaires at 6 and 12-weeks postpartum. Questionnaires pertaining to sleep, health, mood and psychosocial factors were completed at 35-37 weeks gestation and 12-weeks postpartum. Intervention group mothers received a comprehensive information booklet.
Results: At 6-weeks postpartum there was a trend for mothers in the intervention group for less total sleep time in 24-hours than control group mothers by 17 minutes (p = .26). However, intervention group mothers' mean longest sleep episodes were 16 minutes greater (p = .26). Using the General Sleep Disturbance Scale, 37% of control mothers were classified as poor sleepers compared to 16% of intervention mothers. The impact of sleepiness on daytime function was also greater in control mothers (30% compared to 20% in intervention group). Intervention group mothers reported higher levels of confidence in understanding and managing infant sleep, especially in relation to recognising infant cues and tired signs (t(32)=-2.29, p<.03).
Conclusion: Although most differences did not reach statistical significance, mothers in the intervention group had longer episodes of sleep and were more confident in managing their infants sleep. These strategies warrant further investigation in a larger sample.
Support (If Any): Health Research Council of New Zealand Project Grant (09/233).

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SLEEP DISTURBANCE IS ASSOCIATED WITH CARDIOVASCULAR AND METABOLIC DISORDERS

Pak VM[1,2], Grandner MA[1,2], Jackson NJ[1,2], Gehrman P[1,3]
[1]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA, [2]Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA, [3]Department of Psychiatry, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Existing research has demonstrated associations between sleep duration and obesity, diabetes, cardiovascular disease, and mortality. Also, sleep disorders research has shown that sleep apnea, insomnia, and other sleep disorders confer risk for cardiometabolic disease, particularly in the presence of reduced sleep duration. However, these findings do not focus on general sleep disturbance which is a valuable and sensitive estimate of suboptimal sleep. The aim of the present study was to examine the associations between general sleep disturbance as measured in a large, nationally-representative sample, and self-reported history of myocardial infarction, stroke, coronary artery disease, diabetes, and obesity.
Methods: Data from the 2006 Behavioral Risk Factor Surveillance System (BFRSS) were analyzed (n=138,201). Sleep Disturbance was operationalized as "difficulty falling asleep, staying asleep, or sleeping too much" and dichotomized into sleep complaints ≥6/14 days and ≤6/14 days. A population-weighted, binary logistic regression analysis examined associations after adjustment for age, sex, race/ethnicity, education, income, marital status, employment, census region, mental health, health insurance, access to healthcare, smoking, alcohol, and physical health.
Results: After adjusting for demographic, socioeconomic, and health risk factors, sleep disturbance was associated with obesity (OR=1.18,p<.0005), diabetes (OR=1.18,p<.005), myocardial infarction (OR=1.36,p<.0005), stroke (OR=1.22,p<.05), and coronary artery disease (OR=1.59,p<.0005). In fully-adjusted models that included physical health factors, significant relationships remained for obesity (OR=1.14,p<.0005), myocardial infarction (OR=1.23,p<.005), and coronary artery disease (OR=1.43,p<.0005).
Conclusion: Sleep disturbance occurring at least 3 of 7 nights on average is a significant risk factor for obesity, diabetes, myocardial infarction, stroke, and coronary artery disease. Effects for obesity, myocardial

infarction and coronary artery disease were the most robust after adjustment. This study demonstrates that sleep disturbance is a novel risk factor that is potentially modifiable. Future research should determine whether sleep intervention could reduce the cardiometabolic consequences of sleep disturbance.
Support (If Any): This work was supported by T32HL007713. We wish to thank the Centers for Disease Control and Prevention for collecting this data and making it available, as well as the BRFSS participants. We also wish to thank Allan Pack MB, ChB, PhD and Karen Teff PhD for guidance and support.

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SLEEP DEPRIVATION AND NEURAL CARDIOVASCULAR REACTIVITY IN HUMANS

Carter JR[1], Durocher JJ[1], Larson RA[1], DellaValla JP[2], Yang H[1]
[1]Kinesiology and Integrative Physiology, Michigan Technological University, Houghton, MI, USA, [2]Center for Sleep Medicine, Androscoggin Valley Hospital, Berlin, NH, USA

Introduction: Sleep deprivation has been linked to hypertension, and recent evidence suggests that associations between short sleep duration and hypertension are stronger in women. We hypothesize that 24-hour total sleep deprivation (TSD) will elicit augmented sympathetic neural and cardiovascular reactivity in women compared to men.
Methods: Heart rate (HR), blood pressure (BP), and muscle sympathetic nerve activity (MSNA) were measured in 30 normotensive subjects (age, 22±1 yrs; 15 men and 15 women) at rest (10 min) and during mental stress (5 min of mental arithmetic). Spontaneous fluctuations of diastolic arterial pressure and MSNA were used to assess sympathetic baroreflex sensitivity (BRS). Subjects were compared after normal sleep and TSD (randomized, crossover design; repeated-measures ANOVA) approximately one month apart to control for menstrual phase.
Results: TSD elicited similar increases in resting systolic, diastolic, and mean BP in men and women (time, $P<0.05$; time×sex, $P>0.05$). TSD reduced MSNA in men (25±2 to 16±3 bursts/100heart beats; $P=0.02$), but not women. TSD did not alter sympathetic BRS in either sex. However, TSD significantly shifted the sympathetic baroreflex operating point downward and rightward in men only (0.40±0.04 to 0.27±0.07 bursts/100hb/mmHg; $P=0.03$). TSD reduced testosterone in men only, and these reductions were correlated to reductions in resting MSNA ($r=0.59$, $p=0.04$). Resting HR and estradiol were not altered by TSD in either sex, and progesterone decreased similarly in both sexes. Mental stress increased HR, BP, and MSNA in both men and women, but these responses were not altered by TSD or sex (time×condition×sex, $P>0.05$).
Conclusion: TSD increases resting BP in both sexes, but only men demonstrate altered resting MSNA. Sex differences in resting MSNA are associated with sex differences in sympathetic baroreflex function (i.e., operating point) and testosterone. These findings may help explain why associations between TSD and hypertension appear sex-dependent.
Support (If Any): National Institutes of Health (HL-098676).

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GENDER DIFFERENCES IN RELATIONSHIPS AMONG DIETARY NUTRIENTS AND SLEEP SYMPTOMS IN THE AMERICAN POPULATION

Izci Balserak B[1], Jackson NJ[1], Gerstner JR[1], Knutson KL[2], Pien GW[1], Grandner MA[1]
[1]Division of Sleep Medicine and the Center for Sleep and Respiratory Neurobiology, University of Pennsylvania School of Medicine, Philadelphia, PA, USA, [2]Department of Medicine, Section of Endocrinology, University of Chicago, Chicago, IL, USA

Introduction: There is evidence to support the effect of nutrition on sleep, but previous studies have not addressed gender differences in this relationship.
Methods: Data from the 2007-2008 NHANES were used (N=5061, 51% women). Self-reported sleep symptoms (Difficulty Falling Asleep, Frequent Awakenings, Unrestful Sleep, and Daytime Sleepiness) were dichotomized to those reporting a problem 16-30 vs <16 days/month. Sleep duration was categorized as VeryShort (<5h), Short (5-6h), Normal (7-8h) or Long (>8h). 24-hr recall of diet and computation of nutrition profile was performed using validated procedures. All analyses were adjusted for total calories, number of foods, special diet, comparison to typical intake, age, race/ethnicity, education, household income, exercise (minutes), and BMI (objective). All nutrients were evaluated in absolute intake (e.g., mg/day) except fatty acids (ratio of that fatty acid to total saturated/monounsaturated/polyunsaturated, depending on type). Population weighted logistic regression examined whether nutrients were associated with sleep symptoms and duration separately for men and women. $P<0.05$ was considered statistically significant.
Results: Some relationships between sleep and diet were significant for one gender but not the other. However gender interactions were not significant. Difficulty Falling Asleep was associated with decreased intake of retinol, Vitamin-A(RAE), alpha-carotene, Vitamin-B1, choline, phosphorus, magnesium, copper, potassium and selenium, but only in women. Frequent Awakenings were associated with decreased fiber, lycopene, folate, and folate-DFE, and increased eicosatetraenoic acid (polyunsaturated fat), but only in men. Daytime Sleepiness was associated with decreased magnesium in women only. Decreased protein was associated with deviation from Normal sleep duration in women. Decreased carbohydrates, Vitamin-B1, folate, folic acid, folate-DFE, phosphorus, iron, and selenium were associated with VeryShort sleep in women only. Decreased niacin, choline, phosphorus, sodium, and theobromine, and increased alcohol, were associated with Long sleep in women.
Conclusion: Relationships between sleep and diet were found separately for both men and women, but there were no significant gender interactions.

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GENDER DIFFERENCES IN AFFECT OF SLEEP-DISORDERED BREATHING PATIENTS

Stone CD, Goldschmied JR, Cheng P, Ehrmann D, Arnedt J, Kaplish N, Pitt B, Deldin PJ
University of Michigan, Ann Arbor, MI, USA

Introduction: Recent research has shown several gender differences in prevalence and symptoms of sleep-disordered breathing (SDB). SDB, specifically obstructive sleep apnea, is more prevalent in males than females (Young et al., 1993; Quintana-Gallego et al., 2004), and women with SDB persistently score higher on depression and anxiety scales than males (Valipour et al., 2007; Lin et al., 2008). In this study, we aim to determine if subjective mood differed between men and women in SDB.
Methods: 20 adult SDB patients (12 male and 8 female) were recruited from the University of Michigan Sleep Disorders Laboratory. Prior to full-night polysomnography, patients were screened and excluded for major medical problems, alcohol or substance abuse, and use of antidepressant medications. Subjects were administered the Emotional Experience Scale (DES-MOD) and Positive and Negative Affect Schedule (PANAS) to assess positive and negative affect before sleep as part of a larger battery of measures.
Results: A MANOVA revealed a gender difference in positive affect in both DES-MOD ($p=.053$) and PANAS ($p=.040$), while no gender difference in negative affect in DES-MOD ($p=.237$) or PANAS ($p=.112$). Within-subjects effects were also significant for both DES-MOD ($p=.036$) and PANAS ($p=.012$).
Conclusion: Females with SDB had significantly lower scores in positive affect than males with SDB, while they did not differ significantly in negative affect. These results may suggest that the observed difference in depression symptoms in females with SDB may be more reflective of

females experiencing less positive affect, such as happiness and pleasure, with fragmented sleep, rather than more sadness, or negative affect.

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HEART RATE RESPONSE TO SLEEP-DISORDERED BREATHING IS SIGNIFICANTLY ASSOCIATED WITH CARDIOVASCULAR OUTCOMES IN OLDER ADULTS, BUT THE PATTERN IS DIFFERENT IN MEN AND WOMEN: THE SLEEP HEART HEALTH STUDY (SHHS)

Stein PK[1], Lee D[1], Milli S[1], Ojo A[1], Sharif F[1], Norman A[1], Patel SR[2], Redline S[2]
[1]Internal Medicine, Cardiovascular Division, Washington University School of Medicine, St. Louis, MO, USA, [2]Department of Medicine and Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA

Introduction: Sleep-disordered breathing measures (SDB), e.g., AHI, are not associated with cardiovascular (CV) outcomes in population-dwelling older adults in the SHHS. SDB events are associated with cyclic variation of heart rate, i.e., a series of heart rate acceleration-deceleration cycles (HRAs), but the relationship of HRA characteristics and CV outcomes is unknown.
Methods: The magnitude and duration of HRAs in association with apneas and hypopneas were determined by integrating HR tachograms with scored events. N=132 participants in the Cardiovascular Health Study cohort of the SHHS with RDI at 3% desats>15/hr and with CV outcomes (CHD death, MI, revascularization) were matched on age, gender and RDI with participants without a CV outcome. Participants were: 92M, aged 77±4, RDI 29±12, 24,593 eligible HRAs and 40F aged 78± 4, RDI 24± 9, 16,843 eligible HRAs. Mean follow up was 8.7 yrs. ECG channels from PSGs had been scanned using research Holter techniques and formed the basis for the HR tachograms. T-tests, stratified by gender, compared HRA characteristics between outcome groups by scored event type within stage.
Results: Total number of HRAs was similar between groups; but specific predictors and the direction of predictors were generally different in M and F. Among M, increased HRA duration during S2 ($p<0.001$) or REM ($p=0.041$) apneas was associated with outcome, while decreased HRA duration during hypopneas in S2 ($p<0.001$) or S3 ($p=0.004$) were associated with CV outcomes. Among F increased HRA duration for S1 apneas or hypopneas ($p<0.018$) or for S3 apneas ($p<0.001$) was associated with outcome. HRA magnitude was more strongly associated with outcome, but the direction of the effect for M and F was different. Among M increased HRA magnitude during S2 or REM apneas or hypopneas ($p<0.006$) was associated with outcome. Among females decreased HRA magnitude during S2 apneas or hypopneas ($p<0.018$), during S3 hypopneas ($p<0.001$) or during REM apneas ($p=0.035$) were associated with CV outcomes.
Conclusion: Results support potential use of HRA responses to SDB for CV risk stratification in older adults. Gender differences may reflect differences in autonomic function or the greater importance of airway issues in men and a lower arousal index in women as predictors of outcome.
Support (If Any): R0-1 HL62181 from the National Heart, Lung, and Blood Institute.

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GENDER DIFFERENCES IN THE MAGNITUDE OF HEART RATE AROUSALS IN RESPONSE TO APNEAS AND HYPOPNEAS DURING SPECIFIC SLEEP STAGES IN OLDER ADULTS WITH SIGNIFICANT SLEEP-DISORDERED BREATHING: THE SLEEP HEART HEALTH STUDY (SHHS)

Stein PK[1], Lee DJ[1], Milli S[1], Ojo A[1], Sharif F[1], Norman A[1], Redline S[2]
[1]Internal Medicine, Cardiovascular Division, Washington University School of Medicine, St. Louis, MO, USA, [2]Department of Medicine and Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: Gender differences in heart rate variability suggest differences in cardiac autonomic functioning between men and women. Heart rate accelerations (HRAs) occur after sleep disordered breathing (SDB) events and are seen as a cyclic variation in HR pattern. HRAs are mediated by event severity but also by inter-individual and inter-sleep stage differences in autonomic activity. Whether gender mediates SDB-associated HRAs during sleep is unknown.
Methods: The magnitude of post-event HRAs in bpm during cyclic variation in HR associated with apneas (A) and hypopneas (H) were determined by integrating HR tachograms with scored events. N=132 participants in the Cardiovascular Health Study cohort of the SHHS with RDI at 3% desats>15/hr were included in the analysis. Participants were: 92M, aged 77±4, RDI 29±12/hr and 40F aged 78± 4, RDI 24± 9. ECG channels from PSGs had been scanned using research Holter techniques and formed the basis for the HR tachograms. The UNIANOA procedure in SPSS evaluated the influence of gender (M, F), event type (A,H), sleep stage (S1, S2. S3, REM) and their interactions on HRA magnitude. Significant results were explored using ANOVA.
Results: The HRA model had significant main effects for: gender, event type and sleep stage ($p<0.001$). In addition, there was a significant interaction for gender by sleep stage and for sleep stage by event type by gender (both $p<0.001$), confirming the hypothesis of a strong effect of gender on HRA patterns in SDB. The gender effect on HRAs was explained by M having higher HRAs than F for both A and H and for every sleep stage, with the most dramatic difference during REM-A. The event type effect was caused by A resulting in higher HRAs than H for every stage, with the greatest difference (8.9±6.8 for REM-H vs.12.5±bpm for REM-A). The stage effect was explained by the largest mean HRA in S2. When the event by gender by stage interaction was considered, the largest HRAs were seen S2-A and S2-H in women (11.2±5.7 bpm for A, 8.7±5.7 bpm for H) but among men, the largest HRAs for H were also seen in S2.
Conclusion: Results confirm previously-reported differences in HRAs by event type and sleep stage, but the finding that this relationship is mediated by gender suggests that gender must be considered in understanding the physiology of SDB and its relationship to physiologic changes and clinical outcomes.
Support (If Any): RO-1 HL62181 from the NHLBI.

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SEX DIFFERENCES IN ASSOCIATIONS BETWEEN MSLT VS MWT AND OBSTRUCTIVE SLEEP APNEA

Valencia-Flores M[1,2], Santiago-Ayala V[1], Resendiz M[1], Castaño-Meneses VA[1], Aldeco D[1], Aguilar C[4], Mendoza A[1], Vega A[3], Bliwise DL[5]
[1]Neurología y Psiquiatría, INCMNSZ, México, [2]Facultad de Psicología, UNAM, Mexico, [3]Facultad de Ingenieria, UNAM, Mexico, [4]Endocrinología, INCMNSZ, Mexico, [5]Neurology, Emory University, Atlanta, GA, USA

Introduction: This study examines the association between respiratory disturbances and level of sleepiness (MSLT) and alertness (MWT) in obese men and women.

Methods: We studied 78 obese patients (25 women, 53 men) who attended INCMNSZ Sleep Clinic . BMI mean (SD) for women 42.2(9.9) and men 42.3(9.0) was similar, as was age (women=40.6(11.3); men 40.1(10.3)).They underwent two nights of nocturnal polysomnography, and following the second night, daytime testing with MSLT and MWT. We employed Epworth Sleepiness Scale (ESS) to assess sleepiness symptoms.
Results: Respiratory events were more severe in men (M) than women (W), AHI for M=46.5(35.2), and W=19.1(25.2). M had more oxygen desaturations than W (Oxygen Desaturation Index: W=13.4(18.2); M=28.2(29.6), p<0.008)). There were not statistically significant differences in ESS: W=7.1(5.1), M=9.1(5.2), nor objective level of sleepiness MSLT, W=6.5(4.4) min, M=4.7(3.9) min, but W were more alert than M (mean MWT: W=15.5(5.4) min, M=11.6(6.1) min, p<0.021), W also reported a higher level of depression: BDI: W=20.8(13.6), M=12.8(9.6), p<0.004. In multiple regression r2=0.150, p<0.011, the variable most closely associated with alertness (MWT) was the number of oxygen desaturations (Beta=-.261, p<0.047).
Conclusion: As in other populations, middle-aged obese men have more severe respiratory disturbances than women (2.5 more times higher). Despite a sex difference in AHI, the level of subjective (ESS) and objective (MSLT) sleepiness is the same between W and M. Alertness (MWT) was associated to number of oxygen desaturations, and unlike MSLT, appeared a more sensitive marker in M than W.
Support (If Any): This work was supported by PAPIIT IN209109 and CONACYT-46257-H.

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MENSTRUAL CYCLE PHASE, REPRODUCTIVE HORMONE LEVELS, AND SLEEP IN PREMENOPAUSAL WOMEN

Sharkey KM[1], Kim S[2], Regan S[3], Crawford S[4], Joffe H[2]
[1]Alpert Medical School of Brown University/Rhode Island Hospital, Providence, RI, USA, [2]Center for Women's Mental Health, Department of Psychiatry, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA, [3]General Medicine Division, Department of Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA, [4]Department of Preventative and Behavioral Medicine, University of Massachusetts Medical School, Worcester, MA, USA

Introduction: The higher prevalence of poor sleep quality reported by women than by men has been attributed to changing levels of estradiol and progesterone in women. Studies in premenopausal women describe more subjective and objective sleep disruption in the luteal phase of the menstrual cycle when progesterone levels are high, but associations between objective sleep and reproductive hormone levels have not been studied. We examined the association of objective sleep with estradiol and progesterone levels and with changing levels of these hormones in healthy premenopausal women.
Methods: Twenty-six women (mean±SD age 27.8±7.5 years) with monthly menses and without OSA or PLMD tracked their cycles prospectively and had 2 nights of home PSG during the menstrual cycle. Blood samples drawn on the second PSG night and 1-3 weeks before that PSG were assayed for serum estradiol (E2) and progesterone (PROG). We calculated rate of change in each hormone (E2slope and PROGslope) between the two samples. Associations between hormone levels and measures of sleep disturbance standardized to available sleep time (wake after sleep-onset percent [WASO%] and wake index [# of wakes per hour, WI]) were examined using Pearson correlations and linear regression models that adjusted for the absolute level of the hormone of interest from the PSG night.
Results: On average, participants had minimal sleep fragmentation (WASO% 3.8±3.1, range 1-14%; WI 2.4±1.4, range 0.6-6.0 awakenings per hour). E2 and PROG were 51±33 pg/mL and 0.3±0.3 ng/mL prior to PSG (mean days prior=12.2±3.8) and 129±71 pg/mL and 6.3±7.2 ng/mL on the PSG night. Sleep was more fragmented in association with a steeper PROGslope increase (WASO% r=0.56, p=0.008; WI r=0.40, p=0.07), which persisted after adjustment for the PROG level from the PSG night (for WASO% β=0.06, 95% CI 0.005-0.11, p=0.034, and WI β=3.1, 95% CI 0.01- 6.2, p=0.049). Sleep fragmentation measures were not associated with E2slope or with E2 or PROG levels on the PSG night.
Conclusion: Among healthy premenopausal women, a steeper rate of increase in progesterone leading up to the PSG was significantly associated with greater sleep fragmentation. These findings support the perception of worse sleep quality during the luteal phase when progesterone rises in cycling women.
Support (If Any): 5 R01 MH082922 (HJ) and K23 MH086689 (KMS).

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FIRST REPORT: THE EFFECTS OF MENSTRUAL CYCLE ON SLEEP STRUCTURE BY MEANS OF CYCLIC ALTERNATING PATTERN METHOD

Ozone M[1], Kuroda A[1], Yagi T[2], Iwashita M[1], Moriya T[1], Sugita Y[1], Harada D[1], Aoki K[1], Takahashi T[3], Itoh H[1]
[1]Psychiatry, Jikei University School of Medicine, Tokyo, Japan, [2]Ohta General Hospital, Kawasaki, Japan, [3]Psychology, Hosei University, Tokyo, Japan

Introduction: The menstrual cycle often effects on physical condition, mood and sleep to no small extent in young women. The severity of sleep disturbance ameliorates, especially in the second half of luteal phase (Lp) and the first part of follicular phase (Fp). According to the previous reports using conventional polysomnography (PSG), there is no clear difference in non REM sleep (NREM) between different menstrual phases, excepting the decreased latency and percentage of stage REM in Lp. Therefore, this study aimed to clarify the changes in NREM by menstrual cycle in young women using the Cyclic Alternating Pattern (CAP) method.
Methods: The subjects were ten healthy women having regular menstrual cycles (mean age: 29.2+/-4.6 yrs). On the basis of the self-monitoring results regarding oral temperature, the menstrual phase was detected. PSG was recorded twice for each subject in Lp and Fp (not menstrual period) at our Sleep laboratory. The PSG data were analyzed using both of the R&K method and the CAP method. The subjects were also evaluated with questionnaires regarding menstrual related symptoms and sleep (the St.Mary's hospital Sleep questionnaire: SMH).
Results: 1) The mean SMH value of Sleep quality tended to be lower in Lp than that of Fp. 2) The conventional sleep parameters did not change in different menstrual phases. 3) The CAP rate and the number of CAP cycle counts were significantly higher in Lp than in Fp (mean CAP rate: Lp 38.2+/-7.3%, Fp: 30.3+/-8.9). 4) In terms of CAP subtypes, the indexes of A1 and A3 tended to be higher in Lp.
Conclusion: It has been reported that Allopregnanolone, which is a metabolite of progesterone, has sedative effects due to acting at GABA receptors. Low concentration of progesterone in the latter part of Lp could be responsible for the deteriorated sleep of women.

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INSOMNIA SEVERITY INDEX SCORE PREDICTS MENSTRUAL PAIN SEVERITY AND INTERFERENCE

Woosley J, Lichstein KL
Psychology, University of Alabama, Tuscaloosa, AL, USA

Introduction: A large amount of research has explored the bi-directional relationship between sleep disturbance and pain. This research has indicated that poor sleep can result in increased perception of pain intensity. However, there has been no published research exploring the hypothesis that poor sleep predicts menstrual pain.
Methods: Sixty-seven female participants were recruited from a subject pool comprised of college students taking an introductory psychology class. Participants were screened for severe psychological and medical

illnesses, sleep disorders other than insomnia, and use of sleep-active drugs in the evening (with the exception of hypnotics). At the start of the study, participants completed the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). On the second day of participants' next menstrual period, they completed a version of the Brief Pain Inventory (BPI) modified to specifically address menstrual pain. The BPI measures two domains of pain: severity (i.e., pain intensity) and interference (i.e., the impact of pain on functioning).

Results: Stepwise regression analyses were conducted to determine whether PSQI scores and ISI scores predict menstrual pain severity interference. ISI predicted menstrual pain severity, explaining 8.0% of variance ($F = 5.67$, $p = .020$). PSQI scores were not significantly correlated with pain severity ($r = .14$, $p = .12$). While ISI ($r = .38$, $p = .001$) and PSQI ($r = .27$, $p = .015$) were both significantly correlated with pain interference, only ISI predicted a significant amount of the variance in pain interference ($R2 = .14$, $F = 10.78$, $p = .002$).

Conclusion: This research suggests that insomnia severity predicts menstrual pain severity and interference. Further research should explore the effects of an insomnia treatment on menstrual pain in women having both dysmenorrhea and insomnia.

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POLYCYSTIC OVARY SYNDROME: A COMPARATIVE STUDY OF SLEEP PARAMETERS IN PATIENTS WITH AND WITHOUT HYPERANDROGENEMIA

Hachul H[1,2], Tock L[3], Carneiro G[3], Zanella T[3], Togeiro SM[1], Tufik S[1]
[1]Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [2]Ginecologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil, [3]Endocrinologia, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

Introduction: Sleep complaints in women vary according to hormonal fluctuations dictated by their menstrual cycles. Previous studies have shown that the prevalence of obstructive sleep apnea is increased in adults with polycystic ovary syndrome (PCOS).The aim of this investigation was to compare the sleep parameters of PCOS subjects to those of controls as well as to examine, by means of comparison, PCOS sleep parameters in women with and without hyperandrogenemia.

Methods: 17 women (controls) were induced in the follicular phase of the menstrual cycle. These subjects were not taking medication and were not making use of hormonal contraceptive. 38 women included in the study had PCOS according to the Rotterdam criteria: presence of at least 2 of the 3:(1) Anovulation, (2) clinical hyperandrogenism or hyperandrogenemia and (3) polycystic ovary established by means of ultrasound. Polysomnographies were conducted for the sleep analysis. Women with congenital adrenal hyperplasia or Cushing Syndrome were excluded from the sample.

Results: 55 women were included (age varying from 16 to 45. mean=28.3±6.7) Body Mass Index varied from 19.2 to 48.0Kg/m2; (mean 30±8). 18 women presented hyperandrogenemia (free testosterone ≥ 1.07ng/dL) and 20 did not. The polysomnography reaveled that there were no significant differences in AHI between the PCOS group at 8.4±16.0 compared to controls at 1.5±1.0, and there was no difference in AHI when subgroups of POCS were compared (With X without Hyperandrogenemia). Sleep efficiency was higher in the control group, 88.9±6.1 compared to PCOS 80.7±13.4. Other parameters of sleep fragmentation were also higher in PCOS (WASO: 56.1±47.3) when compared to controls (WASO: 29.1±15.7). No significant differences in sleep parameters were found when comparing PCOS groups (with X without hyperandrogenemia). A correlation was found to exist between AHI index and BMI (r=0.5). The logistic regression showed that hyperandrogenemia was a predicting factor to SAOS in women with PCOS, regardless of BMI (OR=8).

Conclusion: Results indicate that PCOS is detrimental to quality of sleep and increased sleep fragmentation in women afflicted by the syndrome. Furthermore, hyperandrogenemia was found to be a predictor of SAOS in women with PCOS.

Support (If Any): CNPq, Fapesp and AFIP.

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DIFFERENCES IN RELATIONSHIPS AMONG DIETARY NUTRIENTS AND SLEEP SYMPTOMS IN PRE/PERI-MENOPAUSAL VERSUS POST-MENOPAUSAL WOMEN

Izci Balserak B[1], Jackson NJ[1], Gerstner JR[1], Knutson KL[2], Pien GW[1], Grandner MA[1]
[1]Division of Sleep Medicine and the Center for Sleep and Respiratory Neurobiology, University of Pennsylvania School of Medicine, Philadelphia, PA, USA, [2]Department of Medicine, Section of Endocrinology, University of Chicago, Chicago, IL, USA

Introduction: Sleep disturbance may produce appetite dysregulation. Menopause disturbs sleep and alters food intake. However, previous studies have not examined relationships between sleep and diet relative to menopausal status.

Methods: Data from the 2007-2008 NHANES were used(N=1928). Self-reported sleep symptoms (Difficulty Falling Asleep, Frequent Awakenings, Unrestful Sleep, and Daytime-Sleepiness) were assessed and dichotomized between those reporting a problem 16+/-days/month. Sleep duration was categorized as VeryShort(5h), Short(5-6h), Normal(7-8h) and Long(>8h). 24-hr recall of diet and computation of nutrition profile were performed using validated procedures. Analyses were adjusted for total calories, foods(number), special diet, comparison to typical intake, age, race/ethnicity, education, household-income, exercise(minutes), and BMI(objective). All nutrients were evaluated in absolute intake (e.g., mg/day) except for fatty acids (ratio of fatty acid to total saturated/monounsaturated/polyunsaturated, depending on type). Population weighted logistic regression examined whether nutrients were associated with sleep symptoms and duration separately for pre/peri and post-menopause.

Results: No differences between pre/peri and post-menopause were found for Difficulty Falling Asleep, Frequent Awakenings, or Unrestful Sleep. Regarding Daytime Sleepiness, decreased fiber, retinol, Vitamin-A(RAE), folate, choline, phosphorus, and octanoic acid (saturated-fat) were associated with Daytime Sleepiness in post-menopausal women. Of these, there were significant interactions for all except folate and choline. In addition, interactions were seen for calcium, alcohol, and saturated fats (butanoic, hexanoic, decanoic, tetradecanoic, and hexadecanoic acids), with effects in the same direction. Regarding sleep duration, VeryShort sleep was associated with decreased protein, choline, phosphorus, potassium, and selenium in pre/peri-menopausal women (no significant interactions). Decreased alpha-tocopherol(added) was associated with VeryShort sleep in post-menopausal women (significant interaction). Decreased choline and increased alcohol were associated with Long sleep in pre/peri-menopausal women only (no significant interactions).

Conclusion: Overall, diet plays a larger role in sleepiness among post-menopausal women, and sleep duration effects are more pronounced in pre/peri-menopausal women. Menopause-related hormonal and psychological changes may have an impact on sleep and food intake.

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A CONSISTENT HISTORY OF PHYSICAL ACTIVITY IS ASSOCIATED WITH IMPROVED SLEEP CONTINUITY AND QUALITY IN MIDLIFE WOMEN: THE SWAN SLEEP STUDY

Kline CE[1], Krafty R[2], Kravitz HM[3], Sternfeld B[4], Dugan SA[3], Buysse DJ[1], Bromberger JT[1], Hall MH[1]
[1]Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA, [2]Department of Statistics, University of Pittsburgh, Pittsburgh, PA, USA, [3]Department of Preventive Medicine, Rush University Medical Center, Chicago, IL, USA, [4]Kaiser Permanente, Oakland, CA, USA

Introduction: The menopausal transition is commonly associated with increased sleep disturbance, but there is a paucity of data on behavioral factors that may underlie this relationship. Exercise, in particular, has been shown in some studies to be related to improved sleep during menopause; however, there are no longitudinal data on this association.
Methods: In a community-based sample of women participating in the Study of Women's Health Across the Nation (SWAN) Sleep Study (N=370, 52.1±2.1 y), sleep was examined using a multi-modal approach. Validated questionnaires, sleep diaries, wrist actigraphy, and in-home polysomnography (PSG) provided measures of sleep quality (Pittsburgh Sleep Quality Index [PSQI], diary restedness upon awakening), duration (total sleep time), continuity (wakefulness after sleep onset [WASO]) and depth (% of slow-wave sleep). Physical activity, as assessed by the Sports Index of the Kaiser Physical Activity Survey, was measured up to four times over six years leading up to the sleep assessments. Physical activity levels were categorized according to their temporal pattern prior to sleep assessments (consistently low, inconsistent/consistently moderate, or consistently high levels of activity in the six years leading up to SWAN Sleep). Between-group differences in sleep were evaluated with analysis of covariance.
Results: Significant univariate associations were found between the pattern of physical activity and sleep quality (PSQI: F2,350=10.70, P<.01; diary restedness: F2,349=6.39, P<.01) and WASO (PSG: F2,350=3.47,P=.03; actigraphy: F2,318=4.96, P<.01). These relationships persisted following adjustment for race, menopausal status, marital status, education, sleep medication use, and body mass index. Physical activity patterns were not associated with any measure of sleep duration or depth.
Conclusion: This study provides intriguing evidence that a consistent historical pattern of physical activity is associated with increased sleep continuity and sleep quality in midlife women.
Support (If Any): SWAN has grant support from the National Institutes of Health, DHHS, through the National Institute on Aging, the National Institute of Nursing Research and the NIH Office of Research on Women's Health (NR004061; AG012505, AG012535, AG012531, AG012539, AG012546, AG012553, AG012554, AG012495) and funding for the SWAN Sleep Study is from the National Institute on Aging (AG019360, AG0019361, AG019362, AG019363); additional support provided by RR024153 and T32 HL082610-05.

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SLEEP AND WAKE BOUT DURATION IN MENOPAUSAL WOMEN

Drake C[1,2], Roehrs T[1,2], Freedman R[2]
[1]Sleep Disorders & Research Center, Henry Ford Health System, Detroit, MI, USA, [2]Psychiatry & Behavioral Neurosciences, School of Medicine, Wayne State University, Detroit, MI, USA

Introduction: It is becoming clear that brief arousal scoring (AASM) does not adequately characterize sleep continuity in that arousal scoring has poor inter rater reliability and only defines the arousal, not its consequence (i.e., rapid vs. delayed return to continuous sleep). Studies have evaluated the probability of sleep-wake transitions and a study calculated the duration of sleep and wake bouts and showed that older people wake more frequently (i.e., have more wake bouts) and have shorter sleep bouts than young people. Bout analyses were conducted to characterize the sleep of menopausal women complaining of hot flash associated sleep disruption.
Methods: Menopausal women with sleep complaints (MN; n=9), premenopausal women with primary insomnia (PI; n=5) (DSM-IV-TR criteria) and healthy controls (HC; n=5) completed a standard 8 hr NPSG. The number and duration of contiguous 30-sec epochs of sleep or wake during the NPSG were calculated and compared among groups.
Results: MN women had more sleep bouts (#48, p<.001) of a shorter duration (8 min, p <.03) than PI (#25, 16 min) and HC (#28, 14 min), both of which did not differ. Importantly, MN women also had shorter duration wake bouts (2 min) than PI (5 min p<.003), but not HC. PI had longer wake bouts than HC (3 min, p<.04). Not surprisingly, latency to sleep in PI (49 min, p<.001) was longer than that of MN (20 min) and HC (17 min), who did not differ.
Conclusion: Menopausal women show an inability to maintain state, resulting in increased homeostatic sleep drive. This is evident in the shorter wake bouts (i.e. return to sleep is rapid) and low sleep latency. This suggests in menopause there is an active arousal process occurring (i.e., more wake bouts), but unlike "classic insomnia" falling asleep and returning to sleep after an awakening is rapid.
Support (If Any): NIH, grants # R01DA17355 (TAR), R01MH63089 (RRF), R01MH082785 (CLD).

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IMPORTANCE OF RELATIONSHIP FACTORS IN WOMEN'S CPAP USE

Baron KG, Gunn HE, Zee P
Northwestern University, Chicago, IL, USA

Introduction: Continuous positive airway pressure (CPAP) improves health and quality of life for patients with obstructive sleep apnea (OSA). Few studies have evaluated predictors CPAP adherence specifically among women with OSA. The goal of this study was to evaluate the role of relationship factors in CPAP adherence among women with OSA.
Methods: Participants included 24 CPAP naïve women diagnosed with OSA. Participants were recruited at their CPAP titration and completed questionnaires about relationship quality and social support prior to starting CPAP. Qualitative interviews about spousal involvement were completed one week after starting CPAP at home. CPAP adherence was downloaded at 10-12 weeks. Data were analyzed using correlations, chi square tests and themes were identified in qualitative responses.
Results: Average age was 50 (+ 10.9) years and half of the sample was white (n=9). Half of the sample had completed college or a graduate degree (n=10). Objective adherence data were available for 15 participants. CPAP adherence was 3.6 SD= 2.7 hours per night (range .1=7.8 hours). The majority of the sample was either married (n=7) or living with a romantic partner (n=6). Among married/partnered participants, 30% reported sharing a bed 7 nights per week. Married/partnered participants had a higher percentage of nights with use >4 hours (14.8 vs. 58.7). p=.008. Relationship conflict among married or partnered participants was associated with a trend for poorer adherence at 3 month follow-up (n=11, r=.6, p=.05). Greater perceived social support was positively associated with adherence among both married/partnered and unmarried participants (r=.013). Partnered or married participants reported similar levels of social support overall compared with non-partnered participants (p=.69). There were no differences in age, race, income, or education. Seven participants provided qualitative responses about helpful and unhelpful spousal involvement in CPAP. "Encouragement " and "support" were the two most commonly reported types of involvement (reported in 6 of 7). Ineffective strategies were reported by 2 participants (repeatedly ask if it's working, and making jokes about the mask).
Conclusion: Relationship factors may be robust predictor of adherence in both married/partnered and unmarried women starting CPAP. Analy-

sis of qualitative responses demonstrates support and encouragement for CPAP are important ways for male partners to be involved in their partners' CPAP use.
Support (If Any): 5K12 HD055884, 1K23HL109110-01.

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SLEEP MODERATES THE ASSOCIATION BETWEEN DIVORCE-RELATED PSYCHOLOGICAL ADJUSTMENT AND SYSTOLIC BLOOD PRESSURE OVER 90 DAYS IN WOMEN

Krietsch KN, Sbarra DA, Mason AE, Dawson S, Bootzin R
Psychology, University of Arizona, Tucson, AZ, USA

Introduction: Marital separation and divorce are associated with substantial risk for increased morbidity and mortality, perhaps due to adulterations in health behaviors following separation. With sleep as a salubrious process that is often disrupted following marital separation, the aim of this study was to investigate the association between self-reported sleep disturbances, divorce-related psychological adjustment, and changes in systolic blood pressure (SBP) over 90 days.
Methods: SBP was measured at two occasions separated by 3 months in a sample of 78 adults (24 men), who had experienced a marital separation within the past 5 months. At intake, participants completed the Pittsburgh Sleep Quality Index (PSQI) and the Impact of Events Scale Revised (IES-R; a self-report measure of emotional disturbance following a stressful event, like marital separation or divorce), which were used as predictors of change in SBP 90 days after intake.
Results: Hierarchical multiple regression models revealed that both the PSQI and IES-R were significantly associated with SBP 90 days after intake ($r = .35$ and $r = .42$, $p's < .05$). When PSQI and IES-R were entered into same model, there was no support for a two-way PSQI by IES-R interaction ($p = .26$). A three-way Sex by PSQI by IES-R interaction approached significance ($p = .09$), and deconstruction of this effect revealed that the two-way PSQI by IES-R effect was significant for women only ($p = .05$). This interaction explained 7% additional variance in SBP at the follow-up assessment after accounting for the main effects of the PSQI and IES-R.
Conclusion: These findings show that women who reported high levels of sleep disturbance and who also reported greater divorce-related emotional disturbance at intake evidenced significant increases in SBP 90 days later. This is consistent with what is currently known about women reporting more sleep disturbance, as well as gender differences in coping following separation.
Support (If Any): National Institute on Aging of NIH: AG036895; National Institute of Child Health and Human Development of NIH: HD069498.

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SLEEP QUALITY, STRESS, AND DEPRESSIVE SYMPTOMS IN MATERNAL CAREGIVERS OF YOUNG CHILDREN WITH BRONCHOPULMONARY DYSPLASIA

Feeley C[1], Avis K[2,1], Heaton K[1], Lozano DJ[2,1], Christian B[1], Su X[1], Turner-Henson A[1]
[1]University of Alabama at Birmingham, Birmingham, AL, USA, [2]Pediatrics, University of Alabama at Birmingham, Birmingham, AL, USA

Introduction: Mothers are often the primary caregivers of young, chronically ill children. A child with a chronic illness, such as bronchopulmonary dysplasia (BPD), often has complex care, requiring the mother to manage the child's care with little to no training before discharge home. For maternal caregivers, this may lead to increased levels of stress, poor sleep quality, as well as increased levels of depressive symptoms. However relationships between sleep, depression, and stress in caregivers of young children, and especially young children with BPD, have not been thoroughly investigated to date.
Methods: 45 maternal caregivers (>16 years old) of young children (2 months-3 years) with BPD were recruited. Maternal caregivers had been living at home with the child for a minimum of 2 months from discharge of the NICU and did not have a diagnosed sleep disorder based on screening criteria. Children with BPD were excluded if they had a tracheotomy or require a ventilator. Caregivers completed demographic information forms and questionnaires on sleep quality (PSQI), depressive symptoms (CES-D), and stress (PSS) during a BPD clinic visit.
Results: Mothers ranged in age from 17-47 years (mean 28 years), with 55% single, 69% African American (AA). Approximately 45% had a high school education or less. Caregivers reported 6 hours of sleep per night. Depressive symptoms were not at a significant level. Sleep quality and stress were positively correlated (.542), as well as sleep quality and depression (.538), and weakly, depression and stress (.327).
Conclusion: In this sample of maternal caregivers of BPD children, possible stressors include young age, basic education, and little paternal involvement. Majority of mothers reported poor sleep quality and nocturnal awakenings. Poor sleep was positively correlated with stress and depression, which may indicate the need for further investigation into how sleep quality may influence depressive symptoms and stress in these caregivers.

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PREDICTORS OF HEALTH-RELATED QUALITY OF LIFE AMONG WOMEN VETERANS WITH INSOMNIA

Martin JL[1,2], Hughes JM[1], Jouldjian S[1], Washington D[3,2], Alessi CA[1,2]
[1]Geriatric Research, Education and Clinical Center, VA Greater Los Angeles Healthcare System, Los Angeles, CA, USA, [2]Department of Medicine, David Geffen School of Medicine at the University of California, Los Angeles, Los Angeles, CA, USA, [3]Health Services Research and Development Center of Excellence, VA Greater Los Angeles Healthcare System, Los Angeles, CA, USA

Introduction: Women Veterans will account for 10% of the US Veterans population by 2020, and understanding factors that impact quality of life among women Veterans is receiving increasing attention nationwide. Within a larger study, we examined factors that were associated with health related quality of life (HRQOL) among women Veterans with insomnia including age, post-traumatic stress disorder (PTSD), self-reported sleep symptoms (insomnia, sleep apnea, restless legs syndrome), and objective (actigraphy) sleep quality.
Methods: Within a larger study, 107 women Veterans (mean age=49 years, 44% non-Hispanic white) meeting ICSD insomnia diagnostic criteria on a postal survey completed a one-hour, in-person sleep and health assessment. The assessment included the PTSD Checklist-Civilian (PCL-C), Comorbidity Checklist, Berlin Sleep Apnea Scale (Berlin), RLS questionnaire (RLS), and SF-12 (HRQOL; Mental and Physical Component Scores). Women then wore an Actiwatch (Respironics, Inc.) wrist actigraph (with sleep diary) for 7 days to objectively estimate nighttime sleep percent. Regression models tested whether age, PCL-C, comorbidity, Berlin, RLS, ISI, and actigraphy nighttime sleep percent predicted mental and physical HRQOL.
Results: In a regression model predicting SF-12 Mental Component Score ($F=18.3$, $p<.0005$; $adjR^2=.54$), Berlin, ISI, and PCL-C were significant independent predictors of HRQOL ($p's<.03$). Comorbidity, age, RLS and nighttime sleep percent were not. In a regression model predicting SF-12 Physical Component Score ($F=10.2$, $p<.0005$; $adjR^2=.38$), comorbidity and Berlin were significant independent predictors of HRQOL ($p's<.001$). Age, RLS, ISI, PCL-C and nighttime sleep percent were not.
Conclusion: Among women Veterans with insomnia, HRQOL is impacted by sleep and other factors, including insomnia symptom severity, sleep apnea symptoms, PTSD and comorbidities. Additional research is needed to understand how sleep and other symptoms impact HRQOL, and to identify the best methods for evaluation and treatment of sleep disorders in this growing segment of the US Veteran population.

Support (If Any): VA Health Services Research and Development (PPO 09-282-1), VA Rehabilitation Research and Development (1RX000135-01), National Institute on Aging (K23 AG028452), and the VAGLAHS Geriatric Research, Education, and Clinical Center (GRECC).

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AGREEMENT IN THE SCORING OF RESPIRATORY EVENTS AND SLEEP AMONG INTERNATIONAL SLEEP CENTERS

Magalang UJ[1], Chen N[2], Cistulli P[3], Fedson A[4], Gislason T[5], Hillman DR[6], Penzel T[7], Tamisier R[8], Tufik S[9], Pack A[4]
[1]Division of Pulmonary, Allergy, Critical Care, and Sleep Medicine, The Ohio State University Medical Center, Columbus, OH, USA, [2]Department of Internal Medicine, Taoyuang Branch, Chang Gung Memorial Hospital, Taipei, Taiwan, [3]Centre for Sleep Health & Research, University of Sydney, Sydney, NSW, Australia, [4]Division of Sleep Medicine, University of Pennsylvania Medical Center, Philadelphia, PA, USA, [5]Department of Respiratory Medicine and Sleep, Landspitali University Hospital, Reykjavik, Iceland, [6]Department of Pulmonary Physiology and Sleep Medicine, University of Western Australia, Nedlands, WA, Australia, [7]Sleep Medicine Center, Charite University Hospital, Berlin, Germany, [8]Sleep Laboratory and EFCR, University Hospital, Grenoble, France, [9]Disciplina de Medicina e Biologia do Sono, Universidade Federal de São Paulo, São Paolo, Brazil

Introduction: The AASM guidelines for polysomnography (PSG) scoring of sleep and associated events are increasingly being adapted worldwide. However, the agreement in PSG scoring using these guidelines among international centers is unknown. We determined the agreement of scoring respiratory events and sleep stages in the nine center members of the Sleep Apnea Genetics International Consortium (SAGIC) [www.med.upenn.edu/sleepctr/SAGIC.shtml].
Methods: 15 previously recorded de-identified PSGs, in European Data Format, were scored by an experienced technologist at each SAGIC site (including Australia, Brazil, France, Germany, Iceland, Taiwan and the USA).The studies were imported into the local software used for scoring at each site. A protocol including the AASM guidelines was provided to each scorer. Each 30-second epoch was manually scored for sleep stage, apneas, hypopneas, and arousals using the AASM "recommended" criteria. The computer-derived oxygen desaturation index (ODI) was also recorded. The primary outcome for analysis was the intraclass correlation coefficient (ICC) of the apnea-hypopnea index (AHI). Given nine sleep scorers (one at each site), the 15 PSGs had a power of 83% to detect an ICC of at least 0.90, assuming a null hypothesis of ICC= 0.70. Epoch-by-epoch agreement on sleep staging was assessed using the kappa statistic for multiple raters.
Results: The ICCs of the respiratory variables were: AHI= 0.95 [95%CI: 0.91-0.98], total number of apneas= 0.77 [0.56-0.87], obstructive apneas= 0.69 [0.52-0.86], central apneas= 0.45 [0.26-0.69], mixed apneas= 0.42 [0.24-0.67], hypopneas= 0.80 [0.66-0.91], and ODI= 0.97 [0.93-0.99]. The ICC of the arousal index was 0.68 [0.50-0.85]. The kappa statistics for sleep stages were: wake= 0.78 [0.77-0.79], non-REM= 0.77 [0.76-0.78], N1= 0.31 [0.30-0.32], N2= 0.60 [0.59-0.61], N3= 0.67 [0.65-0.69], and REM= 0.78 [0.77-0.79].
Conclusion: There is strong agreement in the scoring of the overall AHI as well as the number of apneas and hypopneas among the SAGIC international sleep centers. There is also substantial epoch-by-epoch agreement in scoring wake, non-REM, and REM sleep. Using the AASM recommended definitions by experienced scorers and with good quality PSGs, our results suggest that centralized scoring of PSGs may not be necessary in future research collaboration among the SAGIC centers.

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IDENTIFICATION OF INSOMNIA USING ELECTRONIC HEALTH DATA

Severson CA[1], Pendharkar SR[2], Ronksley PE[3], Tsai WH[2,3]
[1]University of Calgary, Calgary, AB, Canada, [2]Department of Medicine, University of Calgary, Calgary, AB, Canada, [3]Department of Community Health Sciences, University of Calgary, Calgary, AB, Canada

Introduction: Chronic insomnia affects up to 30% of the population and is associated with increased direct and indirect costs. The purpose of this study was to determine if a diagnostic algorithm using data from an online questionnaire could be used to accurately identify insomnia.
Methods: All patients referred to the FMC Sleep Centre (Calgary, Alberta, Canada) between May 2009-2011 filled out an online questionnaire as part of the triage process. For each patient, two board certified sleep physicians independently assigned a primary and secondary sleep diagnosis based on the International Classification of Sleep Disorders - Second Edition (ICSD-2). Logistic regression was used to identify predictive variables from the online questionnaire. A diagnostic algorithm derived from these predictors was evaluated against physician diagnosis as a reference standard.
Results: 1223 eligible health records were reviewed. The prevalence of insomnia was 27.7%. Sleep latency (OR 1.01, $p<0.001$) and use of a sleep aid (OR 2.85, $p<0.001$) were predictive of insomnia. Hours of sleep (OR 0.74/hr, $p<0.001$), benzodiazepine use as a sleep aid (OR 0.38, $p<0.041$), self-reported ability to return to sleep after waking (OR 0.46, $p<0.001$), Epworth Sleepiness Scale score (OR 0.94/point, $p<0.001$), and BMI (OR 0.90, $p<0.001$) were predictive of an ICSD-2 diagnosis other than insomnia. Diagnostic cutpoints were established: sleep latency > 20 minutes, estimated sleep time < 6.5 hours, BMI < 27, and ESS < 9. The diagnostic algorithm had a sensitivity of 11.79%, specificity of 99.32%, positive predictive value of 86.9% and a negative predictive value of 74.6%. Maximum sensitivity could be achieved by using estimated sleep time <= 6.5 hours (sensitivity 70%), but at the cost of reduced specificity (61%).
Conclusion: Diagnostic algorithms derived from electronically administered questionnaires can be highly specific for insomnia but lack sufficient sensitivity as a screening tool.
Support (If Any): University of Calgary, Division of Respirology; The O'Brien Centre for the Bachelor of Health Sciences.

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DEVELOPMENT AND INITIAL VALIDATION OF A QUESTIONNAIRE TO ASSESS SLEEP-RELATED PRACTICES, ATTITUDES, AND BELIEFS

Patel NP[1], Jackson NJ[2], Grandner MA[2]
[1]Respiratory Specialists and Department of Medicine, Reading Hospital and Medical Center, Reading, PA, USA, [2]Sleep Medicine, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Behavioral, social and environmental influences on sleep remain largely unexplored, partly because there are no established instruments that evaluate habitual sleep practices in the context of beliefs and attitudes. The present study develops and evaluates a Sleep Practices and Attitudes Questionnaire (SPAQ), developed based on the Health Belief Model, Theory of Reasoned Action, and Transtheoretical Model.
Methods: The questionnaire items were grounded in health behavior theory and then iteratively refined by expert and community feedback. The final version contains 16 subscales: (1)SleepDuration, (2)SleepDebt, (3)SleepQuality, (4)Sleepiness/Tiredness, (5)CopingWithSleepiness, (6)CopingWithAcuteInsomnia, (7)CopingWithChronicInsomnia, (8)ActivitiesInBed, (9)SleepEnvironment, (10)Knowledge, (11)ImportanceOfSleep, (12)ImpactOnSleep, (13)ImpactOfSleep, (14)Self-Efficacy, (15)SleepAndHealth, and (16)SocialNorms. The SPAQ was administered in an online survey (N=124) with the Pittsburgh Sleep

Quality Index(PSQI), Epworth Sleepiness Scale(ESS), Sleep Hygiene Index(SHI), and Dysfunctional Beliefs and Attitudes about Sleep scale(DBAS-16). Assessment of internal consistency used Cronbach's α and correlations among subscales.
Results: Most subscales demonstrated moderate-to-high internal consistency. Although many subscales correlated with each other, these were predominantly in the moderate range. The SPAQ likely has high face validity and construct validity. Criterion validity was not able to be ascertained for most subscales but was demonstrated for those subscales for which similar measures exist. Correlation between Subscale 1 and PSQI-assessed sleep duration was r=0.53(p<.001). Subscale 3 correlates well with PSQI (rho=0.36,p<.001) and distinguishes Good/Poor Sleepers(p=.002). Subscale 4 correlated with ESS (rho=0.39,p<.001) and differentiated ESS scores >9(p=.003). Correlations with SHI were significant for Subscales 6(r=0.29,p<.001), 8(r=0.53,p<.001), and 9(r=-0.34,p<.001) and several subscales were significantly correlated with the DBAS, including 2(r=0.18,p<.05), 3(r=0.28,p<.01), 4(r=0.31,p<.001), 8(r=0.23,p<.05), 12(r=0.30,p<.001), 13(r=0.45,p<.001), 15(r=0.30,p<.001), and 16(r=0.26,p<.01).
Conclusion: The SPAQ may be useful for developing sleep-health programs. Future studies may utilize the descriptive data obtained using this questionnaire to determine the role of behavioral, social and environmental determinants of healthy sleep.
Support (If Any): This work was supported by T32HL007713.

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APPLICATION OF CONTINUOUS MULTISITE ACCELEROMETRY TO DISCRIMINATE BETWEEN SLEEP AND WAKE: COMPARISON WITH A COMMERCIAL ACTIGRAPH

Lamprecht M[1], Tran T[2], Greenhill J[2], Williams G[2], Parsley CL[2], Terrill PI[1]
[1]School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, QLD, Australia, [2]Department of Respiratory and Sleep Medicine, The Mater Children's Hospital, Brisbane, QLD, Australia

Introduction: In recent years, actigraphy has proven to be useful in a range of sleep medicine and research applications because of its ability to non-invasively estimate sleep and wake states. However, conventional actigraphy has a number of technical limitations which may limit its accuracy- particularly the recording of only summarized activity counts. In this study, the sleep/wake discrimination ability of a system which records continuous tri-axial accelerometry at multiple locations (Continuous Multisite Accelerometry System- CMAS) is compared with the performance of a commercially available actigraph.
Methods: 8 pediatric participants (5-16y/o) with suspected sleep apnea were studied using polysomnography; a commercial actigraph on the left wrist; and CMAS which recorded 100Hz tri-axial accelerometry data from the left wrist and middle finger, left ankle and great toe, and the sternal notch. Four algorithms were applied to 30 second epochs of CMAS data to generate discriminating variables: integrated angle of posture change; Maximum Magnitude of acceleration (MM); integrated magnitude of acceleration; and the number of threshold-crossings. The ability of each variable to discriminate between sleep and wake (defined by manual scoring of the polysomnogram) was assessed using the receiver operating characteristic Area Under Curve (AUC).
Results: When data was pooled across all subjects, the MM variable derived from wrist accelerometry was the best discriminator with an AUC of 0.79, whilst 30 second activity counts from the commercial actigraph achieved an AUC of 0.68. Variables derived from the wrist, finger and toe generally performed better than ankle and sternal notch variables.
Conclusion: Time domain variables derived from CMAS data were able to better discriminate between sleep and wake than a conventional commercial actigraphy system. The improvement in performance may be attributed improved classification variables and the use of tri-axial rather than uni-axial accelerometers. These improved discriminators may lead to the development of more reliable actigraphy systems.

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INSOMNIA: CAN WE DEFINE A VULNERABLE PHENOTYPE?

Harvey C[4,1,2,3], Espie CA[4,1,2,3], Cavanagh J[3], Biello S[2]
[1]Institute of Neuroscience and Psychology, University of Glasgow, Glasgow, United Kingdom, [2]School of Psychology, University of Glasgow, Glasgow, United Kingdom, [3]Sackler Institute of Psychobiological Research, University of Glasgow, Glasgow, United Kingdom, [4]University of Glasgow Sleep Centre, University of Glasgow, Glasgow, United Kingdom

Introduction: A trait like vulnerability to Insomnia has been demonstrated, and a questionnaire devised to assess this (FIRST). There is very little work defining a vulnerable phenotype both psychologically and physiologically view-point. Previous work from our lab suggests that those predicted to be vulnerable to sleep disruption by the FIRST show a psychological profile similar to that of the insomnia population (high on neuroticism, and rumination for example) and show increased baseline cortisol levels during a lab based stress paradigm. This piloting work aims to assess if those who are defined as vulnerable show disrupted sleep in response to real life stress and which factors are likely to mediate this.
Methods: Students who completed the Trier Social stress test were invited to participate in a follow-up. They were provided with 2 weeks of sleep diaries and instructed to fill one out during a week in which they anticipated no stress and during a week which they expected to be more stressful than usual- i.e. increased work-load. Information on personality and stress amongst others had been collected. 2 groups were created post-hoc after the trier based on FIRST score: vulnerable and resilient. It was predicted that the vulnerable group would show greater sleep disruption in the stressful compared to normal week relative to the resilient group, and that this would be mediated by stress-reactivity measured during the trier, and neuroticism.
Results: Due to the small number of returned diaries (n=16)non-parametric analysis was carried out. It was found that the vulnerable group showed greater increase, during the stressful week, in insomnia symptoms compared to the resilient group. This correlated with baseline cortisol levels (r=-0.55, p<0.05). They also showed significantly increased scores on measures of neuroticism and rumination.
Conclusion: Results at this stage are preliminary, but the data suggests that a vulnerable phenotype does exists which can be measured by the FIRST. This population seems to be defined by neuroticism and rumination as predicted and in line with the insomnia literature. Previous work suggests that this population show something similar to the hyperarousal posited to exist in insomnia, and this seems to effect the nature of sleep disruption in response to real life stress. This work is the first to try and understand the nature of insomnia-vulnerability from both a psychological and physiological stance.
Support (If Any): Sackler Institute of Psychobiological Research.

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RELIABILITY OF YOUTH- AND PARENT-REPORT OF SLEEP DURATION WITH AMBULATORY POLYSOMNOGRAPHY

Mograss MA[1,2,3], Jarrin DC[3], Noel N[3], McGrath JJ[3], Constantin E[1,2]
[1]Pediatrics, The Research Institute, McGill University Health Centre (RI-MUHC), Montreal, QC, Canada, [2]Montreal Children's Hospital, Pediatric Sleep Lab, McGill University, Montreal, QC, Canada, [3]Psychology, Pediatric Public Health Psychology Lab, Concordia University, Montreal, QC, Canada

Introduction: Parent-report is a common source for children's sleep characteristics, but parents may not provide accurate information. Previous studies have found parents overestimate child sleep duration com-

pared to actigraphy. However, there are inherent limitations associated with using actigraphy alone for sleep assessment. The study objective was to compare the reliability of youth- and parent-report of sleep duration with home overnight polysomnography (PSG).
Methods: Youth (N=38) aged 9 to 16 years (M=13.2, SD=2.0) participated in the Healthy Heart Project. Parents and youth answered questions about typical sleep duration on school nights and weekends. Each youth underwent a modified PSG consisting of EEG (FPZ), EOG, A2 ref, and ground electrodes. Pulse oximetry and respiratory volume were also monitored. PSG was performed at home on a school night (n=21) or weekend (n=17). Measures of Total Sleep Time (TST) and Sleep Period Total (SPT) were calculated from PSG. Intra-class coefficients (ICCs) were used to test the reliability between youth- and parent-report with PSG.
Results: Preliminary results indicate there was greater reliability on school nights, compared to weekends. For school nights, parent-report of sleep duration significantly corresponded with PSG, yielding strong consistency for TST (ICC=0.82) and SPT (ICC=0.88). Youth-report was fairly consistent for TST (ICC=0.33) and moderately consistent for SPT (ICC=0.52). For weekends, parent-report was fairly consistent for TST (ICC=0.40) and SPT (ICC=0.42). Youth-report was also fairly consistent for TST (ICC=0.36) and SPT (ICC=0.32). On average, SPT was 43 minutes longer on weekends, compared to school nights (t=2.20, p<.05).
Conclusion: Findings suggest youth- and parent-report of typical sleep duration are reliable with PSG measures for school nights, but less so for weekends. Greater structure in routine on school days (e.g., consistent bed and wake times) may partly explain these findings.
Support (If Any): This study was supported by grants CIHR (MOP89886) and (OCO79897). MAM was supported by a CIHR Banting fellowship.

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ASSOCIATION BETWEEN SUBJECTIVE AND OBJECTIVE SLEEP MEASURES: CHICAGO AREA SLEEP STUDY

Kim K[1], Knutson KL[4], de Chavez PJ[1], Ng J[3], Liu K[1], Goldberger JJ[3], Zee P[2], Carnethon M[1]
[1]Preventive Medicine, Northwestern University Feinberg School of Medicine, Chicago, IL, USA, [2]Neurology, Northwestern University Feinberg School of Medicine, Chicago, IL, USA, [3]Cardiology, Northwestern University Feinberg School of Medicine, Chicago, IL, USA, [4]Medicine, University of Chicago, Chicago, IL, USA

Introduction: Sleep studies rely on both subjective and objective measurements. Previous studies showed that participants with poor sleep quality presented week correlations between the two measurements. Since shortened sleep duration was also associated with cardiovascular disease (CVD) risk factors in prior studies, an unbiased measurement of sleep duration is imperative. We explore the relationship between the two types of measurements among participants without obstructive sleep apnea.
Methods: The Chicago Area Sleep Study (CASS) recruited 585 participants aged 35-64 via commercially available telephone listings. Participants underwent 1 night of screening using in-home apnea detection equipment (ApneaLink™). Participants wore wrist actigraphs for 7 days (Actiwatch™) to determine sleep duration. For data analysis, we include participants (n=474) with AHI<15 and subjectively and objectively-measured sleep duration between 4 and 14 hours. Self-reported sleep quality (Pittsburgh Sleep Quality Index [PSQI]), health behaviors and cardiovascular disease risk factors were measured using standard protocols.
Results: Mean self-reported sleep duration of 6hrs 49mins was significantly shorter than the mean objectively-measured sleep duration of 7hrs 6mins (mean [95% CI] of difference is -16.6min[-23.5, -9.8]). The two measures were modestly correlated (Pearson's ρ = 0.37; p < 0.0001). Females showed slightly larger differences than males, -18.1 mins versus -14.4 mins, but not statistically significant. Difference was strongly associated with PSQI (β = -12.4 min/PSQI, p < 0.0001) and age (β = -1.5 min/year, p < 0.0004).
Conclusion: The difference between objective and subjective sleep measurements was statistically significant, while their correlation was relatively small. The difference showed strong association with PSQI and age, indicating that older participants and those with higher PSQI tend to underreport their subjectively-measured sleep duration. The result of PSQI is consistent with results studying participants with poor sleep quality. Therefore, we need to carefully scrutinize the subjectively-measured sleep duration before carrying out further statistical analyses.

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CAN A 30-MINUTE DRIVING SIMULATION TEST DIFFERENTIATE CONTROLS FROM OSA SUBJECTS?

Zhang C[1,2], DeYoung P[1], Batool-Anwar S[1], Varvarigou V[2], Malhotra A[1], Kales S[2]
[1]Sleep Medicine, Brigham & Women's Hospital, Boston, MA, USA, [2]Occupational Medicine and Epidemiology, Cambridge Health Alliance, Cambridge, MA, USA

Introduction: Past research has shown worse performance on the AusEd driving simulation among OSA subjects compared to controls, but most differences were apparent only after 30 minutes. As part of a strategy to determine if a 30-minute AusEd can objectively stratify OSA risk among professional drivers, we first tested the hypothesis that a 30-Minute Driving Simulation Test Differentiate Controls from OSA Subjects.
Methods: Cross-sectional study, in which driving simulation results from professional drivers with low risk for OSA (BMI < 27 kg/m2 and Neck < 17 in. and ESS < 10) recruited at an occupational clinic served as controls and were compared with those from PSG-confirmed OSA patients at a sleep clinic. Primary outcomes of the driving test are: reaction time (RT), crashes, lapses and lane deviations, which are extracted using from the simulator software program. The analysis is adjusted for confounding factors obtained from the Pittsburgh Sleep Quality Index (PSQI) questionnaire (sleep quality, duration, caffeine intake and other co-morbidities) and demographics factors. Sign tests are used to compare the means of the primary outcomes.
Results: Preliminary results from low risk CMV operators (N=13) and PSG-confirmed OSA patients (N=28) show that the PSG-confirmed subjects are significantly worse in median RT (1.18 sec vs. 1.00 sec, p<0.05) and lane deviations (64.91 cm vs. 49.8 cm, p< 0.05) but not significantly different in crashes and lapses. Further subjects are being enrolled.
Conclusion: The median RT and lane deviations of a 30-minute AusED driving simulation testing may help identify drivers at risk for OSA. Further studies of a larger sample as well as drivers at high-risk for OSA are needed.
Support (If Any): NRSA-T32(PA-06468).

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URINE TOXICOLOGY SCREEN IN MSLT: THE CORRELATION OF POSITIVE TETRAHYDROCANNABINOL, DRUG NEGATIVE PATIENTS AND NARCOLEPSY

Dzodzomenyo S[1], Stolfi A[1], Splaingard ML[2], Splaingard D[2], Onadeko O[3]
[1]Pediatrics, Wright State University, Dayton, OH, USA, [2]Pediatrics, Ohio State University, Columbus, OH, USA, [3]Pulmonary Medicine, Critical Care and Sleep Medicine, Ohio State University, Columbus, OH, USA

Introduction: Many drugs and medications may influence the outcome of the Multiple Sleep Latency Test (MSLT). Morning urine toxicology screen is performed routinely in our lab as part of the test. AIM: To identify any drugs that may have a positive or negative effect on MSLT outcomes.

Methods: This is a retrospective study of urine drug screens performed for MSLT in 321 patients aged 13-39 yrs (range 5.5 - 39 yrs) at the Nationwide Children's Hospital, Columbus, Ohio from 2004 to 2011. Urine samples were collected the morning following a polysomnogram before the MSLT was performed. Patients were divided into three groups: 1) negative urine screens, 2) positive urine screens for drugs other than tetrahydrocannabinol (THC) and 3) positive urine screens for THC (+THC). Comparisons between groups for gender, ethnicity, MSLT (normal/abnormal), sleep diagnosis and total sleep time were made with Fisher's exact tests or one-way ANOVA.
Results: Thirty-nine patients tested drug positive: 26 with drugs other than THC and 13 +THC. 85% (11/13) in the +THC group were THC alone; 15% (2/13) were +THC and amphetamine/methamphetamine. Based on MSLT criteria, 69% (9/13) of +THC patients had MSLT consistent with narcolepsy (PN), 8% (1/13) consistent with idiopathic hypersomnia, 8% (1/13) other, and 15% (2/13) were normal. This was statistically different from those with negative screens (27% narcolepsy, 22% idiopathic hypersomnia, 2% other, 49% normal), and those positive for drugs other than THC (23% narcolepsy, 31% idiopathic hypersomnia, 46% normal, p=0.0195). There was no difference in total sleep time, gender or ethnicity among the groups. Ten percent (9/91) of patients with PN were +THC.
Conclusion: There is a significantly increased number of patients meeting MSLT criteria for narcolepsy in patients whose urine tests +THC. Urine drug screening is important in the MSLT evaluation for narcolepsy.

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THE PSYCHOMETRIC PROPERTIES OF THE NONRESTORATIVE SLEEP SCALE (NRSS)

Wilkinson K[1], Shapiro CM[1,2,3]
[1]Cell and Systems Biology, University of Toronto, Toronto, ON, Canada, [2]Psychiatry, Toronto Western Hospital, Toronto, ON, Canada, [3]Youthdale Child and Adolescent Sleep Centre, Toronto, ON, Canada

Introduction: Nonrestorative sleep (NRS) refers to the complaint of sleep as insufficiently refreshing, often despite seemingly "normal" sleep as measured by objective parameters. Due to the paucity of biomarkers available for NRS, a valid and reliable measure of this subjective symptom is necessary for the standardization of its assessment and for comparability of its presentation between different disorders and conditions. For this reason, the initial item pool of the Nonrestorative Sleep Scale (NRSS) was developed in our laboratory.
Methods: The initial 34-item NRSS was created based on a review of the literature regarding NRS and was evaluated for face validity. Each item incorporates a Likert-type scale, with lower scores indicating poorer subjective sleep. The scale was administered to 256 participants recruited from a Toronto sleep clinic population. Participants also completed the Centre for Epidemiological Depression Scale, the Pittsburgh Sleep Quality Index, the Athens Insomnia Scale, and the Toronto Hospital Alertness Test as part of the questionnaire battery. 43 participants completed the questionnaire a second time in order to assess its test-retest reliability. An additional 30 controls were also recruited. Scale items were deleted based on redundancy and low communalities. Psychometric properties of the scale's remaining items were then assessed.
Results: From the initial item pool, 12 items were retained. Exploratory factor analysis suggested a four-factor solution explaining 72.7% of the variance. Factors were: refreshment from sleep, physical/medical symptoms of NRS, daytime consequences of NRS, and affective symptoms of NRS. Factors were well correlated with other items/scales chosen beforehand from the questionnaire battery to represent those domains (r-value ranging from 0.28 to 0.76). The scale demonstrated an overall internal reliability of 0.88 and a test-retest reliability of 0.72.
Conclusion: According to this initial validation study, the NRSS represents a reliable measure of NRS and its concomitant symptoms.

Support (If Any): This research was supported by a grant from Canadian Institutes of Health Research.

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THE NEMURI SCAN NON-CONTACTING ACTIGRAPH DESIGNED TO BE PLACED UNDER THE MATTRESS: SLEEP PATTERN IDENTIFICATION IN PATIENTS WITH SLEEPING DISORDERS AND ASSESSMENT ACCURACY IN COMPARISON TO POLYSOMNOGRAPHY

Hashizume Y
Psychiatry, Kurume University, Kurume, Japan

Introduction: This study examined the performance of a non-contacting actigraph, the Nemuri Scan (N-S; Paramount Bed Co., Ltd,) designed to be placed under a mattress. Like watch-shaped actigraphs, the N-S is simple to use and identifies sleep-wake rhythms. In addition, it provides information on bedtime. Here, we evaluated the accuracy of the N-S, by comparing N-S data and PSG data acquired simultaneously.
Methods: Fifteen patients with sleeping disorder were separated into two groups: Group 1 (without frequent micro-arousal) composed of 3 patients with insomnia, 2 with DSPS, and 1 with narcolepsy; and Group 2 (with frequent micro-arousal) composed of 9 patients with obstructive sleep apnea syndrome (OSAS). The N-S was placed under the mattress of a bed in the Laboratory of Somnology, Kurume University, and then actigraphy using the N-S and PSG were simultaneously performed. Verbal consent for actigraphy with the N-S was obtained from participants. The sleep stage in each 20-s epoch was identified according to the internationally accepted Rechtschaffen and Kales criteria. Patients in the movement time stage were considered to be in the wake state.
Results: When sleep-wake identification results were compared for the two methods, the agreement rate was 89.4%, while the sensitivity (the proportion of epochs in the sleep state identified by the N-S to those in the sleep state identified by PSG) and the specificity (the proportion of epochs in the wake state identified by the N-S to those in the wake state identified by PSG) were 94.9% and 52.1%, respectively. In Group 2, the apnea-hypopnea index (AHI) was in a range 6.3-87.5 (mean 37.3 ± 28.6). AHI was ≥20 in 7 of 9 patients had an . When sleep efficacy, total time scored as sleep, and total time scored as wake were compared between MA and PSG, all showed a significant correlation. When the sleep-wake identification results in individual epochs were compared between two methods, the agreement rate was 74.8%, while the sensitivity and specificity were 78.1% and 60.6%, respectively .
Conclusion: In Group 1, the sleep efficiency assessed by the N-S correlated with that by PSG, with a Pearson's correlation coefficient of 0.84. The agreement rate tended to decrease as AHI increased, albeit not significantly so (Pearson's correlation coefficient, -0.53).

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INFLUENCE OF MISSING QUESTION EIGHT ON THE EPWORTH SLEEPINESS SCALE

Santiago BI, Scharf SM
Division of Pulmonary and Critical Care Medicine, University of Maryland, Baltimore, MD, USA

Introduction: The Epworth Sleepiness Scale (ESS) is a widely used trait scale to assess subjective sleepiness. The ESS asks individuals to rate their usual chance of dozing off or falling asleep in eight common daily life situations. Question eight concerns tendency to doze "In a car, while stopped for a few minutes in traffic." Although the intent is anytime one is in a car, many people who do not drive, or do not travel frequently by car fail to answer this question. We determined how frequently does absence of an answer to question eight would change a determination from "sleepy" to "not sleepy.".
Methods: We studied 100 patients referred to the University of Maryland Sleep Disorders Center from July 2011 to November 2011. Demographic data, clinical information and polysomnographic parameters

were collected for each patient. We compared the complete ESS scores (ESS+8) and the ESS scores with question eight excluded (ESS-8). We used an Epworth score of >10 as a definition of "sleepy.".
Results: The cohort consisted of 59 females and 41 males (mean ± SD): age 47 ± 13 years, BMI 38 ± 16 kg/m^2, neck circumference 17 ± 6.1 inches, respiratory disturbance index (disordered breathing events per hour of sleep) RDI 24 ± 26, and periodic limb movement (PLM) index of 3.3 ± 8.4 per hour. The mean ESS+8 was 11 ± 5.4 while the mean ESS-8 was 10.6 ± 4.9. Using a cutoff of >10, 58 patients had abnormal ESS+8 scores. When question eight was suppressed, 56 of the 58 patients (96.6%) still had ESS >10.
Conclusion: When question eight was not answered, there was little difference in the prevalence of "sleepy" in our patients as assessed from the ESS.

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COMPARISON OF SELF ASSESSMENT VERSUS PHYSICIAN REASSESSMENT OF THE EPWORTH SLEEPINESS SCALE

Santiago BI, Davis M, Verceles A
Division of Pulmonary and Critical Care Medicine, University of Maryland, Baltimore, MD, USA

Introduction: The Epworth Sleepiness Scale (ESS) is the most widely used method for assessing subjective sleepiness in adults. Its brevity and simplicity allow it to be self administered with little potential for misinterpretation. However, patients with underlying sleep disorders tend to underestimate their level of sleepiness. We aim to determine the reproducibility of the ESS score when administered face to face by a physician after initially being self administered.
Methods: Patients referred to a sleep disorders clinic were sent the ESS questionnaire for self assessment (ESSs) prior to their scheduled clinic visit. During the clinic encounter, the ESS was reassessed by a sleep medicine specialist (ESSmd). Statistical analyses were carried out comparing ESSs and ESSmd scores.
Results: There were 41 patients evaluated: 56 % males (54% white, 41% black, 5% other race) with a mean age of 50.7 ± 14.6 years, BMI of 33.3 ± 7.8 kg/m^2, and a neck circumference of 17.8 ± 9.6 inches. When comparing the two scores, the ESSmd was found to be significantly higher 11.6 ± 6.1 vs. 8.9 ± 5.2 (p= 0.04). Analysis of the individual questions showed significant increases in scores for question items five "Lying down to rest in the afternoon when circumstances permit" (p= 0.02) and seven "Sitting quietly after lunch without alcohol" (p= 0.02).
Conclusion: When readminstered face to face by a sleep specialist, the ESS score significantly increases. This allows better assessment of patients' general level of daytime sleepiness. Face to face administration of the ESS may be more accurate in identifying pathological sleepiness when compared to the self administered technique.

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PSYCHOMETRICS OF THE EPWORTH SLEEPINESS SCALE FOR USE WITH SPANISH-SPEAKING MEXICAN AMERICANS AND MEXICANS

Baldwin CM[1], Bonds McClain D[1], Caudillo Cisneros C[2,1], Reynaga-Ornelas L[2,1], Marquez Gamiño S[2,1], Quan SF[3,4]
[1]ASU College of Nursing and Health Innovation, Phoenix, AZ, USA, [2]Health Sciences, Universidad de Guanajuato, Leon, Mexico, [3]University of Arizona Health Sciences Center, Tucson, AZ, USA, [4]Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: No extant studies have compared the psychometric properties of a Spanish language Epworth Sleepiness Scale (ESS) for use with Mexican Americans and Mexicans in bi-national studies of daytime somnolence. This work examines the psychometrics of the Spanish-translated ESS for use with these populations in clinical sleep and sleep research milieus.
Methods: Mexican Americans (N=204; 56% women) and Mexicans (N=202; 53% women) residing in the southwestern United States and central Mexico respectively provided demographic and sleep data derived from the rigorously Spanish-translated ESS and the Sleep Heart Health Study Sleep Habits Questionnaire (SHQ). Psychometric properties included internal and convergent validity, and confirmatory factor analysis using PASW (Version18) software with significance set at p<0.05.
Results: The Epworth for both groups showed Cronbach's alphas of 0.84 indicating robust internal reliability. Bivariate correlations for the ESS and SHQ daytime sleepiness, non-restorative and insufficient sleep items correlated positively and significantly, suggesting convergent validity. Multiple group confirmatory factor analysis models indicated that by dropping only 2 items, a strict level of measurement equivalence across Mexican American and Mexican samples was achieved. Independent samples t-test results suggested that Mexican Americans reported significantly higher levels of sleepiness while watching television and more afternoon 'siestas' compared to Mexicans. On a separate item, Mexican Americans reported significantly higher rates of drowsy driving compared to Mexicans.
Conclusion: The Spanish-language ESS demonstrates appropriate measurement properties and should be useful for assessing daytime somnolence in clinical and research settings among Mexican Americans and Mexicans. Significant differences in ESS scores across Mexican American and Mexican cultures were not due to differences in the meaning of the measure for the different cultures, but to true differences in daytime sleepiness.
Support (If Any): This work was supported through NIH NICHD Grant #1R03 HD051678A2 'Spanish Translation and Validation of a Sleep Measure' (PI: CM Baldwin).

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ARE MWT AND BEHAVIORAL INDEX A USEFUL SYNERGY FOR THE EVALUATION OF SLEEPINESS?

Baiardi S, Poini A, Pizza F, Mondini S, Cirignotta F
Neurology Unit, S.Orsola-Malpighi Hospital, University of Bologna, Bologna, Italy

Introduction: The gold standard for the assessment of the ability to maintain wakefulness is the Maintenance of Wakefulness Test (MWT) but clinical usefulness is limited by poor normative data and correlation with other sleepiness measures. We hypothesized that the video analysis of patients' behavior during MWT, focused on eyelid drops (ED), could improve the sensitivity of the test.
Methods: We studied 12 men with severe OSAS (AHI=54.4±12.0), mean age 55.7±6.4 years. Each patient underwent four MWT sessions according to the International Guidelines with the addition of video recording. We divided patients into three groups according to mean sleep latency (SL) at MWT: pathologic (<8', n=4), borderline (8'-30', n=4), and normal (>30', n=4). In each MWT session we evaluated the eyelid drops equal to or longer than 2 sec. The Behavioral Sleepiness Index (BSI) was defined as the mean number of seconds with eyelid closure per epoch at first, fifth and tenth minute in each MWT session. Behavioral Sleep Onset (BSO) was defined as the first epoch with a BSI longer than 15 sec. We evaluated the relationship between BSI and BSO with the SL in each MWT session (Spearman Test), and compared the mean BSO with the mean SL-MWT in each patient (Wilcoxon Test).
Results: BSI and SL-MWT were inversely correlated at 1-5-10 minutes in each MWT session (p=0.000; p=0,000; p=0.004), whereas BSO was directly related to SL-MWT in each MWT session (p=0.000). Each patient's mean BSO (14, 63±14, 68) was significantly lower than the mean SL-MWT (21.35±15.31; p=0.003) in all three groups. Considering mean BSO as measure of sleepiness 1 "normal" patient at MWT (25%) and 1 "borderline" patient (25%) moved to "pathologic" group.
Conclusion: Video monitoring of eyelid drops seems to improve the sensitivity of MWT in detecting drowsy patients.

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FEASIBILITY PILOT STUDY OF A WEB-BASED STANDARDIZED SLEEP QUESTIONNAIRE

Schutte-Rodin S, Maislin G, Pack F, Gehrman P, Hueter M, Pack A
Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA

Introduction: This feasibility study was one of several projects involving implementation of the web-based Alliance Sleep Questionnaire (ASQ) which was written by sleep experts from Stanford, the University of Wisconsin, St. Luke's, Harvard, and the University of Pennsylvania. The ASQ is a comprehensive sleep questionnaire comprised of validated questionnaires and supplemented by consensus questions. Intake questions include demographics, medical and sleep histories, and baseline outcomes measures. As such, it is lengthy whether done on paper or electronically.
Methods: 50 patients were recruited to complete the ASQ on paper. As occurs with paper questionnaires, patients were able to skip questions, including self-assessment of the total time to complete the ASQ. 31 patients completed the time self-assessment. 250 clinical patients were invited to complete a web ASQ. This ASQ was broken into 16 modular forms that included branching questions. As programmed in this web ASQ, patients could not submit a form until all answers were completed. 44 patients consented to participate in the web ASQ from their homes. 36 patients completed the entire web ASQ with the others nearly completing it. Times to complete the ASQ were objectively assessed by electronic time-stamping of each submitted module.
Results: The average time to complete the paper ASQ was 44.8 min (n=31). The median time to complete the total web ASQ was 40.5 min. (n=44), with a median time of 14.2 min. for demographics + past medical history and a median time of 25.2 min. for all other web ASQ (sleep-related) forms. Web ASQ demographics+MAP+ESS+FOSQ-10, a brief but comprehensive assessment of patient status, required a median time of 9.0 min. Web ASQ electronic data were available for easy export to an electronic medical record (EMR) report and for data analysis of the Epworth, MAP, ISI, ISQ, GAD-7, PHQ-9, FOSQ-10, and other modules.
Conclusion: Times to complete the paper ASQ and the web ASQ were similar. Completion time for all (14) web ASQ sleep-related forms was <30 min. The web ASQ offered several advantages over the paper ASQ. All answers were required to complete the web ASQ while answers could be skipped on the paper ASQ. Web ASQ answers were entered electronically by patients prior to their clinic visit, thus decreasing clerical time at the clinical visit. Web ASQ answers were easily exported into an electronic database for individual EMR report use or for group data analysis. A web-based standardized sleep questionnaire is feasible.

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PATIENTS PREFER ELECTRONIC QUESTIONNAIRES OVER PAPER QUESTIONNAIRES

Schutte-Rodin S, Pack F, Maislin G, Gehrman P, Hueter M, Pack A
Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Electronic medical records are replacing paper charts for clinic visit documentation. To facilitate the intake of clinical information in busy practices, electronic and web questionnaires are needed to replace paper questionnaires in clinics. This study assesses the preferences and willingness to complete electronic questionnaires in an urban sleep clinic. This study was one aspect of several projects involving implementation of the web-based Alliance Sleep Questionnaire (ASQ) which was written by sleep experts from Stanford, the University of Wisconsin, St. Luke's, Harvard, and the University of Pennsylvania.
Methods: Prior to their initial sleep consult appointment date, 250 consecutive new sleep patients were mailed invitation letters to participate in completing a web-based sleep questionnaire, the ASQ. The invitation letters contained a separate pre-stamped mail back response designating their preferences for the method/ location for completing clinic questionnaires. Patients were also called 1 week prior to the appointment and verbally asked their preferences for completing sleep questionnaires. The preference question and response choices were: If the questionnaire must be completed before your sleep evaluation, where would you prefer to complete the questionnaire? ( ) Complete it on a website on your home computer ( ) Complete it on a touch screen computer in the waiting area before the appointment ( ) Complete it on paper at home and bring it to the appointment ( ) Complete it on paper in the waiting room before the appointment ( ) No preference.
Results: Data responses were not obtainable for 38% of patients (n=94). Data responses were obtainable for 62% (n=156) of the 250 patients. For patients with responses, 50% (n=78) preferred "website on home computer"; 17% (n=27) preferred "touch screen in the waiting room"; 24% (n=37) preferred "paper at home"; 6% (n=10) preferred "paper in the waiting room"; and 3% (n=4) had no preference. For the 94 patients that did not have data responses (by letter and by phone calls), 64% of the non-responders did not keep the consult appointment compared to 38% of responders who did not keep their appointment.
Conclusion: Among responders, 67% preferred electronic questionnaires, 30% preferred paper questionnaires, and 3% had no preference. Patients who do not respond to letters and phone calls are less likely to keep their appointment, using any questionnaire format. Those more likely to be seen prefer electronic over paper questionnaires.

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QUALITY ASSESSMENT OF INPATIENT SLEEP MEDICINE PRACTICE: UTILITY OF ESTABLISHING A SLEEP APNEA DIAGNOSIS WITH PORTABLE INPATIENT SLEEP STUDY

Khalil MA[1], Dhotre D[2], Franco RA[1,2]
[1]Otolaryngology, Medical College of Wisconsin, Milwaukee, WI, USA, [2]Medicine, Medical College of Wisconsin, Milwaukee, WI, USA

Introduction: Undiagnosed sleep apnea is common in hospitalized patients. Treatment of sleep apnea reduces readmissions. The utility of diagnosis and treatment initiated inpatient has not been evaluated.
Methods: Patients cared for in a tertiary referral academic hospital between 2004-2011 who underwent a type 3 portable monitor (PM) test while inpatient were retrospectively reviewed for assessment of diagnosis and follow through using chart review and phone contact. The impact of a change in order requirements (mandatory pulmonary consultation to authorize the study) instituted July 2009 was also analyzed.
Results: 117 patients (58 male, 59 female) underwent PM. 67 were studied prior to the new practice implantation. Very few studies were unusable. The number of adequate studies and the number of positive studies were no different before and after the new practice of mandatory pulmonary consultation (88% vs. 90% adequate; 72% vs. 73% positive for sleep apnea (AHI >5)). CPAP set up was made at the time of discharge more often after the new requirement (44% and 66%). Follow up, defined as download study availability, a full PSG set up or a sleep clinic visit also increased (46% vs. 66%) with consultation. Adding the pulmonary consultation was statistically significant by Fishers exact test (p=0.4).
Conclusion: The Type 3 PM in inpatient setting was effective in diagnosis regardless of experience in treating sleep apnea of the ordering physician. However, adding expertise in management through a mandatory pulmonary consultation resulted in significantly more patients leaving the hospital with CPAP set up and improved the likelihood of continued follow up. The increase ongoing attention to addressing the sleep apnea may be in part due to more in-depth education at the time of consultation or more available clinical support after discharge directed specifically at sleep apnea.

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COMPARISON OF SLEEP QUALITY BETWEEN HOSPITAL POLYSOMNOGRAPHY AND HOME SLEEP TEST IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Chao C[1], Lin C[2,3], Lin W[2], Wu H[2], Liu Y[2], Wu J[4]
[1]Department of Otolaryngology, Tainan Municipal Hospital, Tainan, Taiwan, [2]Department of Otolaryngology, Tainan Hospital, Department of Health, Tainan, Taiwan, [3]Department of Occupational and Environmental Medicine, Medical College and Hospital, National Cheng Kung University, Tainan, Taiwan, [4]Department of Otolaryngology, Medical College and Hospital, National Cheng Kung University, Tainan, Taiwan

Introduction: For the diagnosis of obstructive sleep apnea (OSA), standard approach is hospital polysomnography (PSG). However, PSG is labor-intensive and limited in its availability. Home sleep test (HST) is an alternative tool. It allows for a limited number of biosignals in the familiar sleeping environment. Sleep quality in the test night may influence the reliability of the associated parameters. Our study tested the sleep quality between PSG and HST in patients with OSA.
Methods: In this prospective and crossover study, patients with severe snoring were randomly assigned to receive either HST (ApneaLink, ResMed; 1 night) during the first period and PSG (Somte, Compumedics; 1 night) during the second period, or PSG during the first period and HST during the second period. Test periods were separated by an interval of 2 weeks. Test parameters included Apnea Hypopnea Index (AHI) and total sleep time (TST). Sleep quality was assessed using standard 10-cm visual analogue scales (VAS) after each testing period. 10-score meant good sleep quality.
Results: A total of 84 patients completed the study. Fifty (59.5%) were male subjects. The average age was 44.0 years. The body mass index (BMI) was 26.9. Neck circumference was 39.3 cm. The AHI of PSG was 36.0/hr, and that of HST was 29.5/hr (p=0.230). The TST of PSG was 6.9 hours, and that of HST was 7.0 hours (p=0.997). The reported sleep quality of PSG was 3.9, and that of HST was 6.9 (p=0.010). HST identified OSA in 64 of 67 (95.5%) patients using defining thresholds of AHI≧15/hr. Female and elder patients had worse reported sleep quality in the sleep laboratory.
Conclusion: Patients had better sleep quality with home sleep testing than with hospital PSG. Female and old age were the influential factors of sleep quality in the test night.

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NOCTURNAL PULSE OXIMETRY WITH ENHANCED ACQUISITION PARAMETERS: BETTER PERFORMANCE FOR SLEEP APNEA DIAGNOSIS?

Svartman FM[1], Sanches PR[2], da Silva Junior DP[2], Muller AF[2], Menna- Barreto SS[1], Fagondes SC[1]
[1]Pulmonary Service, Hospital de Clinicas de Porto Alegre, Porto Alegre, Brazil, [2]Biomedical Engineering, Hospital de Clinicas de Porto Alegre, Porto Alegre, Brazil

Introduction: Several methods of nocturnal pulse oximetry analysis have been used for the screening of obstructive sleep apnea syndrome (OSAS). Previous studies suggest that signal acquisition parameters (e.g. the averaging time) significantly affect the oximeters ability to detect the characteristic cyclic SpO2 variations of OSAS patients. Furthermore, desaturation definitions and interpretation algorithms of currently used portable oximeters widely differ and are often poorly described. The present study reports the initial clinical evaluation of a new portable device with an oximetry module that averages SpO2 every four heart beats and stores data with a 3 Hz frequency. The accompanying software calculates and reports three distinct desaturation indexes.
Methods: Eighteen adult patients with clinically suspected OSAS referred to overnight polysomnography (PSG) at a university hospital were prospectively included. Whole-night pulse oximetry was recorded by the new portable device simultaneously to the PSG. The portable device software calculates and reports three indexes: the 4% oximetry desaturation index (ODI4); the delta index (for which an averaging time of 12 seconds was used, as originally described); and a new index based on the latter (the delta-3Hz index). Each oximetry index was compared to the apnea-hypopnea index (AHI) obtained from the PSG.
Results: Thirteen patients tested positive for OSAS (AHI > 5/h) and five had normal PSG (AHI < 5/h). Mean (± SD) AHI, body-mass index and Epworth sleepiness scale score were, respectively: 20.4 (17.8) events/h; 31.3 (7.0) Kg/m2 and 11.6 (6.0) points. Good quality, artifact-free oximetry data were obtained for all patients. The three desaturation indexes were strongly correlated with the AHI (r = 0.82, 0.79 and 0.72 for ODI4, delta-index and delta3Hz-index, respectively; p < 0.01 for all). A Bland-Altman plot showed no significant bias (p=0,10) between the number of events detected by the PSG (AHI) comparing to the desaturation events (ODI4), confirming close agreement between the results.
Conclusion: Oximetry indexes derived from the new device showed good correlation and agreement with the AHI. The potential for improved clinical accuracy of an pulse oximeter with these specific acquisition parameters and reading algorithms, as well as the evaluation of the new oximetry index described (delta3Hz), warrant further investigation with a larger sample of patients.

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PREDICTIVE VALUE OF THE APNEA RISK EVALUATION SYSTEM QUESTIONNAIRE AMONG INDIVIDUALS OF DIFFERENT RACE/ETHNICITY

Pandey A[3], Mahmud S[3], Loredo JS[1,2], Williams N[6,1], Dessalines N[1], Donat M[3,4], Jean-Louis G[1,5]
[1]Medicine, University of California, San Diego, San Diego, CA, USA, [2]HSRD (111n-1), VA San Diego Healthcare System, San Diego, CA, USA, [3]Brooklyn Health Disparities Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [4]Department of Family Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [5]Sleep Disorder Center, Department of Medicine, SUNY Downstate Medical Center, Brooklyn, NY, USA, [6]Department of Public Health, Temple University, Philadelphia, PA, USA

Introduction: The validated Apnea Risk Evaluation System (ARES) questionnaire is commonly used to assess risk of obstructive sleep apnea (OSA). However, the predictive value of the questionnaire among individuals of different race/ethnicity has not been assessed.
Methods: 2,590 patients at risk for OSA were referred to sleep clinics across the United States to be assessed with the standardized FDA-approved ARES Unicorder™. They also completed the one page ARES questionnaire to estimate risk and severity of OSA. ARES was used to identify individuals at OSA risk; this is recommended for populations with a large pretest probability for OSA.
Results: The mean age of the sample was 43.8±12.1 years; 31% were female, 65% were non-Hispanic white, 13% were non-Hispanic black, 7% were Hispanic, and 15% were Asian. The mean BMI was 31.8 ± 7.43 kg/m2; mean AHI4 was 18.5±20.9; mean EES score was 9.42±5.4. The percent of patients at risk for OSA based on the ARES questionnaire and ARES Unicorder was 91.3% and 70.2%; respectively. The rate (%) of mild, minimal, moderate, and severe OSA risk was 23.2, 17.07, 19.96, and 39.69; respectively. The sensitivity for non-Hispanic white, non-Hispanic black, Hispanic, and Asian were 0.98, 0.97, 0.99, 0.96, respectively (p<0.01). The specificity for non-Hispanic white, non-Hispanic black, Hispanic, and Asian were 0.24, 0.24, 0.06, 0.29, respectively (NS). The negative predictive value for non-Hispanic white, non-Hispanic black, Hispanic, and Asian were 0.81, 0.78, 0.99, 0.65, respectively (p<0.01). The positive predictive value for non-Hispanic white, non-Hispanic black, Hispanic, and Asian were 0.74, 0.74, 0.73, 0.84, respectively (p<0.01).
Conclusion: Overall the ARES questionnaire is sensitive in assessing risk of OSA and seems a useful and practical tool for OSA screening

in a nonclinical setting. However, its ability to discern OSA risk among Hispanics needs further testing.
Support (If Any): This research was supported by funding from the NIH (R01MD004113, R25HL105444 and P20MD005092). We thank Advanced Brain Monitoring for providing the ARES data.

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COMPARATIVE EFFECTIVENESS OF AMBULATORY DIAGNOSIS OF SLEEP APNEA IN AN URBAN POPULATION

Arantes H[1], Law J[2], Herdegen J[1], Carley DW[2], Prasad B[1,2]
[1]Sleep Science Center, University of Illinois at Chicago, Chicago, IL, USA, [2]Center for Narcolepsy, Sleep and Health Research, University of Illinois at Chicago, Chicago, IL, USA

Introduction: Ambulatory diagnosis of Obstructive Sleep Apnea (OSA) with home-based Portable Monitoring (PM) is increasingly utilized. However, the effectiveness of home-based PM in populations with low socio-economic status, in elderly, with co-morbid medical illnesses, and in minority populations is understudied. We tested the applicability and accuracy of PM in a clinical urban population with limited access to healthcare compared to attended polysomnography (PSG).
Methods: Tertiary-care, single center, prospective, randomized crossover study of home PM and in-laboratory simultaneous PSG + PM in 43 urban African-Americans with high pre-test probability of OSA, identified with the Berlin questionnaire. All participants were trained in the self-application of PM (WatchPAT200, Itamar Medical Ltd.) prior to home-testing.
Results: 31/43 participants were women, ages 45.87 ± 11.8 (mean ± SD) years, Body Mass Index of 40.48 ± 11.31, 43% with <High School education, and household income was <$50,000 per annum in >80% of participants. There was no order of test effect using Grizzle's Model for Crossover Design (p=0.18). The PSG determined apnea-hyponea index (AHI) was 31.22 ± 32.02 (mean ± SD), in-lab PM AHI was 43.41 ± 30.73, and home PM AHI was 35.95 ± 32.8. A paired T-test on square-root transformed AHI (for normal distribution) showed there was a significant difference in PSG AHI and simultaneously performed in-lab PM AHI (mean square-root AHI difference = -0.9613 ± SD= 0.92, $p < 0.0001$), but no significant differences were noted between PSG AHI and home PM AHI ($p = 0.13$) or in-lab PM and home PM AHI ($p = 0.11$). Data-failure rate with Home PM was 4/43 (9%).
Conclusion: Home-based PM testing for OSA in a high risk underserved population yields results (AHI) similar to polysomnography and has low data-failure rates. Therefore, the cost-effectiveness of home-based PM for diagnosis of OSA, including in underserved populations should be examined.
Support (If Any): KM1CA156717 National Cancer Institute.

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ALLIANCE SLEEP QUESTIONNAIRE (ASQ): A COLLABORATIVE ONLINE SLEEP ASSESSMENT QUESTIONNAIRE

Leary EB[1], Barger L[2], Hall-Porter JM[3], Maislin G[4], Peppard PE[5], Rajaratnam SM[2], Rumble M[5], Sullivan SS[1], Walsh JK[3], Mignot E[1]
[1]Center for Sleep Sciences and Medicine, Stanford University, Palo Alto, CA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]Sleep Medicine and Research Center, St. Luke's Hospital, Chesterfield, MO, USA, [4]Division of Sleep Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA, USA, [5]Center for Sleep Medicine and Research, University of Wisconsin-Madison, Madison, WI, USA

Introduction: A systematic tool for evaluating sleep disorders prior to consultation may improve sleep medicine outcomes and efficiency. Standardized collection of clinical information would also be valuable for research opportunities. The Alliance Sleep Questionnaire (ASQ) is a comprehensive and innovative computerized questionnaire developed by the Academic Alliance for Sleep Research (AASR) to meet these needs.
Methods: A multidisciplinary team assembled from the AASR institutions (Harvard University, University of Pennsylvania, University of Wisconsin-Madison, and Stanford University) developed the questionnaire's content utilizing the expertise of a variety of domain experts. Comprised of novel questions and validated measures (permission received from copyright holders), the web-based survey uses complex branching logic to lead patients through a comprehensive set of questions covering medical history, current medications, previous treatments for sleep disorders, sleep habits/schedule, daytime fatigue, as well as symptoms of insomnia, OSA, RLS, narcolepsy and other disorders. The ASQ was built in a modular style so it can be reduced or extended to include outcome modules, a sleep diary, or other assessments. The questionnaire also includes an on-line consent form asking the respondent's permission to incorporate their de-identified data into the AASR Research Repository. The initial paper version was piloted at Stanford University and University of Pennsylvania. Modifications were made based on patient feedback before being adapted for the computer. Subsequently, the online version was completed by 24 Stanford patients and 44 University of Pennsylvania patients to assess feasibility, completion times and clinician satisfaction (See companion abstract).
Results: The ASQ has been successfully deployed at the Stanford Sleep Disorders Clinic. In addition, it has been adopted by the COMET Comparative Effectiveness Trial (CET), a multi-site AASR clinical trial.
Conclusion: We believe the ASQ has the potential to be an efficient and systematic method for collection of clinical data of value to both clinicians and researchers.
Support (If Any): Phillips Respironics Foundation.

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ALLIANCE SLEEP QUESTIONNAIRE (ASQ) FEASIBILITY PILOT STUDY

Leary EB[1], Griffin KS[2], Malunjkar S[1], Qadri S[3], Ruoff CM[1], Sullivan SS[1], Walsh JK[2], Mignot E[1]
[1]Center for Sleep Sciences and Medicine, Stanford University, Palo Alto, CA, USA, [2]Sleep Medicine and Research Center, St. Luke's Hospital, Chesterfield, MO, USA, [3]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA

Introduction: The Stanford Sleep Disorders Clinic assessed the feasibility of using an online questionnaire to collect general medical and sleep specific information from new patients prior to consultation. The usefulness of a clinician summary report was also evaluated. The Alliance Sleep Questionnaire (ASQ) is a comprehensive, electronic questionnaire using branching logic developed by the Academic Alliance for Sleep Research (AASR) (Harvard University, University of Pennsylvania, University of Wisconsin-Madison, and Stanford University) to standardize the collection of clinical information and promote research. (See companion abstract).
Methods: Fifty-seven new patients were contacted by phone before their appointment and asked to complete the ASQ online in addition to the clinic's standard paper questionnaire. Integration with appointment scheduling automatically enabled patient login credentials already known to the patient, eliminating the need to distribute login information. Consent was obtained online. Clinicians received a summary report containing pertinent information from the questionnaire before the appointment. The clinicians and subjects were queried about their experience.
Results: The majority of patients contacted (47, 82%) agreed to participate. The most common reasons for declining included: 1) too busy (7%), and 2) no computer access (7%). Twenty-six patients enrolled (18 m, 8 f; mean age 48.6, range 18-86) and 24 completed the ASQ (51% of those who initially agreed). Median completion time was 42.25 min. Eleven subjects completed the Patient Feedback Survey, 90.9% reported no difficulty logging in, 81.8% easily located the ASQ online and 45.5%

logged in ≥2 times. 100% accessed the ASQ from home, 18.2% logged in from work and 72.7% used a laptop.
Conclusion: Clinicians felt the summary report was helpful and found it convenient to transfer data from the summary report to the electronic medical record (EMR). Clinic patients were receptive to completing an online questionnaire; however only 51% completed the ASQ (of those who agreed). Further work to increase the proportion of compliant patients is needed; however, preliminary experience suggests an online questionnaire may enhance the workflow of a sleep medicine practice.
Support (If Any): Phillips Respironics Foundation.

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HIGH FREQUENCY CARDIOPULMONARY COUPLING AND NOCTURNAL BLOOD PRESSURE DIPPING
Wood C, Thomas RJ
Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Introduction: The ECG Cardiopulmonary Coupling (CPC) spectrogram provides biomarkers of effective and ineffective sleep. High frequency coupling (HFC) is associated with periods of stable breathing, non-cyclic alternating pattern EEG, and strong respiratory sinus arrhythmia. The relationship of HFC and nocturnal blood pressure remains to be determined.
Methods: Healthy adult subjects aged 21-65 years were studied prospectively with standard polysomnography and additional hemodynamic parameters, including Finometer non-invasive blood pressure (Finapres Medical Systems, The Netherlands), a calibrated pulse transit time-based method (SOMNOmedics GmbH, Germany), and a conventional brachial cuff. Continuous blood pressure metrics were graphed alongside CPC state and conventional EEG sleep stages to assess patterns of blood pressure during sleep.
Results: 11 subjects were studied, of which 8 (ages 25.2 ±3.9, 5 male) yielded high-quality data. Additional data from 2 inpatient clinical polysomnograms included real-time invasive blood pressure (radial arterial) and was used to supplement the prospective data. Analysis of blood pressure graphed against AASM sleep staging and CPC spectrographic state shows that periods of dipping occur during sustained periods of high frequency coupling, and that the degree of dip increases with time spent in this state. Stage by stage and state by state BP metrics will be presented.
Conclusion: These findings indicate that blood pressure dipping occurs during prolonged periods of HFC, which may span multiple conventional sleep stages. This suggests that cardiopulmonary coupling identifies states of biological significance, with specific and desirable hemodynamic characteristics, which are not captured by conventional staging.
Support (If Any): NIH/NHLBI RC1 HL099749-01.

1284
AUTOMATED SLEEP STAGING FROM A SINGLE FOREHEAD EEG CHANNEL: VALIDATION IN OSA PATIENTS
Popovic D, Levendowski DJ, Westbrook PR
Advanced Brain Monitoring, Carlsbad, CA, USA

Introduction: Self-applicable devices with electrodes below the hairline (e.g. ZEO, ARES) represent a promising tool for assessment of sleep quality in long-term or large-scale applications where the use of PSG is cost-prohibitive, while the information provided by actigraphs or sleep diaries does not suffice. As part of our efforts towards development of a self-applicable forehead-worn sleep monitor, we have developed algorithms for automated sleep staging from a single EEG channel with electrodes on the forehead (Fp1-Fp2), and validated them on healthy individuals. Here we report on their extended validation on patients with obstructive sleep apnea (OSA).
Methods: As part of the validation study of the Apnea Risk Evaluation System (ARES), 30 patients (7 females; age: 33 - 65 years) with suspected OSA underwent the standard nocturnal polysomnography (PSG) at the Sleep Disorders Center (SDC) of the New York University (NYU). PSG records were scored by SDC sleep technologists in accord with the AASM guidelines. As EEG in these patients was not recorded from the forehead, our algorithms were applied to the difference betweeen the left and right EOG channels, which represented the closest available surrogate for the Fp1-Fp2 channel. Epoch-by-epoch comparison was conducted, sensitivity (Se) and positive predictive value (PPV) were calculated for each stage, and overall agreement was quantified with Cohen's kappa.
Results: Overall agreement on 25,883 epochs was 75% (kappa=0.69). The algorithm accurately detected NREM2 (Se: 81%; PPV: 80%), REM (Se: 77%; PPV: 76%) and slow-wave sleep (Se=81%; PPV=82%), but was less precise in distinguising Wake (Se=71%; PPV=70%) from NREM1 (Se=33%; PPV=35%). The overall accuracy decreased with an increase in OSA severity (Pearson r2=0.44, p<0.01).
Conclusion: The results support the use of self-applicable recorders with only few electrodes on the forehead and/or face for assessment of sleep quality in OSA patients.

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CARDIOPULMONARY COUPLING ESTIMATE OF SLEEP ONSET COMPARED TO MANUALLY SCORED SLEEP ONSET ON POLYSOMNOGRAPHY
Schramm P[1], Neville A[2]
[1]Clinical, MyCardio, Thornton, CO, USA, [2]Development, MyCardio, Ottawa, ON, Canada

Introduction: Development of a sleep recording system that reliably determines sleep and sleep onset (SO) in agreement with polysomnography (PSG) would be important. We evaluated cardiopulmonary coupling analysis (CPC) in the detection of sleep onset using standard PSG electroencephalogram variables and respiratory events.
Methods: The study uses 43 simultaneously recorded polysomnograms with obstructive sleep apnea and Type IV device data sets. Sleep onset (SO) was considered as the first epoch with > 15 seconds of N1 after lights out based on EEG scoring criteria. Sleep onset based on respiratory events (SO-Resp) was assigned to epochs with hypopneas or apneas of ≥ 10 seconds duration associated with oxygen desaturations ≥ 2% following lights out without consideration of EEG sleep stage. CPC sleep (CPC-S) includes sleeping states defined by high or very low frequency coupling and low subject movement, or low frequency coupling regardless of movement. CPC-SO was defined as continuous period of CPC S having high or low frequency coupling; periods of 90, 180 and 300 seconds which were used for comparison to manual scoring of SO and SO-Resp. Pearson correlation and Cohen's kappa analysis was used to determine associations and agreement, respectively between variables.
Results: The highest correlation was between SO-Resp and the first 90 second CPC-S period (r=0.924; p<0.001). No association was found to SO (p=0.640). The first 180 second CPC-S period had a strong correlation to SO-Resp (r=0.861; p<0.001) and a moderate correlation to SO (r=0.479; p=0.002). The first 300 second CPC-S period had moderate correlation to SO (r=0.423; p=0.007) and SO-Resp (r=0.656; p<0.001). CPC-S 180 second period had fair agreement to SO (kappa=0.328, p=0.020) and SO-Resp (kappa=0.327; p=0.008). Agreement between SO and SO-Resp was not significant.
Conclusion: Our findings indicate that using a 180 second CPC-S period adequately captures standard EEG SO and SO-Resp events.

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DEVELOPMENT OF A SMART TEXTILE SHIRT FOR DETECTING BODY POSITION AND SLEEP DISORDERED BREATHING

Bianchi MT[1,2], Lipoma T[3], Darling C[3]
[1]Neurology, Massachusetts General Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]Nyx Devices, Boston, MA, USA

Introduction: Sleep disordered breathing is most commonly diagnosed via a single overnight polysomnogram (PSG). Among the many factors contributing to night-to-night variability, the influence of body position is of interest for both diagnostic and therapeutic purposes. The goal of this study is to develop a smart textile shirt with flexible capacitors to sense respiratory effort and body position.
Methods: Capacitor sensors were attached to the fabric on the chest and back of standard tee-shirts, and connected by conductive thread to a small data logging unit. Validation of respiratory effort sensing was accomplished with simultaneous recording during clinical PSGs. We developed a respiratory event detection algorithm using diagnostic PSG effort belt data from patients with absent, mild, moderate, or severe sleep apnea (10 in each group).
Results: The respiratory effort signal (5Hz sampling) correlated well (~0.8) with the simultaneously recorded effort belts during clinical PSGs, suggesting the shirt sensors provide a reliable continuous measure of respiratory effort. The supine position was readily evident due to the presence of artifact signal caused by laying on the sensor. An event detection algorithm identified instances of >75% amplitude decrement lasting >15 seconds. Event counts according to these parameters showed correlation coefficients of 0.73 with the RDI values and 0.62 with the AHI values. The sensitivity for any OSA (cutoff AHI >5) was 100%, with 50% specificity. Although mis-classifications occurred between mild and moderate severity categories, most of the severe cases were correctly categorized.
Conclusion: A simple, washable, non-adhesive, non-form-fitting shirt with unobtrusive flexible sensors provides information about body position and sleep disordered breathing. Larger validations with principled parameter optimization are underway to determine the utility of the shirt in screening and longitudinal monitoring settings.
Support (If Any): Department of Neurology, Massachusetts General Hospital; Young Clinician Award, Center for Integration of Medicine and Innovative Technology; Harvard Catalyst KL2 Medical Research Investigator Fellowship.

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CLINICAL INVESTIGATION INTO THE USE OF AN UNDER MATTRESS PRESSURE SENSOR IN THE DETECTION OF CENTRAL APNEAS

Townsend D[1], Leech J[2,3], Goubran R[1,4], Knoefel F[1,4,5,6]
[1]Systems and Computer Engineering, Carleton University, Ottawa, ON, Canada, [2]West Ottawa Sleep Centre, Ottawa, ON, Canada, [3]Ottawa Civic Hospital, Ottawa, ON, Canada, [4]Elisabeth Bruyere Research Institute, Ottawa, ON, Canada, [5]Bruyere Continuing Care, Ottawa, ON, Canada, [6]Family Medicine, University of Ottawa, Ottawa, ON, Canada

Introduction: Central apneas are most common at the two extremes of life: infancy and old age. These two groups are often the least cooperative with sensor placement in standardized polysomnography. This project examines the ability of an unobtrusive under mattress pressure sensor array to identify central apneas in adults in comparison with the results from a simultaneous laboratory polysomnogram.
Methods: To arrive at a set of six patients with central apneas, we intended to look at data from consecutive patients referred for overnight laboratory polysomnography who would consent to have an under mattress sensor running simultaneously with a baseline polysomnogram. After scoring, if subjects had obstructive apneas, Cheyne-Stokes respiration (CSR), or presented with a BMI over 35 they would be excluded. PSG signals were obtained with nasal pressure transducers, thermistors, and respiratory inductance plethysmography to define central apneas as per AASM criteria. Two unobtrusive pressure sensor arrays measuring 80 cm by 24 cm and consisting each of 24 pressure sensitive elements captured movement from the patient's torso. The resulting signal was filtered and a thresholded signal variance was used to identify apneas.
Results: From an initial set of 33, 27 were excluded using the criteria, which left six non-consecutive patients were selected with 1 to 7 central apneas. All 23 scored central apneas were visible in the array data and 19 were identified by the algorithm. Apnea length did not have an effect on the probability of detection as the pressure sensor having a sampling rate of 10 Hz was able to differentiate 0.5 seconds differences. Patients could not detect the arrays.
Conclusion: This preliminary validation of the pressure sensitive array demonstrates that central apneas of the non-CSR type can be detected unobtrusively under mattress. Further work will be aimed at identifying other types of sleep-disordered breathing events.

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ANALYZING VIDEO STUDIES IN THE HOME SETTING: QUALITATIVE AND QUANTITATIVE ANALYSIS

Hung Y[1], Ho G[1], Soo S[1], Barbosa AV[2], Black A[3], Vatikiotis-Bateson E[2], Ipsiroglu OS[1]
[1]Department of Pediatrics, University of British Columbia, Vancouver, BC, Canada, [2]Department of Linguistics, University of British Columbia, Vancouver, BC, Canada, [3]Shriners Gait Lab, Sunny Hill Health Centre for Children, Vancouver, BC, Canada

Introduction: Home-based over-night-video-sleep-studies are helpful for the diagnosis of Restless Legs Syndrome/Willis Ekbom Disease (RLS/WED) among children with neurodevelopmental disorders (NDD). Reproducibility of individual symptoms and their description are major challenges in clinical diagnosis, particularly when the patients themselves are unable to verbally express discomfort/urge-to-move/pain. Often, movement patterns remain unrecognized as an indication of possible RLS/WED. In addition, effects of medication are described globally and are difficult to reproduce.
Methods: We developed standardized descriptions using home-based-over-night-video-sleep-studies. The periods of interest were analyzed qualitatively by individual research assistants and quantitatively with Optical Flow, which measures movement by computing horizontal and vertical pixel displacements between consecutive frames of a video. Specific regions of interest were chosen, the amount of motion (over time) was quantified, and the magnitudes and frequency of movements were plotted on time graphs.
Results: Based on our standardized descriptions, we generated qualitative analysis of home-based-over-night-video-sleep-studies (i.e. Total Sleep Time, Sleep Efficiency, Restful/Restless Sleep). By extracting 2D pixel displacements, Optical Flow results identify differences in the magnitude of motion during the falling asleep, restful sleep, and restless sleep periods. Specific body parts (i.e. legs, feet, toes) can also be selected to determine the frequency of movements. Automatic quantification of motions provides us with reproducible results and offer a method of quality control for the clinical descriptions.
Conclusion: The home-based-over-night-video-sleep-studies validate caregivers' narratives about sleep problems. The quantitative analysis of the home-based-over-night-video-sleep-studies can validate the standardized descriptions of the sleep technicians and quantifies movement magnitude and frequency.

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ACCURACY OF TOTAL SLEEP TIME CALCULATION USING PORTABLE MONITORING

Frederick C[1], Foldvary N[2], Andrews ND[2], Tarler M[1], Kayyali HA[1]
[1]CleveMed, Cleveland, OH, USA, [2]Department of Sleep Medicine, The Cleveland Clinic Foundation, Cleveland, OH, USA

Introduction: The objective of this study is to assess the accuracy of an algorithm for total sleep time based on limited physiological signals recorded by a Portable Monitoring (PM) device. Sleep Disordered Breathing (SDB) affects more than 40 million people in the US; yet, more than 80% of affected individuals are undiagnosed and/or untreated. PM is expected to expand sleep testing to the hospital room, the home, and other settings. However, limited physiological signals make it difficult to determine actual sleep time as opposed to time in bed. Although the difference is often small, in some cases it can be significant. Therefore, algorithms that accurately detect sleep time will significantly assist in the implementation and ultimate success of PM.
Methods: An actigraphy based algorithm using the accelerometers already used to monitor body position was developed. Subjects wore both the PM device and a PSG system. Total sleep time of the PSG served as the gold standard. The algorithm was developed and tested using 5 home studies. The performance of the algorithm is being further tested based on similar studies being collected at the Cleveland Clinic Foundation.
Results: Correlation between total sleep times on the home test population was 0.71. The verification of these results at the sleep lab has a correlation of 0.71.
Conclusion: A new algorithm for automated detection of total sleep time that uses PM signals was developed and tested with high correlation to manual scoring of a full PSG study. Although the correlation coefficients are equal, there is not enough data to claim statistical significance. Additional studies are being collected to achieve statistical significance. Overall, this algorithm could serve as an effective tool to improve data analysis of PM studies including home sleep evaluations.

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ALL-NIGHT POLYSOMNOGRAPHY FOR SLEEP DISORDERED BREATHING: END TIDAL CARBON DIOXIDE

Chaudhary BA[1], Dungan GC[2], Whitesell PL[3], Rousseau D[3], Lain D[2]
[1]Sleep Institute of Augusta & University Hospital Sleep Center, Augusta, GA, USA, [2]Oridion Capnography, Inc., Jerusalem, Israel, [3]Shore Health Systems, Easton, MD, USA

Introduction: Sleep disordered breathing (SDB) alters ABGs by interrupting ventilation. End-Tidal CO_2 ($EtCO_2$) via capnography is commonly used in long-term monitoring on patients with an increased likelihood of SDB (e.g., postoperative monitoring). Mean and standard deviation of all-night $EtCO_2$ recordings may provide SDB-diagnostic information.
Methods: 42 consecutive clinical sleep laboratory patients admitted for PSG were consented to participate in this IRB approved study. In addition to full standard diagnostic PSG parameters - EEG, EOG, EMG, ECG, respiratory effort (nasal/oral pressure, thermistor, effort thorax/abdomen), SpO_2, anterior tibialis EMG, snoring, body position - $EtCO_2$ was monitored using waveform capnography (Capnostream 20, Oridion Capnography, Jerusalem, Israel). $EtCO_2$ data were collected at 50Hz and recorded on the PSG via calibrated analogue input, and analysed using Matlab Simulink software. PSG data were scored using current AASM clinical diagnostic standards.
Results: Patients were representative of typical sleep diagnostic subjects (age 47±12years, BMI 35.7±7.7kg×m^{-2}), with typical in-laboratory sleep architecture (TIB 385±48 min, TST 293±62 min, SEI 77.4±16 %, SL 26±29 min), apnea/hypopnea index 19.4±21.4 hr^{-1}, and SpO_2 behaviour (mean 93±3, min 84±7%). Patients expressed modest sleepiness Epworth Sleepiness Scale (ESS) (11.5±5.8). Mean overnight average $EtCO_2$ across all subjects was 41.3±5.6 mmHg, and the average standard deviation (SD) across all subjects was 8.1±3.6 mmHg. Mean and SD $EtCO_2$ was not significantly correlated to ESS. Mean $EtCO_2$ was correlated with AHI (r=-0.47, p=0.004), as was $EtCO_2$ SD (r=0.56, p=0.0003). $EtCO_2$ mean did not predict diagnostic classification using receiver operator characteristic curve analysis as compared to AHI classification of mild/moderate/severe disease (AHI 10/15/30 hr^{-1} respectively). $EtCO_2$ SD achieved reliable diagnostic comparability (AUC 0.79, 0.88, 0.81 respectively, all p<0.0005).
Conclusion: The all-night $EtCO_2$ SD adequately allows diagnostic classification of SDB as compared to AHI. The utility of this measure outside the sleep laboratory must be evaluated further to determine its clinical utility.
Support (If Any): Oridion Capnography, Inc.

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A NEW OPEN-SOURCE DRIVING SIMULATOR FOR SLEEP RESEARCH

Waxman J[1,2,3], Leigh J[4], Carley DW[3]
[1]Medical Scientist Training Program, University of Illinois at Chicago, Chicago, IL, USA, [2]Electrical and Computer Engineering, University of Illinois at Chicago, Chicago, IL, USA, [3]Center for Narcolepsy, Sleep, and Health Research, University of Illinois at Chicago, Chicago, IL, USA, [4]Electronic Visualization Laboratory, University of Illinois at Chicago, Chicago, IL, USA

Introduction: Numerous studies have investigated the relationship between disrupted sleep and driving using computer-based driving simulators. However, most simulators are overly simplistic or prohibitively expensive. The aim of this study was to develop a free, open-source, high quality driving simulator designed for sleep research.
Methods: Two 30 minute simulations were designed. The first involved long, straight roads and few curves in a rural setting. The second involved following directional signs through an urban environment. At random intervals, a ball appeared in the distance and moved at a constant velocity towards the driver. In response, the brake pedal had to be pressed as quickly as possible. 26 healthy control subjects (mean±SD 31.5±13.8 years, 19 women, 7 men) and 14 patients with obstructive sleep apnea (46.4±10.2 years, 10 women, 4 men, AHI 23.4±20.2) participated. 15 control subjects additionally underwent a full night of sleep deprivation. Following sleep or sleep deprivation, subjects engaged in two city and two rural simulations. Results were compared using one-way ANOVA and post-hoc t-tests.
Results: Significant differences during city simulations were found between rested and sleep deprived controls for brake position and speed variability (p<=0.01). Brake position also was significantly different between rested controls and patients (p<=0.01). Significant differences during rural simulations were found between rested and sleep deprived controls for brake position (p=0.02), lane position (p=0.04), lane position variability, speed, speed variability, off-road events, and lane crossings (p<=0.01). No differences were found between rested controls and patients.
Conclusion: On most measures, patients performed the same as rested controls. This could be due to mild disease severity and low daytime sleepiness. Sleep deprivation produced deficits in numerous variables during rural simulations, but not during city simulations. The engaging nature of the city simulations might have masked existing deficits. Nevertheless, our simulator provides a free, open-source platform on which to base further development.
Support (If Any): This project was supported by NIH Award F30HL097403.

1292

DETECTING SLEEP APNEA USING LOAD CELLS INSTALLED UNDER THE BED

Beattie Z[1], Hagen C[2,3], Hayes TL[1]
[1]Biomedical Engineering, Oregon Health & Science University, Portland, OR, USA, [2]Sleep Disorders Program, Psychiatry, Oregon Health & Science University, Portland, OR, USA, [3]Pacific Sleep Program, Portland, OR, USA

Introduction: Sleep apnea is clinically evaluated with Polysomnography (PSG). During PSG the patient's breathing is monitored using thermistors, nasal pressure cannulas, and chest/abdomen belts. These breathing sensors are not always tolerated by patients and are not conducive for long-term monitoring of sleep apnea. We are developing a non-contact method to monitor breathing and detect sleep apnea using load cells installed under bed supports.
Methods: Load cells were mounted under the supports of a bed at the Pacific Sleep Program sleep lab, and load cell data were collected simultaneously with PSG during regularly scheduled overnight tests. Records were selected from consecutive nightly PSG's until 7 records were selected for each of three classes of apnea patients (Negative: AHI < 5, Mild: 5 ≤ AHI < 15, Moderate-Severe: AHI ≥ 15). Routine 16 channel montages were scored by a registered polysomnographic technologist for apneic events and hypopneas. Records were stripped of identifiers, previous scoring, nasal pressure, thermistry, all flow, and all effort related channels prior to re-scoring using the load cell breathing signal. AHI estimates for each montage (standard and load cell) were compared.
Results: The load cell AHI and the standard AHI had an Intraclass Correlation Coefficient of 0.96. The 95% confidence interval for the differences between traditional and load cell scoring was [-4.29 2.91]. The 21 records were correctly binned into the three apnea classes using the load cell scoring 81% of the time. For the detection of sleep apnea (AHI > 5), there was one false negative and no false positives.
Conclusion: Our results demonstrate the feasibility of using load cells to detect sleep apnea with unobtrusive sensors which correlate well with respiratory flow and effort. Refining load cell scoring rules to improve event specificity and evaluating load cells for home sleep testing are still needed.
Support (If Any): This work was supported in part by NHLBI grant R01HL098621.

1293

USING COMMON DIAGNOSES IN PRIMARY CARE TO IDENTIFY PATIENTS AT RISK FOR OBSTRUCTIVE SLEEP APNEA

Lima CB[1,2,4], Thornton RS[2], Norris AE[1], Rash EM[1], Lima WB[3], Rosendo LM[4]
[1]College of Nursing, University of Central Florida, Orlando, FL, USA, [2]Florida Hospital Sleep Disorder Centers, Orlando, FL, USA, [3]Kladium Systems, Inc., Altamonte Springs, FL, USA, [4]Mid-Florida Primary Care Physicians, Apopka, FL, USA

Introduction: Obstructive sleep apnea (OSA) affects over 15 million adults in the United States, and is an independent risk factor for all-cause mortality. The under-diagnosing of OSA has been linked to inadequate screening by primary care practitioners (PCPs), possibly due to their time constraints. This study demonstrates how obesity and common high-risk diagnoses (hypertension, diabetes mellitus type 2, dyslipidemia, arrhythmia, and coronary artery disease) can be used to help PCPs easily identify adult patients at risk for OSA.
Methods: This descriptive, cross-sectional study used a retrospective chart review of a random sample of 220 health records (from 2009 and 2010). The setting was six sleep centers located in five cities in Central Florida. The age range was from 18 to 82 years of age. Logistic regression was used to analyze the data to determine interaction among variables and odds ratios. The power in the logistic regression for detecting an odds ratio of 2.0 or bigger was 80%, assuming significance level of $p < 0.05$.
Results: The variables "obesity" and "two or more high-risk diagnoses" had significant effects on the likelihood of being diagnosed with OSA independently of each other (odds ratio of 4.2 and 4.3 respectively; $p<.001$). There was no significant interaction between the two variables ($p=.56$). The predictive value for an OSA diagnosis using "obesity" was 83%, and 88% using "two or more high-risk diagnoses.".
Conclusion: The proper screening of high-risk patients leading to diagnosis and treatment of OSA has the potential to improve patient outcomes, health conditions, and quality of life. PCPs are in a key position to identify patients at risk for OSA as they treat comorbidities associated with OSA on a daily basis. The use of diagnoses combinations may be a fast and simple way for PCPs to identify these patients in routine visits.

1294

THE USABILITY OF AMBULATORY SLEEP STUDIES AND ECG BASED SLEEP ARCHITECTURE EVALUATION IN A CARDIOLOGY CLINIC SETTING

Baharav A[1], Ofir H[2], Fuxman Y[1], Kidman G[2], Koval S[2], Henkin Y[2]
[1]Sleep Laboratory, Wingate Institute, Netanya, Israel, [2]Cardiology, Soroca Medical Center, Beer Sheba, Israel

Introduction: Obstructive Sleep Apnea (OSA) is prevalent, frequently undiagnosed and is associated with conditions that account for the leading causes of mortality in adults: hypertension, cardiovascular and cerebrovascular disease. A significant cross-sectional association of OSA with prevalent cardiovascular diseases in persons undergoing polysomnography was found in the Sleep Heart Health Study. OSA is frequently overlooked by cardiologists. We aimed to evaluate whether offering an ambulatory diagnostic procedure to a population of patients with Coronary Heart Disease (CHD) presenting for routine visits at a cardiology clinic may reduce the overlooked OSA, allowing a better treatment.
Methods: All patients with stable CHD presenting at the clinic for a routine visit were offered to participate. Exclusion criteria were: a previous sleep study, residence farther than 50 km from the clinic, pacemaker, chronic atrial fibrillation. All subjects enrolled underwent a sleep evaluation including sleep history, questionnaires, physical examination and an ambulatory unattended sleep study with ECG,inductive abdomen and chest belts, oxygen saturation with pulse wave, and body position. Patients performed the hook up procedure in their home environment after detailed instructions received from a trained technician at the clinic. Scoring was performed automatically using HC1000P software to get sleep architecture based on ECG analysis and respiratory events. Respiration was also evaluated manually.
Results: 249 CHD patients visited the clinic during 6 consecutive months, 105 met inclusion criteria and enrolled. 89% were man, mean age 67.4+8.8. Ninety nine studies were of good quality and allowed scoring, only 6 were to be referred to an attended whole night PSG. 25.3% had RDI less than 5, 50.5% between 5 and 15, 14% between 15 and 30 and 10.1% greater than 30. Thus 24% of the tested subjects met the criteria for moderate to severe OSA and only a quarter were normal.
Conclusion: 35 patients met the criteria for CPAP therapy and were offered to meet a sleep physician, only 24 agreed to do so, 10 agreed to a CPAP titration and treatment trial, 3 improved significantly after weight loss. Finally, only 6 patients continued CPAP therapy. OSA diagnosis based on partial ambulatory sleep studies, including ECG based automatic sleep analysis is feasible. Treatment remains a challenge.

1295

COMPARISON OF NEW LEVEL 3 AND 4 PORTABLE MONITORS FOR HOME SLEEP TESTING VS. IN-LAB POLYSOMNOGRAPHY

Kushida CA, Cardell C
Stanford Sleep Medicine Center and Stanford Center for Human Sleep Research, Stanford University, Redwood City, CA, USA

Introduction: A 7-channel (nasal pressure, effort, snoring, SpO2, pulse rate, body position and movement) Level 3 portable monitor (PMP-300E, 11.2 x 3.3 x 5.5cm, 80g) and a 5-channel (SpO2, pulse rate, effort, body position and movement) Level 4 portable monitor (PMP-200GplusX, 7.4 x 4.6 x 2.9cm, 135g) (Pacific Medico Co., LTD) were comparison tested against conventional in-lab polysomnography (PSG) for detection of sleep-related breathing parameters.
Methods: Ten subjects 18 yrs and older suspected of having OSA were recruited and underwent a clinical evaluation after informed consent. They were instructed on the use of the 300E and 200GplusX and wore it at home for 1 night. They returned for 2 consecutive in-lab nights and wore the 300E on the first night and the 200GplusX on the second night, plus the usual PSG sensors. The subjects completed the Epworth sleepiness scale (ESS), an attitude toward device use questionnaire, and sleep logs. The 5th and final visit consisted of reviewing the results and discussing treatment options. The 300E and 200GplusX data were compared against PSG data (scored using AASM rules) by Wilcoxon signed-rank tests. In order to determine the baseline accuracy of the scoring of respiratory events by the devices against gold standard PSG, the automated scoring program was used and the raw downloaded data from the devices were reviewed but not manually modified.
Results: Six men (mean age 54.3, BMI 29.5) and 4 women (mean age 56.8, BMI 29.5) were enrolled. The mean ESS score was 6.9. The mean AHI was 19.2 from the 300E vs. 31.3 from PSG ($p<.05$). The mean AI was 7.7 vs. 9.8, respectively ($p=.17$). The scoring of hypopneas was responsible for the discrepancy in AHI; with a mean HI of 8.8 vs. 21.3, respectively ($p<.05$). There were no differences in ODI, mean SpO2, and duration of SpO2 less than 90% for the 300E vs. PSG, or for the 200GplusX vs. PSG.
Conclusion: The PMP-300E and PMP-200GplusX represent easy-to-use, compact, and lightweight Level 3 and 4 portable monitors, respectively, that generate sleep respiratory data. For the 300E, the mean AHI difference (12.1) is consistent with the differences between PSG and automated portable monitor scoring reported in the literature (10.7-24.0). Manual review of each patient's data by sleep technologists according to AASM standards should only improve the diagnostic accuracy of the device. For the 200GplusX, there were no differences in its sleep respiratory data vs. those from PSG, indicating its acceptability as a Level 4 device.
Support (If Any): Pacific Medico Co., LTD, Tokyo, Japan.

1296

HOW APNEA AND OBESITY EFFECT CIRCADIAN ACTIVITY PATTERNS USING FUNCTIONAL LINEAR MODELING OF ACTIGRAPHY DATA

Shannon B[1], Xian H[1], Licis A[2], Deych E[1], Ding J[3], McLeland JS[2], Toedebusch C[2], Li T[1], Duntley S[2]
[1]Medicine, Washington University School of Medicine, St Louis, MO, USA, [2]Neurology, Washington University School of Medicine, St. Louis, MO, USA, [3]Mathematics, Washington University School of Medicine, St. Louis, MO, USA

Introduction: This presentation describes new statistical tools for analyzing actigraphy data to measure and compare circadian activity patterns..
Methods: Actigraphy was used to measure activity over 5 days in over 400 subjects recruited from an academic sleep medicine center. A new type of statistical tool based on 'functional linear modeling' was used to test if the circadian activity patterns were different in subjects based on apnea and BMI, and statistical measures of significant differences across these groups were calculated.
Results: Results indicate that participants in high apnea group have statistically lower activity during the day and similar activity patterns overnight, and that BMI in our study population does not significantly impact circadian patterns. BMI distribution in our study population was skewed higher than would be found in the general population.
Conclusion: Compared with usual methods for analyzing actigraphy data summary measures (e.g., average activity over 24 hours, total sleep time), Functional Data Analysis (FDA) more efficiently analyzes the information from actigraphy data. In addition FDA allows circadian patterns to be directly compared minute-by-minute throughout the day. FDA has the potential to reposition the focus of actigraphy data from general sleep assessment to rigorous analyses of circadian activity rhythms.
Support (If Any): This work was supported by R01 HL092347 "New Data Analysis Methods for Actigraphy in Sleep Medicine" (Shannon, PI), the Washington University Dept. of Medicine's Biostatistics Center (Shannon, Director), and the Dept. of Neurology Sleep Center (Duntley, Director).

1297

ACCEPTANCE AND ADHERENCE TO AN ELECTRONIC SLEEP LOG: COMPARISON BETWEEN PATIENTS AND HEALTHY CONTROLS

Lainey E[1,3,4], Brion A[2], Rémont P[3], Schmidt MH[4]
[1]CENAS Sleep Center, Geneva, Switzerland, [2], Paris, France, [3]Adsensio, Castries, France, [4]Ohio Sleep Medicine Institute, Dublin, OH, USA

Introduction: Sleep logs or diaries are simple and useful tools to evaluate sleep disturbances, particularly regarding insomnia and hypersomnia. Sleep logs are also recommended for 1 or 2 weeks prior to an MSLT*. Historically, sleep logs were designed as a paper and pencil tool where patients described graphically theirs nights, but graphic data on paper are difficult to use for numerical analysis and comparison. We developed an electronic sleep log (SWES : Sleep Wakefulness Electronic Solution, Adsensio, France) which allows the patient to connect to a website to enter graphically information about his/her sleep. The aim of this study was to evaluate acceptance and adherence to this tool in two groups of patients, and to compare them to a healthy control group. *Sullivan and Kushida, Chest 2008;134:854-61.
Methods: Patients from two sleep clinics (EL, Geneva, Switzerland; AB, Paris, France) were proposed to complete an electronic sleep log instead of a classical paper log. The only requirements were for the patients to have Internet access and a valid email address. We measured the acceptance (initiating or not an electronic sleep log) and adherence (days of sleep log completion) in these two groups of patients, and compared them to data obtained from a third group of healthy controls. Controls were recruited from the investigators' personal network.
Results: Patients and controls had similar demographic characteristics. Acceptance rates between patients and controls were similar (70.1 vs. 63.9%), but adherence differed significantly between patients and controls: 53.2% of patients completed the electronic sleep log for more than a week, and 41.9% for more than 15 days. Adherence rates for controls were respectively and significantly lower at 19.4% ($p<.01$) and 5.5% ($p<.001$).
Conclusion: Acceptance rates of initiating an electronic sleep log were high in both patients and controls, but adherence to this tool was significantly higher in patients.

1298

BEDPARTNER REPORTED DREAM ENACTMENT BEHAVIOR MEASURED WITH THE UNIVERSITY OF MICHIGAN RBD QUESTIONNAIRE (UMRBDQ) CORRELATES WITH DAYTIME ALERTNESS INDEPENDENTLY FROM MOTOR DISABILITY IN PARKINSON'S DISEASE (PD)

Bliwise DL, Trotti L, Juncos J, Factor SA, Wilson A, Greer S, Rye DB
Neurology, Emory University School of Medicine, Atlanta, GA, USA

Introduction: Several questionnaire approaches have been used to derive data on dream enactment in patients with synucleinopathies. We report here associations between the UMRBDQ (Consens et al, Sleep 2005: 28: 993-7) and MWT-defined alertness and ratings of motor disability.
Methods: PD pts (n = 42) (X age = 64.1 [SD = 8.0]; 27 M, 15F) underwent a 48-hr sleep lab protocol of 2 PSG nts followed by 2 days of 4-nap MWT. MWT duration was held constant at 40 mins. Mean sleep latency (SL) on MWT was 19.2 (SD = 12.9) mins. Mean (SD) UPDRS Motor Score = 18.3 (8.4) and mean (SD) years diagnosed = 5.5 (4.2) suggested moderate disease. Bedpartners completed the UMRBDQ (mean = 0.33 [SD = 0.22]) blind to MWT results.
Results: There were modest relationships between higher frequency of RBD symptoms (UMRBDQ) and motor disability (UPRDRS) ($r = .32$, $p < .04$) and impaired alertness, as captured by MWT mean sleep latency ($r = -.29$, $p < .07$). We used linear models to regress UMRDBQ on UPDRS and mean MWT sleep latency. The resulting regression ($F = 4.11$, $p = .02$; adjusted r-squared = .13) indicated that both MWT sleep latency (beta = -.002, $t = 1.81$, $p < .08$) and UPDRS (beta = .008, $t = 2.09$, $p < .05$) were independently associated with RBD symptoms.
Conclusion: The Braak model of synucleinopathic degeneration predicts that the deterioration of ascending arousal systems and disinhibition of brainstem nuclei controlling REM atonia should occur in parallel. The relative independence of such relationships from motor disability further emphasizes heterogeneity of disease course through at least moderate stage PD.
Support (If Any): R01 NS-050595; KL RR-025009 (ACTSI).

1299

MATHEMATICAL ANALYSIS OF SLEEP AND COGNITIVE PERFORMANCE USING NETWORK MODELS

Roy S[2], Krueger JM[1], Van Dongen H[1], Wan Y[3], Corrigan P[2]
[1]WWAMI, Washington State University, Pullman, WA, USA, [2]EECS, Washington State University, Pullman, WA, USA, [3]EE, University of North Texas, Denton, TX, USA

Introduction: Recently, a new paradigm has emerged, that views sleep as a local and use-dependent phenomenon: functional units as small as a group of neurons are recognized to have local sleep states, that evolve through local stimulation or activity, loose couplings with other neuronal assemblies, and some global regulation. The recognition that sleep is local- and use- dependent informs understanding of aspects of cognitive performance, for instance the "time-on-task" effect. A mathematical model termed the activity-integrator network (AIN) has been developed, that is predictive of local, use-dependent sleep. Here, we pursue enhancement of the AIN model, toward quantitative prediction of sleep and its effect on cognitive performance.
Methods: Three model analysis/development tasks were undertaken: 1) Correlations among AIN local-activity states were found through simulation, and were compared to data from cultured neuronal networks. 2) Plasticities, which play a central role in evolving cognitive performance, were incorporated using the jump-Markov formalism. 3) Cognitive tasks are being explicitly captured as coordinated stimulation at sequences of nodes in the AIN; route-modeling techniques from transportation-dynamics applications are being used. Local sleep-state-dependent metrics for cognitive-task performance are defined.
Results: The analysis/development tasks yielded the following: 1) Correlations coefficients were found to range between 0.2 and 0.95 in randomly-generated networks of 10-100 neuronal assemblies, and decayed with spatial distance. The correlations were statistically similar to those from cultured networks (n=9). Local over-stimulation yielded decreased correlation. 2) A plasticity model was developed. Simulations of randomly-generated 16-node networks consistently yielded stable yet adaptive circuits. Initial modeling of cognitive tasks was completed successfully.
Conclusion: Analysis and simulations of the enhanced AIN indicate that the model robustly maintains a global sleep-wake cycle, yet is adaptive to activity including cognitive effort. In addition, the enhanced model appears promising as a tool for understanding the impact of sleep dynamics on cognitive performance.
Support (If Any): : NSF-CNS-1035369/NSF-CNS-1058124 to SR and YW.

1300

TOUCH POINT CARE AND ADVANCED MONITORING TECHNOLOGIES IMPROVES COMPLIANCE RATE OF CPAP USAGE

Donepudi R[1,2], Cohen E[1], McCabe J[1]
[1]National Sleep Therapy, Portland, ME, USA, [2]PCCM and Sleep Medicine, Emerson Hospital, Concord, MA, USA

Introduction: Compliance with CPAP remains a serious issue to this day and the reported compliance rates vary anywhere between 40-60% optimistically. One of the main hindrances to CPAP compliance is poor patient education and understanding of the disease management process. There has been a paradigm shift in recent years with insurance carriers, including CMS, emphasizing on better compliance for continued coverage of services. In this paper we aim to outline a proprietary model of delivery of care with the newest technological advances in monitoring therapy. We also would like to present our data to show that using an advanced technological approach to monitoring and focusing on patient engagement in the treatment process improves compliance with CPAP.
Methods: The program is designed to be initiated in a "Clinic setting" rather than in a patient's home as we believe that this is a more conducive atmosphere for patient learning. The program sets certain patient achievement goals which are discussed with the patient on the initial set-up visit which is scheduled after the diagnostic test. The goals that are discussed include: expectations, education, expertise, equipment and awareness. The program has designed a series of "touchpoints" to address each of the above stated patient goals. The "touchpoints" include live points i.e. patient calls and passive i.e. e-mail or text notifications. The program uses Phillips Respironics devices with Encore anywhereTM online database technology which allows for real-time collection of sleep data using a modem. Sleep data from all the CPAPs is daily filtered via predefined criteria and actions are triggered if the criteria are not met and at the earliest indication of problems with compliance or technical aspects of CPAP.
Results: A random sample size of 626 patients over a 90 day trial period was followed. Medicare criteria were used in the data filtering process and adequate compliance was defined as adherence with CPAP of over 4 hours/night and greater than 70% of the nights over a contiguous 30 day period between days 1to 90. At the end of 90 days we reported 88.5% adherence rate according to Medicare criteria.
Conclusion: We conclude that engaging patients in the disease management process and using the newest technologies to monitor therapy greatly improves CPAP adherence. We hope to show that the actual adherence with CPAP improves beyond the set Medicare standards in our future research.
Support (If Any): We acknowledge Phillips Respironics providing support by giving access to their live data base to apply our filters.

1301

IMPAIRED VIGILANT PERFORMANCE IN SLEEP WAKE DISORDERS

Werth E[1], Thomann J[1], Landolt H[2], Baumann CR[1]
[1]Department of Neurology, University Hospital Zürich, Zürich, Switzerland, [2]Institute of Pharmacology and Toxicology, University of Zurich, Zurich, Switzerland

Introduction: In current practice and in most clinical studies, diagnostic tests to assess daytime alertness and wakefulness focus almost exclusively on the quantification of excessive daytime sleepiness. Hence, an equally important complaint of patients suffering from sleep-wake disorders has been widely underestimated, i.e. impaired vigilant performance. The Psychomotor Vigilance Test (PVT) is one of the leading assays of vigilant attention in sleep research and highly sensitive to the effects of sleep loss. Rather little is known about PVT performance in patients suffering from sleep wake disorders. With the present study, we aimed at evaluating the use of PVT in clinical routine in a sleep laboratory.
Methods: We retrospectively analyzed data from 356 patients referred to the sleep laboratory of the Department of Neurology of the University Hospital Zurich between January 2006 and May 2009 and 67 healthy control subjects. Patients were diagnosed with one of the following sleep disorders: narcolepsy with cataplexy, behaviorally induced insufficient sleep syndrome, hypersomnia, fatigue, sleep related movement disorder, central and obstructive sleep apnea, REM-sleep parasomnia and insomnia. The following PVT outcomes were analysed: median reaction time, lapses (>500 ms), false starts (<100 ms) and variability (interpercentile range between 10th and 90th percentile).
Results: PVT performance was significantly better in healthy controls than in patients with sleep-wake disorders. Furthermore, we found additional differences between specific sleep-wake disorders. Based on the comparison between patients and healthy controls we suggest cut-offs of 270 ms for median reaction time, 1 for lapses and 120 ms for variability. As there were influences of age, sex, major depression and Parkinson's disease on PVT results, they must be interpreted in combination with other clinical findings and sleepiness tests.
Conclusion: In conclusion, our study quantified the differences in vigilance performance between patients with sleep-wake disorders and healthy controls. It is the first suggestion of cut-offs for the distinction between normal and impaired vigilant attention measured with PVT.

1302

A SYSTEM FOR THE AUTOMATED ASSESSMENT AND CONDENSED DISPLAY OF THE POLYSOMNOGRAM BASED ON AN ENHANCED EEG SPECTROGRAM AND A NEW RESPIRATION INDEX

Vivaldi EA, Bassi A, Diaz J
Physiology and Biophysics, University of Chile, Santiago, Chile

Introduction: The two main tasks of polysomnogram (PSG) analysis are the epoch-by-epoch staging to generate a hypnogram and the detection of apneas and hypopneas. Analysis is typically based on event detection (such as spindles, delta waves or obstructive apneas) from detailed observation of original biosignals. We propose a system that starting from processed EEG and PTAF data provides a global and fully informative summary of the night study.
Methods: Log-scaled EEG spectrograms (matrixes) summarizing the spectral features (rows) of each epoch (columns) are generated. The intensity of each cell in the grid denotes the FFT amplitude of the EEG signal at given time and frequency. A technique that equalizes the dynamic range over the frequency domain is then applied. Subject-specific activity bands are derived and state and stage transitions are detected by an ad-hoc pattern recognition algorithm. Breathing patterns are described by the coefficient of variation of the envelope curve of the PTAF signal (PTAF-ECV), which is obtained from the Hilbert transform of the latter.
Results: Sleep architecture and all-night breathing patterns are immediately accessible to the user by the contiguous display of the spectrogram, the hypnogram derived from it and the PTAF-ECV in a single depiction. The user soon learns to read the spectrogram directly as if it were a much more informative hypnogram, readily recognizing states and stages. In the equalized spectrogram the relative density of delta and sigma in NREM sleep is easily appraised and very low levels around the 8-14 Hz band is a marker of REM sleep. The PTAF-ECV is a continuous curve where low levels indicate regular breathing and high levels indicate disturbed intermittent patterns.
Conclusion: New techniques for processing EEG and PTAF signals provide an alternative starting point for the analysis of sleep studies, offering overall reports on sleep architecture and breathing disorders that are richly informative and easily visualized.
Support (If Any): Partially supported by Grant Fonis SA10I20034.

1303

A NOVEL MARKER OF SLEEP DISORDERED BREATHING: A PILOT STUDY OF A PULMONARY INDEX

Whitesell PL[1], Dungan GC[2], Chaudhary BA[3], Pearce J[1], Lain D[2]
[1]Shore Health System, Easton, MD, USA, [2]Oridion Capnography, Inc., Jerusalem, Israel, [3]Sleep Institute of Augusta & University Hospital Sleep Center, Augusta, GA, USA

Introduction: Sleep disordered breathing (SDB) alters blood gases by interrupting ventilation during sleep. A composite measure of end-tidal carbon dioxide ($EtCO_2$), oxygen saturation (SpO_2), heart and respiratory rate (HR, RR) may capture important information to help make diagnostic classifications for SDB patients. Such a measure (the Integrated Pulmonary Index - IPI [Oridion Capnography, Jerusalem, Israel]), employing a dimensionless value scaled 1-10 with 10 being normal, is evaluated in this study.
Methods: 42 consecutive clinical sleep laboratory patients admitted for PSG were consented to participate in this IRB approved study. In addition to full standard diagnostic PSG parameters, Integrated Pulmonary Index (IPI) was monitored (Capnostream 20, Oridion Capnography, Jerusalem, Israel). IPI data were collected at 50Hz on the PSG via calibrated analogue inputs. IPI was analysed using Matlab Simulink software. PSG data were scored using current AASM clinical diagnostic standards.
Results: Patients were representative of typical sleep diagnostic subjects with typical in-laboratory sleep architecture, apnea/hypopnea index 19.4±21.4 hr^{-1}. Patients expressed modest sleepiness Epworth Sleepiness Scale (ESS). Mean overnight average IPI across all subjects was 8.2±3.6, and the average standard deviation (SD) across all subjects was 1.7±0.8. Mean IPI was correlated to ESS ($r=-0.37, p=0.035$). Mean and SD IPI were correlated with AHI ($r=-0.67$ and $r=0.63$ respectively, both $p<0.0001$). IPI SD accurately classified (using receiver operator characteristic curve analysis as compared to AHI classification of mild/moderate/severe disease [AHI 10/15/30 hr^{-1}]) with AUC 0.83, 0.85, 0.94 respectively, all $p<0.0001$. IPI mean did reliably categorize severe SDB (AHI 30hr-1) (AUC 0.89,$p<0.0001$).
Conclusion: The mean IPI composite may provide information related to perceived sleepiness. The all-night IPI SD appears to adequately allow diagnostic classification of SDB as compared to AHI. This composite of PSG-related parameters shows greater variability with higher AHI, and may provide important additional information for diagnostic classifications. Further testing is required.
Support (If Any): Oridion Capnography.

1304

EMPIRICAL VALIDATION OF THE INSOMNIA SEVERITY INDEX IN PRIMARY CARE SETTINGS

Gagnon C, Bélanger L, Ivers H, Morin CM
Universite Laval, Quebec, QC, Canada

Introduction: Although insomnia is a prevalent complaint with significant consequences for health and quality of life, it often remains undiagnosed and untreated in primary care settings. Brief, reliable, and valid instruments are needed to facilitate the screening of insomnia in general practices. This study examined psychometric indices of the Insomnia Severity Index (ISI) to identify individuals with clinically significant insomnia in primary care settings.
Methods: A sample of 410 patients (60.4% women; mean age of 47.9) recruited from six general medical clinics completed the ISI, a 7-item self-report questionnaire assessing the nature, severity, and impact of insomnia (total score ranging from 0 to 28). A subsample of 101 individuals also completed a clinical interview administered by telephone, which included the Insomnia Diagnostic Interview. Convergence between ISI total score and the diagnosis derived from the interview was investigated. Receiver operator characteristic analyses were used to determine the optimal ISI cut-off score that correctly identified individuals with an insomnia disorder.
Results: Of those who completed the interview, 33.7% (n= 34) received a diagnosis of insomnia. The area under the ROC curve was 0.87 (95% CI: 0.80-0.94). A cut-off score of 14 was optimal (82.4% sensitivity, 82.1% specificity and 82.2% agreement) for detecting clinical level of insomnia. The agreement between the ISI and the diagnostic interview was moderate (k= 0.62).
Conclusion: These findings suggest that the ISI is a valid screening instrument for detecting insomnia among patients consulting in primary care settings. Further validation examining response patterns as a function of medical and physical comorbidity would be useful.

1305

COMPARISONS OF THREE PRACTICAL FIELD DEVICES USED TO MEASURE PERSONAL LIGHT EXPOSURES AND ACTIVITY LEVELS

Figueiro M, Rea MS
Lighting Research Center, Rensselaer Polytechnic Institute, Troy, NY, USA

Introduction: The Dimesimeter was designed to be a small, unobtrusive, and user-friendly research tool to collect personal light exposures and activity levels over multiple days and nights. The Dimesimeter is calibrated in terms of the photopic luminous efficiency function and the spectral sensitivity of the circadian system.
Methods: The measurement characteristics of the Dimesimeter and those of the Actiwatch Spectrum, a widely accepted device used for ambulatory monitoring of light and activity are presented. Also presented are light and activity data from 12 healthy older adults who wore Dimesimeters at three different locations on the body for five consecutive days. Subjects also wore the Actiwatch Spectrum and the Daysimeter, a previously documented device that measures corneal light exposures and activity levels.
Results: Activity trends measured with the Actiwatch Spectrum and the Dimesimeter devices are similar, but some small, systematic differences were observed. Compared to a commercial grade illuminance meter, significant photometric errors can occur when using the Actiwatch Spectrum to measure common light sources. Dimesimeter measurements of circadian light stimulus on three locations on the body (wrist, torso and chest) were similar to those obtained with the Daysimeter (eye level).
Conclusion: The Dimesimeter is a user-friendly device that can provide useful estimates of circadian light exposures when worn in the field.
Support (If Any): National Institute on Aging (R01AG034157) and National Institute on Drug Abuse (DA023822-01).

1306

ACCURACY, SENSITIVITY, AND SPECIFICITY OF A WRIST ACTIGRAPHY ALGORITHM FOR SLEEP/WAKE AND WASO AS COMPARED TO POLYSOMNOGRAPHY

Marino M[1], Li Y[2], Rueschman M[3], Winkelman J[4,5], Ellenbogen JM[4,6], Solet JM[4,7], Dulin H[3], Berkman L[8], Buxton OM[3,4]
[1]Department of Biostatistics, Harvard School of Public Health, Boston, MA, USA, [2]Department of Biostatistics, University of Michigan, Ann Arbor, MI, USA, [3]Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [4]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [5]Department of Psychiatry, Brigham and Women's Hospital, Boston, MA, USA, [6]Department of Neurology, Massachusetts General Hospital, Boston, MA, USA, [7]Department of Medicine-Massachusetts General Hospital, Cambridge Healh Alliance, Cambridge, MA, USA, [8]Harvard Population Center, Harvard School of Public Health, Cambridge, MA, USA

Introduction: Published validation studies for existing wrist actigraphy algorithms currently in use are limited. We sought to determine the overall accuracy (epoch-level sensitivity and specificity, and night-level wake after sleep onset [WASO]) of a commonly-used algorithm in a variety of subjects.
Methods: Actigraphy (AW-64 and Spectrum uni-dimensional wrist accelerometers, Philips/Respironics; medium sensitivity, Cole-Kripke algorithm) and PSG were collected simultaneously during inpatient sleep laboratory visits of young and older adults, healthy sleep restricted subjects, chronic primary insomniac (PI) patients, and nightworkers during daytime sleep (n= 77, age 35.0±12.5, 30 F, mean nights= 3.2±3.0). All studies involved 8.5 hr Time in Bed except sleep restriction. Epochs (30-second; n=232,849) were characterized for Sensitivity (actigraphy=sleep when PSG=sleep), Specificity (actigraphy=wake when PSG=wake), and Accuracy (total proportion correct); WASO was assessed by night. A generalized estimating equation (GEE) model included age, gender, insomnia diagnosis, and daytime/nighttime sleep timing factors, providing an unbiased estimation of population-averaged regression coefficients.
Results: Overall Sensitivity (0.965), Specificity (0.329), and Accuracy (0.863) were only slightly modified by gender and day/night sleep timing (magnitude of change <0.04). Sensitivity, specificity, and accuracy in participants without insomnia, controlling for age, sleep timing and gender (0.967, 0.331, 0.869, respectively), were slightly different than PI patients (0.946, 0.347, 0.833). Age had no meaningful impact on the sensitivity of actigraphy, but demonstrated a minimal effect on the specificity and accuracy as age increased. Mean WASO per night was 49.1 minutes by PSG compared to 36.8 minutes by actigraphy (Spearman rank correlation, r_s=.61, p<0.0001; regression coefficient β= 0.81; CI= 0.42, 1.21).
Conclusion: These findings provide a comprehensive validation study confirming that a current algorithm provides generally accurate results for determining sleep and wake patterns. These data describe specific limitations for specificity (wake estimation) and an empirical bound to estimates of sleep, wake, and WASO when using actigraphy.
Support (If Any): This was not a device industry-sponsored study. Kennedy Shriver National Institute of Child Health and Human Development (Grant # U01HD051217, U01HD051218, U01HD051256, U01HD051276), National Institute on Aging (Grant # U01AG027669), the National Heart, Lung and Blood Institute (R01HL107240), Office of Behavioral and Science Sciences Research, and National Institute for Occupational Safety and Health (Grant # U01OH008788, U01HD059773), and General Clinical Research Center grant M01-RR02635. Grants from the William T. Grant Foundation, Alfred P Sloan Foundation, and the Administration for Children and Families have provided additional funding. The contents of this publication are solely the responsibility of the authors and do not necessarily represent the official views of these institutes and offices. Special acknowledgement goes to Extramural Staff Science Collaborator, Rosalind Berkowitz King, Ph.D. and Lynne

Casper, Ph.D. for design of the original Workplace, Family, Health and Well-Being Network Initiative. Further support was provided through investigator-initiated research grants from the Academy of Architecture for Health, the Facilities Guidelines Institute, The Center for Health Design; investigator-initiated grants from Sepracor Inc (now Sunovion; ClinicalTrials.gov Identifiers NCT00555750, NCT00900159), and Cephalon Inc (ClinicalTrials.gov Identifier: NCT00895570).

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SLEEP DISORDERS ARE ASSOCIATED WITH ADVERSE PHYSICAL AND MENTAL HEALTH OUTCOMES IN POLICE OFFICERS

Rajaratnam S[1,2,3], Barger L[1,2], Lockley SW[1,2], Shea SA[1,2,4], Wang W[1,2,5], Landrigan CP[1,2,6], O'Brien C[1], Qadri S[1], Sullivan J[1], Czeisler CA[1,2]
[1]Division of Sleep Medicine, Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]School of Psychology and Psychiatry, Monash University, Clayton, VIC, Australia, [4]Sleep HealthCenters, Boston, MA, USA, [5]Channing Laboratory, Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA, [6]Division of General Pediatrics, Department of Medicine, Children's Hospital Boston, Boston, MA, USA

Introduction: Sleep disorders often remain undiagnosed and may adversely affect mental and physical health. The present study sought to examine the health risks associated with sleep disorders in sample of North American police officers.
Methods: Police officers (n=4,957) from across North America completed a baseline questionnaire to screen for common sleep disorders. Validated screening questionnaires were used for all sleep disorders except for Shift Work Disorder (SWD). For SWD, the screening questions were based on the International Classification of Sleep Disorders-2 criteria. The survey also contained questions regarding physical and mental health. Multiple logistic regression models were used to evaluate associations between sleep disorder screening and health outcomes. Odds ratios adjusted for sex, age, BMI, primary police activity, shift rotation, second job, number of night shifts worked, mean total work hours per week and monthly sleep.
Results: The percentage of police officers who screened positive for at least one sleep disorder was 40.4% and 33.6% screened positive for obstructive sleep apnea (OSA). Compared with those officers who did not screen positive for a sleep disorder, a positive screening was associated with increased prevalence of reported depression (Adjusted odds ratio [AOR] 2.75, 95% confidence interval [CI] 1.66-4.56, p<0.001), burnout-emotional exhaustion (AOR 2.87, 95% CI 2.17-3.80, p<0.001) and anxiety (AOR 3.02, 95% CI 1.75-5.19, p<0.001). Compared to those officers who did not screen positive for OSA, a positive screen was also associated with an increased prevalence of diabetes (AOR 2.10, 95% CI 1.26-3.50, p=0.005) and cardiovascular disease (AOR 1.96, 95% CI 1.07-3.59, p=0.03).
Conclusion: Positive screening for a sleep disorder is significantly associated adverse mental and physical health outcomes in police officers.

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SLEEP DISORDERS ARE ASSOCIATED WITH ADVERSE PERFORMANCE AND SAFETY IN POLICE OFFICERS

Barger L[1,2], Rajaratnam SM[1,2,3], Lockley SW[1,2], Wang W[1,2], Landrigan CP[1,2,4], O'Brien C[1], Qadri S[1], Sullivan J[1], Cade BE[1,2], Czeisler CA[1,2]
[1]Medicine/Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA, [2]Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA, [3]School of Psychology and Psychiatry, Monash University, Clayton, VIC, Australia, [4]Division of General Pediatrics/Department of Medicine, Children's Hospital, Boston, MA, USA

Introduction: Sleep disorders often remain undiagnosed and may adversely affect performance and safety. The present study sought to examine the performance and safety risks associated with sleep disorders in sample of North American police officers.
Methods: Police officers (n=3,545) from across North America completed a baseline questionnaire to screen for common sleep disorders. Validated screening questionnaires were used for all sleep disorders except for Shift Work Disorder (SWD). For SWD, the screening questions were based on the International Classification of Sleep Disorders-2 criteria. In a two-year follow up period, officers completed 15,735 online monthly surveys (6,587 person-months with positive screens and 9,148 with negative screens for sleep disorders) regarding performance and safety outcomes. The generalized estimating equations (missing indicator) method was used to assess outcomes with odds ratios adjusted for sex, age, BMI, primary police activity, shift rotation, second job, number of night shifts worked, mean total work hours per week and monthly sleep.
Results: Each officer completed a mean (SD) of 4.4 (5.2) monthly surveys. Compared to those officers who did not screen positive for a sleep disorder, officers who were prospectively identified as screening positive for a sleep disorder had higher risk of reporting a serious administrative error (adjusted odds ratio [AOR] 1.43, 95% confidence interval [CI] 1.23-1.67, p<0.001), falling asleep while driving (AOR 1.51; 95% CI 1.20-1.90, p=0.001), an error or safety violation attributed to fatigue (AOR 1.63; 95% CI 1.43-1.85, P<0.001), occupational injury (AOR 1.22, 95% CI 1.01-1.49, p<0.05) and other adverse work-related performance measures including uncontrolled anger towards a suspect (AOR 1.25; 95% CI 1.09-1.43, p=0.001), absenteeism (AOR 1.23; 95% CI 1.08-1.40, p=0.002), and falling asleep during meetings (AOR 1.95; 95% CI 1.52-2.52, p<0.001).
Conclusion: Positive screening for a sleep disorder in police officers is significantly associated with attentional failures and adverse performance and safety in the work place.

1309

PHYSICAL EXERCISE PERFORMED BEFORE BEDTIME IMPROVES THE SLEEP PATTERN OF HEALTHY YOUNG GOOD SLEEPERS

Queiroz SS[1,2], Flausino NH[2], Prado JM[2], Tufik S[1], Mello MT[1,2]
[1]Psicobiologia, Universidade Federal de São Paulo, São Paulo, Brazil, [2]Centro de Estudos em Psicobiologia e Exercício, São Paulo, Brazil

Introduction: Physical exercise has been associated with better sleep quality and is accepted as a nonpharmacological intervention for sleep disorders by the American Sleep Disorders Association. One important factor impacting sleep pattern based on sleep hygiene recommendations is the schedule of exercise. Some studies have indicated that physical exercise in the morning can improve sleep, while the opposite effect can be observed for physical exercise in the evening. Objective: To investigate the influence of different intensities and durations of exercise before bedtime on the sleep pattern and core body temperature of individuals considered good sleepers.
Methods: Seventeen healthy young adult males underwent 5 nonconsecutive randomized days of study. Measurements of polysomnographic parameters and core body temperature were taken at baseline and after each experimental protocol performed at night between 8:00 and 8:30 pm. The testing exercise was conducted on a treadmill to determine the functional capacity (VO2peak) and ventilatory thresholds 1 (VT1) and 2 (VT2) for each subject. On each of 4 experiments the subjects ran continuously at 30 and 60 min on VT1 and 30 and 60 min at intensity 50% above VT1 (Delta50). The interval between experiments was at least 1 week. The physical activity of the participants was monitored by wrist actigraphy.
Results: Sleep efficiency was significantly increased (p=.016) among all protocols compared with baseline data as well as in REM sleep latency (p=.047) between experiments VT1 30 and Delta50 60 min. Further, there was significant decrease in percentage of stage 1 sleep (p=.046) and in wake after sleep onset (p=.003). Core body temperature did not change significantly during the nights following exercise.
Conclusion: Our data suggest that physical exercise before bedtime positively affects the sleep pattern of healthy, nonathlete, young adult males without sleep complaints and then it may be considered to improve sleep pattern.

Support (If Any): Associação Fundo de Incentivo à Pesquisa-AFIP, Fundação de Amparo à Pesquisa do Estado de São Paulo-FAPESP and Conselho Nacional de Desenvolvimento Científico e Tecnológico-CNPq.

1310
WITHDRAWN

1311
CME ON EXCESSIVE SLEEPINESS AND SLEEP-WAKE DISORDERS CAN ADDRESS GAPS IN CLINICAL KNOWLEDGE AND COMPETENCE

Johnson M[1], Roth T[2]
[1]Medical Resources Group, CME Outfitters, LLC, Rockville, MD, USA, [2]Psychiatry/Sleep Disorders Research Center, University of Michigan/Henry Ford Health System, Detroit, MI, USA

Introduction: Excessive sleepiness (ES) is reported by 21% of women and 30% of men in the United States and represents a hallmark symptom of an underlying sleep-wake disorder (SWD) or chronic sleep restriction. ES is associated with significant physiological and psychological consequences that impact individual and public health. Despite high prevalence and associated morbidity, ES is underdetected, underdiagnosed and undertreated. A number clinician practice gaps, many addressable via continuing medical education (CME), have been systematically identified. Recently, we published on the effectiveness of a CME activity in improving clinician competence in diagnosis and management of SWDs. Results revealed need areas for additional educational interventions. To further explore best educational strategies for improving practice behavior regarding management of SWDs, we are conducting further inquiry of clinicians.
Methods: Clinicians in the CME Outfitters learner database who self-identified as primary care clinicians were queried about educational needs via online surveys. Surveys included items related to detecting ES, diagnosing and treating SWDs, and working with sleep medicine specialists. Additionally, 5 in-depth interviews were conducted with a randomly-selected subset of the survey respondents about the role of CME in sleep medicine education. Data collected was analyzed as a whole and sub-analyses were conducted based on personal and practice demographics as well as previous exposure level to education on sleep-related topics.
Results: Ongoing practice gaps regarding SWDs for primary care clinicians include: 1) need for improved knowledge level about differential diagnosis; 2) underuse of validated diagnostic questionnaires; and 3) seeing limited utility in referring patients to a sleep specialist.
Conclusion: Optimal patient care is an ongoing educational process, and constant assessment and improvement of clinician knowledge and skills are needed to help clinicians individualize care for patients with SWDs.

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IMPROVING SLEEP IN COLLEGE STUDENTS: AN EDUCATIONAL INTERVENTION

Lamberti MP[1,2], Kenefick A[1], Bassi S[1], Briddell J[2], Redeker NS[3]
[1]University of Connecticut, Madison, CT, USA, [2]Connecticut College, New London, CT, USA, [3]Yale University, New Haven, CT, USA

Introduction: Multiple studies document the prevalence of sleep problems in college students. Previously in other research, in the setting of this study, students identified sleep difficulties at the rate of 23.6% as a factor affecting their academic performance and 24.1% said their sleep difficulties were difficult to handle. The purpose of this study was to evaluate the effects of an intervention to improve sleep hygiene, sleep quantity and sleep quality in college students.
Methods: The sample included first year college students at a traditional, small, private, Southern New England liberal arts college. A randomized repeated measures design was used. The intervention included a one-time in-person discussion and twice-weekly emails over 9 weeks. Outcomes included sleep quality (Pittsburgh Sleep Quality Index) and the Sleep Hygiene Practice Scale.
Results: Among 508 entering first year students, 77 completed the baseline survey; 66 completed the follow-up surveys. Baseline analysis showed no significant between-group differences in PSQI or the four SHPS domains by independent sample t-test. After five weeks there was no significance of the interaction between the experimental manipulation and the pretest - posttest measures using repeated measures ANOVA.
Conclusion: Final data collection and analysis are ongoing. The final report will provide comparison data from baseline and two months post-intervention.
Support (If Any): Acknowledged from the Yale University School of Nursing, Sigma Theta Tau, Delta Mu Chapter and Connecticut College.

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IMPACT OF AN EDUCATIONAL INTERVENTION ON SLEEP IN TOWING VESSEL CREW

Reid KJ[1], Preuss F[2], Rowan E[2], Turek FW[2]
[1]Neurology, Northwestern University, Chicago, IL, USA, [2]Neurobiology, Northwestern University, Evanston, IL, USA

Introduction: Fatigue as a result short sleep is a concern in the maritime industry particularly since work schedules often involve more than one rest/work period per 24 hours. For example the predominant schedule in the United States (US) tow boat industry includes 2 x 6 hour work and 2 x 6 hour rest periods/day. This schedule poses several factors that could influence sleep including night work and limited rest intervals. Education addressing these issues is often a core component of fatigue management plans. The aim of this study was to assess the impact of a sleep education program on sleep in maritime crew.
Methods: Participants included 31 crew members of towing vessels on US waterways. There were 15 crew working the front watch (FW; 6am-12pm; 6pm-12am), and 16 on the backwatch (BW; 12am-6am; 12-6pm). Rest-activity cycles (time in bed (TIB), sleep duration (SD), fragmentation index (FI)) were assessed using actiwatch Spectrum (Philips/Respironics) for 5 consecutive days prior to and 5 days after a 2 day educational intervention. The educational intervention involved dissemination of educational materials in conjunction with a structured one-on-one session with research staff that covered topics such as sleep hygiene, sleep disorders, circadian disruption, split sleep schedules and consequences of short sleep. Data were analyzed using t-test and 2 factor repeated measures ANOVA for time (pre-post) and group (FW, BW).
Results: There were no significant differences in sleep pre and post intervention. Mean TIB was 7.9 (±1) hours at both baseline and post intervention (p=0.5). Man SD was 6.2 (±0.86) hours at baseline and 6.3 (±0.96h) hours post intervention (p=0.48). Mean FI was 37 (±9.5) at baseline and 39 (±10.9) post intervention (p=0.15). There were no differences between FW and BW in any of the sleep parameters at baseline or in response to the intervention.
Conclusion: While there was no improvement in sleep following the 2 day intervention, the findings provide important information to policy makers and industry, because such educational programs are often a core component of fatigue management. Consideration should be given to the duration of the intervention, as this is a potential limitation of the current study. There may have been little room for improvement, since TIB was close to 8 hours. However, the 1.7 hour difference between TIB and SD suggests that sleep is quite fragmented. Studies to determine factors impacting sleep quality would be important to include in future programs.
Support (If Any): American Waterways Operators.

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THE EFFECTS OF AN ONLINE EDUCATIONAL PROGRAM ON NURSE PRACTITIONERS' KNOWLEDGE OF OBSTRUCTIVE SLEEP APNEA IN ADULTS

Valerio TD[1,2], Heaton K[3,4]
[1]Mennonite College of Nursing, Illinois State University, Normal, IL, USA, [2]Student Health Services, Illinois State University, Normal, IL, USA, [3]School of Nursing, The University of Alabama at Birmingham, Birmingham, AL, USA, [4]Deep South Center for Occupational Safety and Health, The University of Alabama at Birmingham, Birmingham, AL, USA

Introduction: Primary care providers' knowledge of obstructive sleep apnea is essential to their recognizing and screening adults at-risk. However, these providers, including nurse practitioners, report limited education on sleep disorders. Few studies have evaluated the effectiveness of educational programs on medical students' and physicians' knowledge of sleep; none were found for nurse practitioners. This study evaluates the effects of an online educational program on nurse practitioners' knowledge of obstructive sleep apnea in adults.
Methods: Knowledge was assessed with 15 case-study based questions in a pre-test and post-test. The 53 minute online narrated PowerPoint educational intervention utilized guidelines from the American Academy of Sleep Medicine Adult OSA Task Force. Pre-test and post-test answers were compared to determine the change in knowledge.
Results: Fifty-four nurse practitioners entered the study, and 38 (70.4%) completed. Participants reported a mean of 1.97 hours (SD = 3.93 hours) of previous sleep education. Those who completed the entire program (n = 38) had a significant improvement in post-test scores as compared to pre-test scores ($p < .001$, $t(37) = -5.024$). This was particularly evident ($p = .05$) in questions on clinical prevalence ($p < .001$), routine health evaluation ($p = .001$), signs and symptoms ($p = .031, .003, .023$), high risk situations ($p = .023$) and screening tools ($p < .001$). After the educational session, 97.4% of participants indicated they were "very likely" or "likely" to evaluate their patients for obstructive sleep apnea.
Conclusion: Nurse practitioners, as well as many other primary care providers, have limited formal education on sleep disorders; although are in a key position to make a significant impact on evaluating adults for obstructive sleep apnea. Knowledge of how to recognize and evaluate adults for this disorder would likely lead to an improved rate of diagnosis and reduce associated chronic health problems.
Support (If Any): Illinois Society for Advanced Practice Nursing and OSF Saint Francis Medical Center.

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EXCESSIVE SLEEPINESS AND POOR SLEEP QUALITY IN MEDICAL STUDENTS

Morgan C[1], Attarian H[2], Guo R[3], Viola-Saltzman M[1]
[1]Neurology, Loyola University Medical Center, Maywood, IL, USA, [2]Neurology, Northwestern University, Chicago, IL, USA, [3]Research Services, Loyola University Medical Center, Maywood, IL, USA

Introduction: Sleep-related issues and the association with work and driving errors have been well- documented in medical professionals. However, few studies have addressed these issues in medical students. We attempted to characterize sleepiness and sleep quality in medical students and determine if these are associated with academic performance and/or potentially injurious behaviors.
Methods: A web-based, anonymous survey was administered to 283 American medical students, containing 37 questions which included the Epworth Sleepiness Scale (ESS), the Pittsburg Sleep Quality Index (PSQI), demographics, year of training, cohabitation, current academic or clinical rotation, self-assessed workload, on-call schedule, self-rating of academic performance, exercise, drug use, work-related errors and driving accidents. Fisher's Exact or Wilcoxon Test and regression analysis were performed between sleepiness, sleep quality and other factors.
Results: 230 (81.3%) medical students completed the survey. 95% of respondents were 20-30 years of age, 60% female and 87% Caucasian. The average ESS was 8.73 (45% scored >9), the average PSQI was 6.05 (51% scored >5) and the average sleep duration was 6.65 hours. There was no correlation between body mass index (BMI) or caffeine use and ESS or PSQI scores. 25% of students reported at least one near-miss or driving accident and 35% at least one work-related error in the preceding month. Fisher's exact or Wilcoxon Test analysis showed significant correlations between excessive sleepiness and poor sleep quality (ESS >9, PSQI >5) with driving accidents ($p=0.0007$, $p=0.0035$), work-related errors ($p=0.0092$, $p=0.0076$), falling asleep during class ($p<0.0001$, $p=0.03$), and less amount of sleep reported per night ($p<0.005$, $p=0.0052$). An ESS>9 was more prevalent in females ($p=0.008$) and students on their pediatric, surgery or obstetrics/gynecology rotations ($p=0.0027$).
Conclusion: Excessive sleepiness and poor sleep quality is prevalent in this group of medical students and is associated with a reported increase in driving accidents, work-related errors, falling asleep in class and decreased sleep time.

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CORRELATES OF ACUTE WORK-RELATED FATIGUE IN STUDENTS AGED 19-21 YEARS WHO HAVE JOBS DURING THE SCHOOL YEAR

Laberge L[1,2], Gaudreault M[2], Auclair J[2], Arbour N[2], Ledoux [3]
[1]Health Sciences Department, Université du Québec à Chicoutimi, Chicoutimi, QC, Canada, [2]ÉCOBES Recherche et transfert, Cégep de Jonquière, Jonquière, QC, Canada, [3]Robert-Sauvé Occupational Health and Safety Research Institute (IRSST), Montréal, QC, Canada

Introduction: Young workers, defined as those age 15 to 24 years old, face high risk for injury while on the job. In older workers, work-related fatigue is an acknowledged risk factor for occupational accidents. This study aimed to explore risk factors for acute work-related fatigue in students who work while studying.
Methods: Eighty-eight (36 males) 19-21 year old full-time students were interviewed at the beginning of school session to gather data on school and job characteristics, including exposition to physical (e.g. difficult postures) and psychosocial/organizational constraints (e.g. high level of concentration required by the work). For two consecutive weeks, sleep was monitored with an actigraph (Actiwatch, Mini-mitter/Respironics, OR). Students also completed the Morningness-Eveningness Questionnaire, the Occupational Fatigue Exhaustion Recovery (OFER) scale, and the Job Content Questionnaire. A multiple linear regression was performed to identify factors associated with acute work-related fatigue assessed by the OFER.
Results: Students averaged a 45-hour workweek (school, paid work, and homework). They fell asleep (24h06 vs. 01h29, $p<.001$) and woke up (7h49 vs. 9h07, $p<.001$) earlier on schooldays than on weekends. Their mean(SD) sleep duration was 6.51(0.7) hours. Fifteen students were morning types, 55 intermediate types, and 18 evening types. Their mean(SD) score on the psychological demand subscale was 19.8(4.7). Also, their mean(SD) number of jobs since age 15 and of psychosocial/organizational constraints were 4.4(1.7) and 4.8(2.0), respectively. The multiple regression ($R2adjusted=0.34$) revealed that higher number of psychosocial/organizational constraints ($b=2.8$, $p<.01$), night shift working ($b=14.0$, $p<.01$), greater number of jobs since age 15 ($b=9.8$, $p<.05$), and higher psychological demand ($b=0.9$, $p<.05$) were associated with increased acute work-related fatigue levels.
Conclusion: Student workers had relatively short sleep duration. Exposure to significant psychosocial/organizational constraints constitutes a potentially modifiable risk factor that may diminish the work-related fatigue levels in this population, and hence the chance of workplace injuries occurring.
Support (If Any): This project was supported by an IRSST grant (0099-5500) awarded to LL.

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A PILOT INTERVENTION TO INVESTIGATE THE FEASIBILITY OF EXTENDING SLEEP DURATION TO REDUCE BODY WEIGHT IN SHORT SLEEPING OBESE INDIVIDUALS

Arora T[1], Thomas G[2], Taheri S[1]
[1]College of Medical and Dental Sciences, University of Birmingham, Birmingham, United Kingdom, [2]Public Health, Epidemiology and Biostatistics, University of Birmingham, Birmingham, United Kingdom

Introduction: Cross-sectional evidence suggesting a link between short sleep duration and obesity is plentiful. Longitudinal evidence is available but is limited and the possibility of reverse causality remains. Experimental sleep manipulation studies have mainly studied young healthy men with some attempting to extend sleep following sleep restriction for 2 nights in a laboratory. We sought to examine the possibility of extending sleep duration in short sleeping overweight/obese individuals for 28 nights to examine potential body weight alterations.
Methods: Four volunteers (3 men, 1 woman), age 35-42 years, body mass index (BMI) ≥25, with self-reported short sleep duration (≤6hours) were recruited. Height and weight were measured, Stanford Sleepiness Scale (SSS) was completed and visual analogue scales were completed for hunger and appetite both pre and post sleep intervention. Sleep hygiene advice was provided at baseline to aid sleep extension. Volunteers were then instructed to extend sleep duration to ≥7hours and were issued actigraphy and sleep diaries to complete for 28 nights in their own environment and returned for data download.
Results: Sleep duration ≥7hours was achieved by all volunteers for at least 20 of the 28 nights. As a group, body weight was reduced by 11kg. Mean group appetite for fruit and vegetables increased post intervention (7.6±1.3), compared to baseline (4.5±1.4). Mean group appetite for sweets (3.2±1.7), hunger (4.3±0.7) and SSS (2.3±0.8) scores decreased post intervention compared to baseline (6.7±2.1, 7.6±1.4 and 8.5±1.1, respectively).
Conclusion: Evidence from this small pilot feasibility study demonstrates that extending sleep to desirable amounts may aid weight loss in already overweight/obese short sleeping individuals. If confirmed in larger samples, sleep extension may complement other obesity treatments and prove to be a cost-effective addition.

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MODERATE CAFFEINE CONSUMERS BENEFIT FROM HIGHER VIGILANCE ENHANCEMENT AND LESSER SLEEP ALTERATIONS FOLLOWING CAFFEINE CONSUMPTION THAN LIGHT CONSUMERS

Robillard R[1,2], Cartier A[1], Nicolau L[1], Bouchard M[1], Lupien F[1], Jacob-Lessard A[1], Carrier J[1,2,3]
[1]Center for Advanced Research in Sleep Medicine, Hopital du Sacre-Coeur de Montreal, Montreal, QC, Canada, [2]Département de Psychologie, Universite de Montreal, Montreal, QC, Canada, [3]Institut Universitaire de Geriatrie de Montreal, Universite de Montreal, Montreal, QC, Canada

Introduction: The pattern and duration of caffeine consumption are likely to influence the impacts of caffeine on sleep and vigilance. This study evaluated the effects of caffeine on sleep and vigilance in young (20-30y.o.) and middle-aged adults (40-60y.o.) in relation to their habitual caffeine consumption.
Methods: In the evening, 26 moderate caffeine consumers (100-300mg/day; 12 young and 14 older) and 24 light consumers (≤50mg/day; 12 young and 12 older) received a capsule of placebo and a capsule of caffeine (200mg) in a double-blind counterbalanced crossover design. All subjects then performed a psychomotor vigilance task (PVT) and rated their subjective vigilance on a visual analogue scale (VAS). Three-ways ANOVAs with two independent factors (age group: young and middle-aged, habitual caffeine consumption: light and moderate) and one repeated measure (condition: placebo and caffeine) were performed on sleep and vigilance variables.
Results: Interactions involving habitual consumption are reported. Caffeine significantly reduced mean reaction time and the number of lapses on the PVT and increased subjective vigilance on the VAS for moderate, but not light consumers (all $p<.05$). During the subsequent sleep episode, caffeine increased wake after sleep onset (WASO) and decreased sleep efficiency and total sleep time less strongly in moderate consumers than in light consumers (all $p<.05$). No significant interaction between age and caffeine consumption were found for sleep and vigilance variables.
Conclusion: Independently of the length of consumption history, moderate caffeine consumers seem to have a higher sensitivity to the vigilance promoting effect of caffeine, while being less affected by its adverse effect on sleep. Habituation/sensitisation and genetic predisposition may contribute to the better response of moderate caffeine consumers to caffeine.
Support (If Any): This research was supported by scholarships and grants from the Canadian Institutes of Health Research (CIHR), the Fonds de Recherche en Santé du Québec (FRSQ) and the Natural Sciences and Engineering Research Council of Canada (NSERC).

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DIETARY INTAKE AND SLEEP DURATION IN THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (HCHS/SOL)

Mossavar-Rahmani Y[1], Patel SR[2], Sotres-Alvarez D[3], Rock CL[4], Arens R[5], Ramos AR[6], Van Horn L[7]
[1]Epidemiology & Population Health, Albert Einstein College of Medicine, Bronx, NY, USA, [2]Sleep Medicine, Brigham Women's Hospital, Boston, MA, USA, [3]Biostatistics, University of North Carolina, Chapel Hill, NC, USA, [4]Department of Family & Preventive Medicine, University of California at San Diego, San Diego, CA, USA, [5]Division of Respiratory & Sleep Medicine, Montefiore Medical Center, Bronx, NY, USA, [6]Sleep Medicine Program, University of Miami, Miami, FL, USA, [7]Department of Preventive Medicine, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA

Introduction: The association of sleep duration and timing with dietary intake among Hispanic-Americans has received limited attention. Hispanic-Americans are at increased risk for obesity, diabetes and stroke. In this study we characterize the relationship of sleep and diet in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL).
Methods: HCHS/SOL enrolled over 16,000 Hispanic/Latino participants aged 18-74 yr. in four cities (Miami, Bronx, Chicago, and San Diego). This preliminary analysis describes results from two-thirds of the community sampling who responded to questions regarding sleep timing and duration and completed 24 hour dietary recalls. Habitual sleep duration was taken as the weighted average of self-reported sleep on weekdays and weekends. Participants with sleep apnea (apnea hypopnea index > 15) or who worked night or irregular work shifts were excluded. All analyses accounted for the sampling design and adjusted for age and gender.
Results: Average sleep duration was 8.6 +/- 0.04 hr. among the 8,853 participants (mean age = 40.4 yr±0.30, BMI = 28.9±0.11, 55.1 % female). Overall, 18% were short sleepers (< 7h), 51% were average sleepers (7-8 h) and 32% were long sleepers (> 8h). Sleep durations varied by ethnicity ($p<0.05$). Cubans were less likely to be short sleepers compared to Puerto Ricans (13% vs. 25.9%, $p<0.0001$). On weekdays, 30% went to bed before 8 pm; and 60% woke up before 7 am. Dietary intake did not differ by sleep duration with no significant differences in mean energy (1816.5 kcal), protein (238.3g), carbohydrate (74.9g), and total fat (63.0g).
Conclusion: In general, short self-reported sleep durations were less common in this Hispanic-American population though variability exist-

ed by ethnicity. No significant differences were seen in dietary intake by sleep duration. On-going analyses will focus on stratification by gender, include napping frequency and investigate timing of meals with sleep duration.

Support (If Any): HCHS/SOL was carried out as a collaborative study supported by the National Heart, Lung, and Blood Institute (NHLBI) and the following Institutes/Centers/Offices contributed to the study: National Institute on Minority Health and Health Disparities, National Institute on Deafness and Other Communication Disorders, National Institute of Dental and Craniofacial Research, National Institute of Diabetes and Digestive and Kidney Diseases, National Institute of Neurological Disorders and Stroke, NIH Institution-Office of Dietary Supplements.

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WHERE ARE THE CBSMS AND WHERE ARE THEY NEEDED? A CARTOGRAPHIC ASSESSMENT

McKay GD[1], Grandner MA[2], Gehrman P[2], Bremer EM[2], Perlis ML[2]
[1]Psychology, University of Rhode Island, Providence, RI, USA, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, USA

Introduction: Cognitive Behavioral Therapy for Insomnia (CBT-I) is widely considered the treatment of choice for chronic insomnia. There is, however, an insufficient number of credentialed clinicians to provide these services. While it is clear that the <200 therapists currently credentialed cannot serve even a fraction of the ~30 million individuals with chronic insomnia, what is unclear is whether this problem is more acute in some states and cities as opposed to others. Accordingly, a cartographic approach was taken to assess this issue.

Methods: The American Board of Sleep Medicine (ABSM) listing of clinicians certified in Behavioral Sleep Medicine (CBSM) was reviewed and updated to reflect the current location of each credentialed provider using the APSS directory and internet searches. The location data were cataloged in spreadsheets and then plotted by city and state as density maps.

Results: The total number of CBSMs worldwide for 2011 is n=159. This represents a doubling over the past 5 years. Of these, n=149 of these individuals currently reside in 34 states. 50% reside in just 7 states (NY, IL, CA, MI, FL, MD, and PA) and 16 states are without CBSMs (AK, DE, NV, NM, OK, SC, ID, WYO, ND, SD, IO, IND, VM, NH, ME, and HI). The regional distribution of CBSM clinicians is as follows: 48 in the South, 42 in the Midwest, 32 in the Northeast, and 27 in the West. 79 CBSMs currently reside in 50 of the 275 cities with >100,000 individuals. 25% reside in the nation's 10 largest cities. The cities with the greatest density of CBMs are Chicago, Detroit , Washington D.C. and New York City.

Conclusion: Although there is a nationwide lack of providers in general, the need for providers is most acute in 16 states and in 225 cities.

Support (If Any): 5R01AT003332-05, 5R01MH077900-03, T32-HL007713.

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HEALTHCARE UTILIZATION PRE- AND POST-CBT FOR INSOMNIA

Bramoweth AD[1,2], Mosti C[3], Williams JM[4], Berry RB[5], McCrae C[4]
[1]VISN 4 Mental Illness Research, Education and Clinical Center (MIRECC), VA Pittsburgh Healthcare System, Pittsburgh, PA, USA, [2]Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA, [3]Department of Psychology, University of Florida, Gainesville, FL, USA, [4]Department of Clinical and Health Psychology, University of Florida, Gainesville, FL, USA, [5]Department of Medicine, University of Florida, Gainesville, FL, USA

Introduction: Chronic insomnia is a prevalent disorder with considerable economic impact. People with chronic insomnia have significantly greater healthcare utilization (HCU) than those with normal sleep or acute insomnia. However, little research exists on HCU following treatment of chronic insomnia using cognitive behavioral therapy for insomnia (CBTi).

Methods: A review of records for patients treated for insomnia (N=84) at a behavioral sleep medicine clinic in an academic medical center from 2005-2010. Data extracted from records included sleep diaries, medical and psychiatric diagnoses, and HCU for 6-months pre- and post-CBTi. HCU included number of physician visits and medications, direct costs of visits, and Chronic Disease Score.

Results: For the whole sample, direct costs of care reduced approximately $100 6 months pre-CBTi ($334.96) to 6 months post-CBTi ($233.26); however, this was not statistically significant (p=.164). There was a trend (p=.070) for treatment responders with decreased direct costs post-CBTi ($167.47). There was also a trend for treatment responders with decreased estimated HCU post-CBTi: total costs (p=.076), outpatient costs (p=.072), and physician visits (p=.072). No trends, or significant HCU differences, were found post-CBTi for treatment non-completers and non-responders.

Conclusion: This was a preliminary investigation of changes in HCU following evidence based treatment of chronic insomnia. Results found trends for decreased HCU following CBTi for patients who responded to treatment. Even though the change was not statistically significant, an average decrease of $167 has real world implications. The findings were promising, and the study was limited by its small sample size, retrospective design, and missing data. Additionally, the sample was highly comorbid, both psychiatric and medical problems, which increases HCU regardless of treatment response. Future research should focus on conducting prospective studies evaluating the cost-effectiveness of CBTi and its potential for reducing HCU, short-term and long-term, among samples both high and low in comorbid disorders.

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BED SHARING WITH DOGS AND THE INFLUENCE IN OWNERS' SLEEP

Bertocco BP[1], Carvalho LB[1], Prado AF[2], Prado LB[1], Prado GF[1]
[1]Neurology, Neuro-Sono, Unifesp, São Paulo, Brazil, [2]Faculdade de Medicina, Universidade de São Paulo, São Paulo, Brazil

Introduction: In Brazil, 63% of households have dogs and consider them as family members, and many people share their beds with dogs. There are no studies about the effect of bed sharing with dogs on people's sleep. Objective: To study the influence of bed sharing with dogs on patients with sleep disorders.

Methods: We interviewed 90 patients with sleep disorders, 12-89 years old, 48 women (53%), from Neuro-Sono outpatients' clinic, of Universidade Federal de Sao Paulo, Brazil, from August to December 2011. We considered three places that the dog could sleep: on the interviwed's bed, inside or outside the interviwed's bedroom. We asked how the interviwed considers his sleep in the three situations above: (1) good or bad, (2) if the interviwed awakes with the dog movement or snore, and (3) if the dog asked to go outside the bedroom. We used the Chi-square and Fisher tests, with a significance of <.05.

Results: Out of the 90 patients, 50 had dogs (55.5%), 42% (21/50) shared the bedroom with the dog, and 62% (13/21) shared the bed with the dog. There were more patients referring that their sleep is good sharing their bed with the dog (9/13) or sleeping with the dog inside the bedroom (5/8) than the dog sleeping outside the bedroom (1/11), p=0.006. Seventeen (60%) patients did not answer question #1. There was no significant difference related to sleep quality of the owner if the dog snores or asks to leave the bedroom during the sleep period.

Conclusion: There was a better subjective response on the interviewed's sleep when the dog slept inside the bedroom. This preliminary study shows the need for further research to assess the risks or benefits associated to patients sharing their beds with dogs.

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CO-SLEEPING WITH PETS

Zareie R[3], Stevens S[2], Stevens DR[1]
[1]Medicine, KU Medical Center, Kansas City, KS, USA, [2]Neurology, KU Medical Center, Kansas City, KS, USA, [3]Family Practice, KU Medical Center, Kansas City, KS, USA

Introduction: Studies of co-sleeping or sharing the bed have been performed previously but typically have only evaluated sharing the bed with a spouse or children. Previous studies have not focused on the possible effect of sharing a bed with a pet. Co-sleeping with pets may lead to sleep fragmentation or have other adverse consequences on sleep quality.
Methods: We sampled 148 consecutive subjects in the waiting room of a family practice clinic in an urban, academic setting. After being consented, they were asked to fill out a questionnaire asking questions about the impact of pet ownership on their sleeping habits. Questionnaire responses were tabulated and reported.
Results: There were 88 females and 59 males. The types of pets these subjects owned were cats and dogs. 80 (54%) had pets bed either in their bed or the bedroom. 77 (52%) shared the bed with the pet. 18 (20%) reported better sleep with the pet in the bed, 16 (18%) reported worse sleep, and the remainder either slept the same or were unsure. Twenty-eight (19%) report having to get out of bed at least once per night for the pet. Ten subjects (7%) got out of bed 3 or more times per week to let the pet outside the home. Forty-four subjects (30%) report waking at least once per night due to the pet. Eight (5%) report almost always or always having trouble reinitiating sleep after being woke by the pet.
Conclusion: Nearly one-third of pet owners report being woken up at least once per night due to their pet. Five percent report "almost always to always" having difficulty re-initiating sleep after being awakened by their pet. Incorporating questions regarding pet ownership into an insomnia history may offer insight into factors that may disrupt sleep. Further research of co-sleeping with pets in indicated to better define the impact of this behavior on sleep quality.

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THE EFFECTS OF DISPOSITIONAL OPTIMISM, LOCUS OF CONTROL ON RELATIONSHIP BETWEEN WORK STRESS AND SLEEP QUALITY OF COLLEGE TEACHERS

Ren H[1,2], Zhang Y[1,2], Chung S[1,2], Jin H[1,2]
[1]Applied Psychology, Harbin Engineering University, Harbin, China, [2]Sleep Laboratory, Harbin Engineering University, Harbin, China

Introduction: The impact of work stress on nocturnal sleep quality was described in several studies. But the mechanism of this relation still remains unknown. Locus of control and dispositional optimism have been found association with work stresses and sleep quality. The purpose this study was to evaluate the impact of locus of control and dispositional optimism on the relation between work stresses and sleep quality.
Methods: 323 participants were recruited by random cluster sampling method. Four self report questionnaires included Pittsburgh Sleep Quality Index (PSQI), Reevaluation of the Life Orientation Test, Work Locus of Control Scale, and Scale for Stress on University Teachers were administrated. Pearson correlation was first applied to analyze the relation of these variables. Linear regression with step-wise method and path analysis were then applied to analyze the interaction within them.
Results: Work stresses were significantly correlated with sleep quality ($r=0.222$, $P<0.01$). Five subscales of stress included academic research ($r=0.130$, $P<0.05$), workload ($r=0.138$, $P<0.05$), career development ($r=0.226$, $P<0.01$), tissue function ($r=0.179$, $P<0.01$) and interpersonal relationship ($r=0.193$, $P<0.01$) also reached significant. Linear regression model showed work stress, dispositional optimism and locus of control significantly predicted sleep quality ($R2=0.091$, $P<0.05$). The difference of regression coefficient confirmed the moderating effect of dispositional optimism ($t=6.567$, $P<0.01$). Path analysis confirmed the partial mediating effect of locus of control between work stresses and sleep quality, and the ratio to the total effect was 12.8%. There was also a partial mediating effect between dispositional optimism and sleep quality, and the ratio was 31.6%.
Conclusion: Results demonstrate dispositional optimism moderates the relationship between work stresses and sleep quality. Locus of control plays a mediating role between work stresses and sleep quality, the same between dispositional optimism and sleep quality.

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FATIGUE IN THE GENERAL POPULATION: PREVALENCE, ASSOCIATIONS, AND SELF-MANAGEMENTS

Aritake-Okada S[1,2], Kaneita Y[3], Ohtsu T[4], Uchiyama M[5], Mishima K[6], Akashiba T[7], Uchimura N[8], Nakaji S[9], Munezawa T[3], Ohida T[3]
[1]Department of Somnology, Tokyo Medical University, Tokyo, Japan, [2]Japanese Society for the Promotion of Science, Tokyo, Japan, [3]Department of Public Health, Nihon University School of Medicine, Tokyo, Japan, [4]Department of Public Health, Showa University School of Medicine, Tokyo, Japan, [5]Department of Psychiatry, Nihon University School of Medicine, Tokyo, Japan, [6]Department of Psychophysiology, National Institute of Mental Health, National Center of Neurology and Psychiatry, Tokyo, Japan, [7]Department of Sleep and Respiratory Medicine, Nihon University School of Medicine, Tokyo, Japan, [8]Department of Neuropsychiatry, Kurume University School of Medicine, Kurume, Japan, [9]Department of Social Medicine, Hirosaki University Graduate School of Medicine, Hirosaki, Japan

Introduction: The present study was conducted to clarify the prevalence and associated factors of subjective fatigability and residual fatigue and to examine the self-managements for reducing subjective fatigue. We analyzed epidemiological data for an authentic representative sample of the Japanese population.
Methods: The survey was conducted in November 2009 using face-to-face interview method, targeting a population that was selected randomly from among 4000 household throughout Japan. Among the respondents, 1,224 (539 male and 685 female) individuals aged 20 years or older were analyzed. Oral informed consent was obtained from the participants, and their privacy was protected in accordance with Declaration of Helsinki guidelines.
Results: The prevalence of fatigability and residual fatigue were significantly higher among female than that in male (fatigability: male12.6%, female 20.9%; residual fatigue: male10.0%, female 16.5%). Multivariate logistic regression analyses revealed that female, norestorative sleep, decreased quality of life, and stress showed significant positive associations in common with fatigability and residual fatigue. However, mood depression showed specifically significant positive associations with fatigability, and short sleep duration and over working time ($\geq$9h) were specifically significant positive association with residual fatigue. Regarding copings with fatigue, the prevalence of fatigability and residual fatigue were highest among subjects who take medicine (39.2% and 35.4%), followed by taking counsel (39.1%, 29.7%, respectively), massage (24.2%, 21.2%, respectively). Multivariate analyses revealed that taking medicine and taking counsel had significantly higher odds ratio for fatigability and residual fatigue.
Conclusion: Mood depression is strongly associated with fatigability and working long hours or short sleep duration is more likely to the development of residual fatigue. Moreover, both the existence of fatigability and residual fatigue tend to take medicine and get counseling for reducing these symptoms.

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ACGME DUTY HOURS: IMPACT ON SLEEPINESS AMONG MEDICAL INTERNS AND RESIDENTS

Ortiz LE[1], Drake EA[2], Khan R[1]
[1]Internal Medicine-Pediatrics, Charleston Area Medical Center, West Virginia University, Charleston Division, Charleston, WV, USA, [2]Education, Charleston Area Medical Center Health Education and Research Institute, Charleston, WV, USA

Introduction: ACGME duty hour requirements have become a necessity in the post-graduate educational setting, given that chronic sleep deprivation and prolonged work hours have been associated with increased errors. However, worries of "throwing out the baby with the bath water" occur: increased errors due to multiple sign outs, lack of continuity of care, and missed educational opportunities. Starting July 2011, the ACGME enacted further restrictions on duty hours. However, effects on resident sleepiness from initial 2003 requirements have not been thoroughly investigated.
Methods: The Epworth Sleepiness Scale (ESS) was administered to 113 current residents and incoming interns in the last week of June 2011. Fifty-eight incoming interns at PG1 and 55 current residents at PG2 or above participated. Participants were also given a questionnaire, modified from an earlier study, to gather attitudinal data.
Results: No significant differences in mean ESS scores were found between current residents and incoming interns (8.93 versus 9.34). Thirty-eight percent of residents reported being sleepy (ESS $\geq$ 11). Only 6 % of residents reported severe sleepiness (ESS $\geq$ 17). Residents reporting subjective sleepiness (ESS $\geq$ 11) were found to report significantly fewer hours of sleep. Additionally, current residents reporting subjective sleepiness were more likely to be female than male (63% vs. 27%).
Conclusion: While there is little normative data on resident sleepiness, results here demonstrate that current residents were not significantly sleepier than new interns. This suggests that 2003 duty hours restrictions were protecting residents from pathological sleep-deprivation. However, lack of significant differences between current residents' and incoming interns' ESS scores poses questions regarding further restrictions (July 2011) and any benefit in error prevention. Further investigations are needed to identify trends and assist with strategies to protect residents from effects of sleep loss, while also maximizing educational opportunities.

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SLEEP AND QUALITY OF LIFE: FOLLOW-UP ON IMPACT OF HOUSING UPGRADE AMONG SLUM DWELLERS AT ONE AND SIX MONTHS

Simonelli G[1], Vigo D[1], Hyland M[1], Cardinali D[1,2], Boilard A[4], Leanza Y[4], Vallieres A[4], Perez Chada D[3]
[1]Facultad de Medicina, Universidad de Buenos Aires, Buenos Aires, Argentina, [2]CONICET, Universidad Católica Argentina, Buenos Aires, Argentina, [3]Hospital Universitario Austral, Buenos Aires, Argentina, [4]École de Psychologie, Université Laval, Quebéc City, QC, Canada

Introduction: This study evaluates the transitional impacts on sleep quality and quality of life in slum dwellers associated with moving from a very low quality house to a basic prefabricated 18m2 modular house.
Methods: A total of 30 (Men=36%, Mean age=30.5) slum dwellers that participated in the non-profit organization's housing program of "Un Techo Para Mi País" were recruited. Participants moved from their very low quality house to a basic prefabricated 18m2 modular house provided by the program. The Pittsburgh sleep quality index (PSQI) and WHO quality of life brief scale were administered before program (BEF), one (Follow-up1) and six (Follow-up6) months after upgrade. Data about previous housing conditions, income, education, sleeping conditions, and cardiovascular risk was also collected. Differences were assessed through repeated measures Anovas.
Results: Results showed that sleep quality significantly increased after the housing-program when measured one and six months after the house. PSQI score (mean±SD) BEF=8.43±3.7; Follow-up1=3.90±2.9; Follow-up6=3.43±2.3 ($p<0.001$). Sleep duration also improved and was significantly increased by about one hour after improvement ($p<0.001$). Sharing the bed with at least one child decreased 27% at Follow-up1 ($p=0.013$) and 30% by Follow-up6 ($p<0.005$). Self rated quality of life improved from "Poor" to "Good" ($p<0.001$).
Conclusion: Positive changes in sleep and quality of life were continuous over time between assessments, indicating that the prominent effects of the housing program assessed at time one, were similar to those assessed at time two. The initial improvement in sleep and quality of life was not a "placebo effect" from having just moved to a new home. Low cost housing interventions might be the first step in reducing sleep disparity in developing countries while improving quality of life. Further qualitative assessment of behavioural changes associated with improved living conditions will help ascertain the long term psychosocial implications of the program.

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SLEEP, HOUSING CONDITIONS AND QUALITY OF LIFE IN SLUMS

Simonelli G[1], Hyland M[1], Perez Lloret S[5], Vallieres A[4], Cardinali D[1,2], Vigo D[2], Perez Chada D[3]
[1]Facultad de Medicina, Universidad de Buenos Aires, Buenos Aires, Argentina, [2]CONICET, Universidad Católica Argentina, Buenos Aires, Argentina, [3]Hospital Universitario Austral, Buenos Aires, Argentina, [4]École de Psychologie, Université Laval, Quebéc City, QC, Canada, [5]Faculty of Medicine, Université Paul Sabatier (Toulouse III), Toulouse, France

Introduction: Urban poverty is estimated to affect approximately one third of all urban residents in the developing world. Slums are settlements of impoverished people who live in improvised dwellings made from scrap materials: often plywood, corrugated metal and sheets of plastic. According to the United Nations, one billion people live in slums and little is known about their sleep. This study intends to explore sleep quality, quality of life and housing conditions in slum dwellers.
Methods: A total of 150 (Men=39%, Mean age=30, BMI=26) slum dwellers, from different slums located in the metropolitan area of Buenos Aires, were interviewed using the Pittsburgh Sleep quality Index (PSQI) and WHO quality of life brief scale. Data on housing conditions, income, education, sleeping conditions, and cardiovascular risk was also collected.
Results: Results showed 76.7% (SE=0.03) of participants reported a PSQI score above 5. The PSQI mean was 8.34 (SE=0.29). At the same time, 63% (SE=0.03) rated their quality of life as "poor" and 78% (SE=0.03) were dissatisfied with housing conditions. When asked about sleeping conditions, 74% (SE=0.03) reported sharing the bed with an extra person besides their partner, and 35.3% (SE=0.03) reported sharing the bed with more than one person besides their partner. In terms of major problems associated with sleeping conditions in the house, 73.3 (SE=0.03) answered dampness, 70% (ES=0.03) rain and 57.3% (SE=0.04) wind or roof problems.
Conclusion: The mean PSQI of our sample is associated with poor sleep quality. This finding, coupled with poor housing conditions and dissatisfaction with housing conditions reported by approximately 80% of the participants, reinforces the idea of an existent "sleep disparity" in society. A better understanding of sleep conditions in extremely low-income populations of developing countries may help families find targeted low cost housing interventions, which will reduce sleep inequity while improve quality of life.

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TREND IN SLEEP DURATION OVER TIME IN THE UNITED STATES POPULATION 2005-2008

Szklo-Coxe M[1,2], Lamichhane R[3], Vorona RD[2], Ware J[2]
[1]Community and Environmental Health, Old Dominion University, Norfolk, VA, USA, [2]Internal Medicine, EasternVirginia Medical School, Norfolk, VA, USA, [3]Mathematics and Statistics, Old Dominion University, Norfolk, VA, USA

Introduction: While sleep duration is a known predictor for health outcomes (e.g.,obesity), its trend over time has not, to our knowledge, been investigated in the large population. We investigated sleep duration time trends- including gender-and race-specific trends--in a large, nationally representative population.
Methods: We analyzed National Health Interview Survey(NHANES) 2005-2006 and NHANES 2007-2008 data (civilian, non-institutionalized adult US population), each classified into two waves (6-months each), by interview date, on 5891 and 6307 participants 16-85 years, respectively, who completed the sleep duration item, "How much sleep do you usually get in the night on weekdays or workdays ?" A linear regression model, incorporating NHANES' complex survey design, was fitted for time predicting sleep duration, and age-, gender-, body mass index-(BMI) adjusted. Average sleep duration, and gender- and race-specific trends, were estimated for each wave. A bootstrap resampling method (2000 samples run) estimated trend parameter distributions, estimating bias-corrected, accelerated(BCa) confidence intervals(CI), used also to assess statistical significance($P<0.05$).
Results: Time (6-month periods) significantly predicted sleep duration (adjusted p-value=0.02). For waves 1, 2, 3, 4, respectively, average (se) sleep durations (hours) were 7.18(0.12), 7.01(0.065), 7.09(0.083), 6.83(0.059); average ages (years), 43.7, 45.0, 42.41, 45.8; and percent male, 48.5%, 48.2%, 49.3%, 47.7%. Overall sleep duration rate (hours per 6-month period) 95% CI(BCa) were −0.2633,−0.0167, or,−1.7%,−26.3%, translated as −1.0minutes(min), −15.8min; for females: (-0.3533,-0.0789), or −4.7min,−21.2min($P<.05$); and for males: (0.2533,0.1200) or −15.2min,7.2 min. Race-specific sleep duration rate (hours per 6-month period) 95% CI were: Mexican-American: (−0.0620, 0.2067) or −3.7min,12.4 min, Non-Hispanic Whites: (−0.3333, −0.0519),or −3.1 min,−20.0($P<.05$), Non-Hispanic African-Americans (−0.3650, 0.1918), or−21.9min,11.5min, Non-Hispanic other: (−0.5833, 0.1033) or −35.0min,6.2minutes.
Conclusion: Sleep duration changed (decreased) with time in the U.S. population 2005-2008, per 6-month wave, significantly, by up to 16 minutes overall; 5 to 21 minutes in females, up to 22 minutes in non-Hispanic whites. No significant changes were found for males or other ethnicities.

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HEALTH CARE CONSULTATIONS FOR SLEEP PROBLEMS AND DETERMINANTS OF HELP-SEEKING IN PATIENTS ATTENDING GENERAL MEDICAL CLINICS

Gagnon C, Perozzo C, LeBlanc M, Morin CM
Universite Laval, Quebec, QC, Canada

Introduction: The objective of this study was to examine self-reported health care consultations for sleep problems and determinants of help-seeking in patients attending general medical clinics.
Methods: Participants were 410 adults (mean age = 47.9 years; 60.4% women), recruited in six general medical clinics from the Quebec metropolitan area. They completed a questionnaire assessing sleep/insomnia (using the Insomnia Severity Index), health, lifetime consultations for a sleep problem and determinants of help-seeking.
Results: Of the total sample, 28.8% had previously consulted a health care professional for a sleep problem, with general practitioners being the most frequently consulted practitioners (88.1%). The main determinants prompting such consultations were daytime fatigue (44.1%), psychological distress (28.0%), and cognitive difficulties (15.3%). Of the 410 participants, 99 individuals (24.1%) met criteria for a probable diagnosis of an insomnia disorder as defined by a total ISI score higher or equal to 14. Of this subgroup, 65.7% had previously consulted a health professional for a sleep problem, with the majority (60%) having consulted in the previous year. Compared to individuals with insomnia who never consulted for their sleep problems, those who did reported more severe insomnia; there were also higher proportions of individuals using prescribed medications for sleep and with a self-reported comorbid psychiatric disorder in this subgroup relative to those who had not consulted previously for a sleep problem.
Conclusion: Given the high prevalence of insomnia in general medical clinics and that general practitioners are the most frequently consulted health care professional for a sleep problem, it is particularly important to target this group of practitioners for disseminating information about best practice guidelines for the evaluation and management of insomnia.

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COSTS AND EFFICIENCIES OF ALTERNATIVE RECRUITMENT STRATEGIES IN A SLEEP APNEA CLINICAL TRIAL

Weinstock TG[1,2], Rueschman M[1], Patel SR[1,2], Lewis EF[1], Mittleman M[2], Redline S[1,2]
[1]Medicine, Brigham & Women's Hospital, Boston, MA, USA, [2]Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA

Introduction: Clinical trials are needed to advance the practice of sleep medicine. However, patient recruitment into clinical trials is a major obstacle, especially when medical problems span more than one discipline; most US trials fail to meet their initial benchmarks. We analyzed the costs and efficiencies of three different methods of recruiting into a sleep apnea clinical trial in order to understand which strategies are most effective.
Methods: Data were based on the first 8 months of recruitment in a Phase 2 trial comparing continuous positive airway pressure (CPAP) and control interventions in patients with sleep apnea and cardiovascular disease/risk factors (Best Apnea Interventions in Research; BestAIR). The strategies evaluated included: sleep and cardiology clinic medical record screening with face-to-face recruitment and large volume mailings to patients in cardiology practices. Outcomes include: number of subjects consented relative to total screened and staff costs.
Results: From sleep clinics, over 5,000 patients were screened over 8 months, identifying 132 meeting eligibility criteria. Of these, 25 were consented, yielding a recruitment rate of ~0.5%. From cardiology clinics, 216 patients were screened over 2 months, of whom 25 were eligible and 10 consented, yielding a recruitment rate of 4.6%. Of 1500 mass-mailings to two cardiologists' patient panels, 113 responses were obtained, of whom 54 were eligible and 10 consented, yielding a recruitment rate of 0.7%. Rates of recruitment were 3.1 subjects/month for sleep clinic, 5 subjects/month for cardiology clinic, and 10 subjects/month for mass-mailings. The cost incurred per patient consented from face-to-face encounters was $1228 versus $67 for mailings.
Conclusion: Recruitment yields and costs vary by strategy and site of recruitment. Cardiology clinic recruitment was more efficient than sleep clinic recruitment for identifying patients with sleep apnea and cardiovascular disease with trial equipoise. Mass-mailings were more cost-effective than face-to-face recruitment.
Support (If Any): NIH: U34HL105277; R01HL106410, RC2HL101417.

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DEVELOPMENT OF AN ELECTRONIC SLEEP DISORDERS CENTER DATABASE

Rauch M[1], Lopez S[1], Polnaszek N[1], Brown LK[1,2]
[1]Sleep Disorders Center, University of New Mexico Hospital, Albuquerque, NM, USA, [2]Internal Medicine, University of New Mexico School of Medicine, Albuquerque, NM, USA

Introduction: The UNMH Sleep Disorders Center previously utilized a hospital-wide electronic medical record (EMR; PowerChart, Cerner Corporation, Kansas City, MO), paper shadow charts, paper log book, and a limited-functionality database packaged with our polysomnograph system (Polysmith DMS, Nihon Kohden America, Inc, Foothill Ranch, CA). The EMR was not customizable to our needs, and patient progress through diagnosis and treatment could not be accurately tracked since pertinent information resided in different sites on various media. Consequently, some patients did not move through the diagnostic and treatment process in a timely fashion. We recognized the need for a unified database to accurately track patient and laboratory workflow with functionality specific to sleep disorders center operations but could not identify a commercially-available product.
Methods: We constructed an Access 2010 (Microsoft Corporation, Redmond, WA) database after evaluating our processes and identifying the functions needed to eliminate manual steps and provide comprehensive reporting. Interfaces were customized for staff performing specific functions.
Results: The database 1) stores patient demographics and details of sleep laboratory encounters; 2) communicates to a case manager results and treatment plan; 3) tracks communication to patients of their results; 4) creates durable medical equipment orders that we forward to vendors via encrypted e-mail; 5) schedules patient visits and technologist shifts; 6) tracks inventory and ordering of laboratory supplies. Automated report generation and forwarding include 1) for sleep laboratory testing: flagging of studies in the queue for scoring, interpretation (overall and by individual physician), patient notification, equipment prescriptions, and follow-up scheduling; 2) technologist and provider productivity; 3) laboratory equipment problems. Manual workflow processes were automated, achieving > 20 hours/week of reduced staff time and preventing patients from getting "lost" in the system.
Conclusion: A database specifically designed for a sleep disorders center increases productivity and efficiency and enhances the quality of patient care.

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THE SLEEP-SCHOOL PROJECT: A SLEEP EDUCATION PROGRAM IN PORTUGUESE SCHOOLS

Paiva T[1,2], Pinto TR[1,2], Rebelo Pinto H[1]
[1]Centro de Sono, CENC, Lisbon, Portugal, [2]Sleep Sciences, Lisbon Medical Faculty, Lisbon, Portugal

Introduction: Altogether sleep reduction, bad sleep hygiene and high tech gadgets overuse at bedtime together with low sleep literacy, lack of awareness of health care services and a marked economic national crisis render the Portuguese situation dramatic mostly for children and adolescents. Objectives A national educational program "The Sleep-School Project" delineated for the period 2009-2014 with the following purposes: 1) Systematic research; 2) Dissemination; 3) Materials development; 4) Tailored interventions; 5) Awareness raising; 6) Tutors training; 7) Impact education and health policies.
Methods: The methodology was based in the formulation of simple and clear educational objectives together with an adaptive strategy. The CONCEPTUAL FRAMEWORK, displayed in a simple matrix, had the following structure: 1) SLEEP HABITS: Duration, regularity, autonomy; 2) ENVIRONMENTAL FACTORS: Organization, meals, activities; 3) PERSONAL FACTORS: Emotions, sleep literacy, problems. The economic restrictions prevented national grants; therefore voluntary work has been systematically used.
Results: 1) Systematic research: pilot studies; collaboration with National epidemiological studies (Matos et al 2010 and 2011) ; Validation of assessment instruments (Pinto et al 2010; Loureiro et al 2011; Rebelo-Pinto et al 2011); Master degree thesis (Pinto, 2010; Loureiro; Moreno); Population observation studies; 2) Dissemination 2010-2011 included: 96 Schools; 6000 Students; 630 Teachers, Librarian and Psychologists and 2010 parents. The dissemination sessions included evaluations batteries 3) Materials development: entertainments and educational materials developed for children Books: "Sleep is good; Sleep makes good"; My Friend Sleep"; "The Mysteries of Sleep" and songs "The Sleep Songs" and adults "My Sleep and I"; 4) Interventions tailored: Theater performances; Books dramatization; Pillow painting; Sleep gadgets developments; 5) Awareness: Debates and Work around book characters; 6) Tutors training: One day sessions and e-learning programs; 7) Impact education and health policies via the National reading PLAN and a National Contest in 2012 under the target "Sleep More, read better".
Conclusion: The project has so far multiple successful indicators. The remaining years are promising in terms of long term achievements.
Support (If Any): CENC, Medical Faculty of Lisbon, Pfizer and Linde Sogas.

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ELECTROCARDIOGRAPHIC ARTIFACT MIMICKING ATRIAL FLUTTER CAUSED BY TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) DURING POLYSOMNOGRAPHY

Wongba W[1], Gangal KS[1], Schotland HM[2]
[1]Department of Neurology, University of Michigan, Ann Arbor, MI, USA, [2]Department of Internal Medicine, Division of Pulmonary and Critical Care, University of Michigan, Ann Arbor, MI, USA

Introduction: Electrocardiographic artifact is a common finding in patients undergoing cardiac monitoring. These findings can mimic a wide variety of arrhythmias. Recognition of these artifacts is essential for appropriate clinical management and to prevent unnecessary intervention. We describe a case of artifactual atrial flutter caused by transcutaneous nerve stimulation (TENS) observed in a patient during an overnight polysomnogram.
Report of Case: The patient is a 41-year-old morbidly obese Caucasian woman with reflex sympathetic dystrophy from a traumatic ulnar compression, treated with a left upper extremity TENS unit. She was evaluated for sleep-disordered breathing in the setting of snoring and chronic daily headache. Her split-night polysomnogram confirmed a diagnosis of severe obstructive sleep apnea with an apnea-hypopnea index of 153 events/hour. On limited electrocardiographic tracings, the patient's cardiac rhythm resembled atrial flutter. However, there were multiple positive deflections that marched independently throughout the entire tracing despite a background identifiable regular sinus rhythm, and these two patterns were clearly dissociated from each other.
Conclusion: Electrocardiographic artifact can result from internal (physiologic) and external (non-physiologic) sources.There are several case reports describing interference from TENS units and implantable defibrillators.TENS as a source of electrocardiographic artifact has been described in several groups of patients, including postoperative cardiac patients and women in labor.Previous studies have revealed the misdiagnosis of artifacts as clinically significant arrhythmias by as many as 94% of internists.Twelve patients in one report underwent invasive intervention because of a misdiagnosed electrocardiographic artifact.These observations highlight the importance of recognizing electrocardiographic artifacts caused by TENS to ensure appropriate patient management.

1335

USE OF UNATTENDED PORTABLE SLEEP APNEA MONITORING IN THE HOSPITAL

Abouhouli H, Masood S, Rauch M
University of New Mexico Sleep Disorders Center, Albuquerque, NM, USA

Introduction: The use of home sleep testing (HST) to diagnose sleep disordered breathing has increased dramatically since Medicare agreed to accept this to confirm the need for CPAP or other reimbursed treatment. Few hospitals have the capability to perform full polysomnography at the bedside but use of HST for OSA diagnosis for inpatients is still being explored. We will discuss a case, which demonstrates the potential benefits of HST for inpatient use.
Report of Case: During the hospital course for a non-related illness, a 40-year-old male endorsed symptoms of morning headaches, nocturnal cough, and waking up gasping for air. The medical staff documented heroic snoring (snoring heard two rooms away) and witnessed apneic events. The patient's vital signs showed BP 150/70, RR 14, HR 90, and an oxyhemoglobin saturation nadir of 88%. His weight was 120 kg/m^2, height 180 cm tall, neck circumference 18 inches and he had a BMI of 37. Pertinent medications included antihypertensives and hypoglycemic drugs. A Type III Portable monitoring device (defined as a minimum of 4 channels) was chosen for use. This unit provided measures of nasal pressure, thermocouple, chest and abdominal effort, snore signal and oximetry. The results of the study indicated an apnea-hypopnea index (AHI) of 29 and an oxygen saturation nadir of 85%. Pre and post study ABGs were obtained to evaluate for hypercapnia as this would necessitate a change in treatment.
The results showed a diagnosis of moderate obstructive sleep apnea and treatment was started with Auto-PAP. A two week follow up demonstrated that his treatment was efficacious.
Conclusion: HST may benefit a select group of inpatients.

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CPAP INDUCED ARRHYTHMIAS: WHEN THE CURE BECOMES THE PROBLEM

Uysal A[1], Wang L[1], McCarty DE[1], Chesson AL[1] , Liendo C[1,2]
[1]Department of Neurology, Louisiana State University Health Sciences Center Sleep Disorders Center, Shreveport, LA, USA, [2]Sleep Disorders Center, Overton Brooks Veterans' Administration Hospital, Shreveport, LA, USA

Introduction: Obstructive sleep apnea (OSA) is well-understood to be an arrhythmogenic condition. Positive Airway Pressure (PAP) is typically felt to decrease the propensity for serious arrhythmias in patients with OSA. We report a case in which PAP was provocative of an atrial arrhythmia.
Report of Case: A 44 year old man with a history of hypertension complained of snoring, daytime fatigue, excessive daytime sleepiness (Epworth Sleepiness Scale score = 12/24) and witnessed apneas. His exam was remarkable for obesity (body mass index = 31) and crowded posterior oropharynx (Mallampati Class III). His baseline electrocardiogram (ECG) was normal, while echocardiogram showed evidence of moderate pulmonary hypertension with right ventricular systolic pressure of 55 mm Hg. A cardiopulmonary sleep study (Embletta® Cardio), showed OSA with an apnea-hypopnea index of 72 events/hour and no arrhythmias.
During a CPAP titration polysomnogram, frequent runs of premature atrial contractions emerged at a treatment pressure which optimally opened the airway (14 cm H2O). Lower pressures were not associated with atrial arrhythmias. A PubMed search for similar cases was performed. One case was described in which a patient developed frequent premature atrial contractions in the setting of PAP therapy, which resolved when therapy was discontinued.
Conclusion: Arrhythmias emerging in the setting of PAP are believed to result from an elevated right atrial preload, leading to increased atrial irritability in predisposed patients. Propensity for arrhythmias appears to increase with higher PAP settings. Lower settings may allow the best balance between airway management and rhythm control in some patients.

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16-YEAR-OLD GIRL WITH RESTLESS LEGS SYNDROME AND ABNORMALLY HIGH FERRITIN

Wang L, Uysal A, Liendo C, Chesson AL
Department of Neurology, LSU Health Sciences Center, Shreveport, LA, USA

Introduction: RLS is a clinical diagnosis, sometimes secondary to medical conditions, including iron deficiency. Complicating co-morbities often create diagnostic and therapeutic challenges.
Report of Case: A 16-year-old girl with a recent 3 month hospitalization for multiple medical problems including fulminating meningococcemia, multi-digit amputations due to purpura fulminans, skin gangrene and acute renal failure, presented to Sleep Clinic post-discharge with severe difficulty sleeping because of the discomfort in her legs and arms. She met all of "URGE" criteria. Her symptoms were so severe that she only obtained a few hours of sleep at the end of each night. On presentation to us, medications prescribed, without therapeutic control by an outside neurologist, were high dose gabapentin, cymbalta, clonazepam, duragesic patch and oral iron. We added ropinirole but that provided limited

improvement. Iron studies revealed hemoglobin 10.9 g/dl, iron 94 ug/dl, TIBC 173 ug/dl, and ferritin 784 ng/ml. She also showed chromic kidney failure and hypercalcimia. What treatment plan would you consider?.

Conclusion: RLS related to functional iron deficiency, associated with renal failure and chronic malnutrition was suspected. Ferritin is a commonly used marker for treatment decisions for RLS; typically <50 ng/ml warrants treatment by most guidelines. The increasing prevalence of multiple comorbidities among anemic patient with chronic kidney disease has made the use of serum ferritin more challenging in this patient group. There is a spectrum of iron deficiency, from absolute iron deficiency to functional iron deficiency that occurs in renal anemia. Our patient had elevated ferritin, which can indicate high iron storage, but also can be associated with extreme function iron deficiency, occurring in acute or chronic infection/inflammation since ferritin is an acute-phase reactant. Our recommendation was IV iron which was instituted in a series of infusions with significant improvement.

1338

FREE-RUNNING CIRCADIAN RHYTHM DISORDER IN AN 18-YEAR-OLD PATIENT WITH FASCIOSCAPULOHUMERAL MUSCULAR DYSTROPHY

Labowsky A[1,2], Canapari C[1,2]
[1]Harvard Medical School, Boston, MA, USA, [2]Massachusetts General Hospital for Children, Boston, MA, USA

Introduction: Free-running sleep disorder (FRSD) is a rare sleep disorder in which a patient's circadian rhythm is not entrained to external time cues. The condition primarily affects those who are blind and seldom occurs in sighted individuals. The sighted patients are typically male, in their teens and have co-morbid psychiatric disorders. We present the case of an 18 year-old sighted male with fascioscapulohumeral muscular dystrophy (FSHD) and depression with FRSD treated with melatonin and behavioral modifications.

Report of Case: An 18-year-old male with FSHD presented to our clinic for further evaluation of his severe restrictive lung disease. He was diagnosed with FSHD at age 10 and had been unable to ambulate independently for many years. He was on sertraline for a history of depression. He was not attending school but was pursuing a GED. He was irritable in clinic which his mother attributed to insomnia since 11 PM the prior evening. On review, he slept between 8 to 12 hours and denied napping during the day or feeling tired. However, his sleep period cycled around the clock. When he returned to clinic several weeks later, a diagnosis of FRD was confirmed based on his sleep diaries. His sleep schedule had advanced each day over a 3-week period. His lack of structure during the day was thought to also be contributing to his sleep pattern. Once he reached an 11 PM-9 AM sleep period, he was started on melatonin and instructed to wake at the same time daily. He was rapidly entrained to an 11pm to 9 am sleep schedule.

Conclusion: This is the only case in the literature of FRD in a patient with FSHD. There have been few reports of successful treatment in these sighted individuals.

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PNEUMOCEPHALUS FOLLOWING THE INITIATION OF BILEVEL POSITIVE PRESSURE THERAPY FOR SEVERE OBSTRUCTIVE SLEEP APNEA IN A PATIENT WITH A HISTORY OF NEUROSURGERY

Spitale N[1], Sinclair J[1,2], Kilty S[1,2], Soucy L[1,2], Leech J[1,2]
[1]The Ottawa Hospital, Ottawa, ON, Canada, [2]The University of Ottawa, Ottawa, ON, Canada

Introduction: The term pneumocephalus describes the presence of air in the cranial cavity. Symptoms of pneumocephalus include dizziness and headache, and in severe cases, seizures, decreased consciousness and death may ensue. Pneumocephalus is a known, but rare complication of non-invasive positive pressure ventilation when used following acute head injuries or immediately after neurosurgery. There is one reported case of the spontaneous development of pneumocephalus in a patient treated with continuous positive pressure (CPAP) for sleep disordered breathing. We report the first case of pneumocephalus that developed after bilevel positive pressure therapy (BiPAP) was started for treatment of obstructive sleep apnea (OSA) in a patient who, several months prior, had a craniotomy.

Report of Case: A fifty-six year old man with a history of a craniotomy was referred for assessment of snoring and witnessed apnea. The patient underwent a Level I Polysomnogram with split night CPAP titration ten months after undergoing neurosurgical intervention for the management of a ruptured aneurysm. He was given the diagnosis of severe OSA with an apnea-hypopnea index of 38.4 per hour. One month later the patient began to use auto-BiPAP (maximum inspiratory pressure of 22cm H_2O and minimal expiratory pressure of 14cm H_2O) using a full facemask. Within weeks, the patient developed a severe headache and sought medical attention. A computed tomography scan of the head demonstrated the presence of extra-axial air in the right cerebral hemisphere, predominately in the frontal region. A defect in the frontal sinus was also noted on imaging studies. BiPAP was discontinued and surgical repair of the defect in the frontal sinus was required.

Conclusion: Pneumocephalus should be considered as a possible complication in patients using positive pressure therapy for sleep disordered breathing. A history of a craniotomy may be a risk factor for the development of pneumocephalus following the initiation of CPAP or BiPAP.

1340

A CASE OF PULMONARY ARTERY HYPERTENSION WITH THE USE OF MODAFINIL

Patel D, Gupta D
NJ Neuroscience Institute at JFK Medical Center, Seton Hall University, Edison, NJ, USA

Introduction: Modafinil is a wakefulness promoting medication used to treat excessive daytime sleepiness associated with narcolepsy, shiftwork disorder or as an adjunct to obstructive sleep apnea (OSA) treatment with CPAP. Some common cardiovascular side effects include hypertension, palpitations and tachycardia We describe the case of a woman who developed Pulmonary Arterial Hypertension (PAH) in association with long term Modafinil use for the treatment of narcolepsy, suggesting a possible non-identified adverse reaction.

Report of Case: A 50-year-old woman being seen at a sleep clinic since 2001 for the treatment of narcolepsy without cataplexy, and was on methylphenidate p.r.n for 16 years, and Modafinil 400 mg for 8 years. She was evaluated by her cardiologist in 2009 for hypertension and nocturnal palpitations, with no prior history of cardiac co-morbidites. A transthoracic echocardiogram (TTE) in November 2009 showed a high-normal pulmonary artery systolic pressure (PASP) of 28mmHg. She was treated with Hydrochlorthiazide and her palpitations improved. A followup TTE on December 2010 showed an elevated PASP of 38mmHg. In February 2011, a diagnostic sleep study ruled out OSA as a contributory factor to PAH with a normal apnea+hypopnea index (AHI) of 0.3/hour. In March 2011, her Modafinil dose was reduced to 200mg and discontinued later that month. Her follow up TTE done in June 2011 showed a decreased PASP of 30mmHg.

Conclusion: PAH has not yet been reported with Modafinil in any clinical tests or case reports until now. Described above is a case of a woman without any significant cardiac history who developed PAH in association with long term Modafinil use. An improvement was seen after discontinuing only Modafinil, which raises the possibility that Modafinil may have played a role in the development of PAH. Further case reports and vigilant cardiac monitoring for patients who present with cardiac symptoms on Modafinil are needed.

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AN UNUSUAL CASE OF SEVERE NARCOLEPSY WITH CATAPLEXY MANAGED WITH THE ASSISTANCE OF A SERVICE DOG

Nikhanj N[1], Wallace J[2]
[1]Cedars Sinai Sleep Medicine Fellowship Program, Los Angeles, CA, USA, [2]Pulmonary, Critical Care and Sleep Medicine, Olive View-UCLA Medical Center, Los Angeles, CA, USA

Introduction: For more than a decade, service dogs have been employed to assist with patients with epilepsy. Indeed, a limited but growing body of evidence suggests that properly trained service dogs may help alert patients of oncoming seizures and reduce their frequency and duration. Anecdotal reports among the general public suggest that service dogs may also be helpful in patients with narcolepsy. As such, the service dog industry has expanded to assist these patients. However, to our knowledge, there have been no reports in the medical literature of such benefit.
Report of Case: We report a case of a 58 year-old female with severe narcolepsy with cataplexy that was formally diagnosed in 2005. She had fragmented care throughout the years, and has been on a variety of medications to help reduce the frequency of her cataplexy attacks with varying success. At their worst, she would endure up to six attacks per hour, resulting in multiple injuries. Additionally, the patient suffered from depression and anxiety, isolating herself from social situations. Two years ago, she adopted a small mixed-breed dog named "Shoebox". Shortly thereafter, it became apparent that Shoebox was able to "sense" the onset of a cataplexy attack, and warn the patient by barking. These warnings allowed her to brace herself and prevent injury. Furthermore, the patient has noted a reduction in the frequency of attacks and injuries since honing in on the cues from her pet. As a result, she has experienced a significant improvement in her quality of life and no longer lives in isolation.
Conclusion: Narcolepsy with cataplexy can be an extremely debilitating disease, particularly in its severest form. Service dogs may provide benefit to these patients, as they do with some epileptics. Further study is needed to validate and elucidate the nature of such benefit.

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A RARE CASE OF LARGE ANTRALCHOANAL POLYP PRESENTING AS OBSTRUCTIVE SLEEP APNEA IN AN ADULT

Patel S, Garetz S
Michael. S. Aldrich Sleep Disorders Center, Department of Neurology and Department of Otolaryngology/Head and Neck Surgery, University of Michigan, Ann Arbor, MI, USA

Introduction: In rare cases, obstructive sleep apnea (OSA) can be caused by upper airway masses.We present an unusual case of a large antralchoanal polyp presenting as obstructive sleep apnea in an adult. Antralchoanal polyps are benign, polypoid lesions arising from the mucosa of maxillary antrum. They most often present in childhood with uni- or bilateral nasal obstruction or rhinorrhea. Three case reports of children with antralchoanal polyps presenting as OSA have been described, but adults presenting with OSA have not been reported to date.
Report of Case: A 26-year-old male presented to our sleep clinic with a 10 year history of loud snoring, severe nasal obstruction and daytime sleepiness. His wife reported witnessed apneas. He was of normal body weight. A baseline polysomnogram revealed OSA with an apnea hypopnea index (AHI) of 8.0, worse in REM sleep. The patient was unable to tolerate CPAP, largely because of nasal obstruction. He was referred to otolaryngology for surgical correction of his OSA and/or nasal obstruction. Flexible nasopharyngoscopy showed a large mass emanating from his left maxillary ostia and almost entirely obstructing his naso-pharynx. A subsequent CT scan demonstrated a polypoid mass originating in the left maxillary antrum and occupying virtually the entire nasopharyngeal lumen compatible with an antrochoanal polyp. The lesion was removed endoscopically. Post-operatively, the patient's snoring and nasal obstruction was significantly decreased and his wife no longer noticed apneic episodes. He endorsed marked improvement in his daytime sleepiness. A post-operative polysomnogram was recommended, but declined due to the resolution of his symptoms.
Conclusion: This represents the first reported case of an adult with antralchoanalpolyp presenting as OSA. The patient had resolution of his symptoms after removal of the mass. Even when dealing with common disease entities such as OSA the hoof beats we hear may occasionally be from zebras.

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NARCOLEPSY IN A PATIENT WITH MULTIPLE SCLEROSIS

Cheng J[1], Ramos AR[1], Wallace DM[1], Abreu AR[2], Shafazand S[2], Dib S[1]
[1]University of Miami, Department of Neurology, Division of Sleep Medicine, Miami, FL, USA, [2]University of Miami, Department of Medicine, Division of Pulmonary, Critical Care and Sleep Medicine, Miami, FL, USA

Introduction: Narcolepsy and multiple sclerosis (MS) are posited to be of autoimmune origin, and share genetic susceptibility. However, literature is limited regarding narcolepsy in individuals with MS. This case describes the clinical and diagnostic features of a patient with MS and narcolepsy.
Report of Case: A 32-year-old woman was referred for evaluation of cataplexy. Five years earlier, she was diagnosed with relapsing-remitting MS after presenting with right hemibody sensory loss. She was started on interferon beta-1a, without further MS exacerbation.Cataplexy began one year ago, and was described as generalized weakness elicited by laughter, startle or fear. The patient also reported seconds-long episodes of sleep paralysis since the age of 20 years, which occurred during the transition from wakefulness to sleep, or sleep to wakefulness. She endorsed daytime sleepiness, with an Epworth Sleepiness Scale of 13. There was no history of sleep attacks or hallucinations. Medications consisted of modafinil and interferon beta-1a. Family history was significant for a cousin with narcolepsy. Neurological examination was normal except for a brisk right patellar reflex. Polysomnography (PSG) did not show evidence of sleep disordered breathing or parasomnia. Sleep efficiency was normal. However, shortened sleep and REM onset latencies were recorded. Subsequent multiple sleep latency testing (MSLT) showed reduced mean sleep latency and 3 of 5 sleep-onset REM periods (SOREMP), meeting narcolepsy diagnostic criteria. Modafinil was continued, and she was started on sodium oxybate for treatment of cataplexy.
Conclusion: MS and narcolepsy with cataplexy demonstrate genetic susceptibility with specific human leukocyte antigen (HLA) subtypes, and share in common multiple haplotypes, including HLA DR2, DQB1, -DQA1, and -DQw1. Symptoms of narcolepsy may occur before or after MS. Given the association between these autoimmune conditions, patients with MS and EDS should be evaluated for narcolepsy, and those with narcolepsy should be assessed for secondary causes, such as MS.

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COMPLEX NOCTURNAL HALLUCINATIONS: A CASE OF CHARLES BONNET SYNDROME

Lipford MC, St. Louis EK
Center for Sleep Medicine and Department of Neurology, Mayo Clinic, Rochester, MN, USA

Introduction: Charles Bonnet Syndrome (CBS) is characterized by nocturnal visual hallucinations in patients with poor vision. Patients maintain insight into the false nature of the hallucinations, and report the visions as non-threatening. We describe a case of CBS initially presenting to the sleep physician.
Report of Case: A 69–year-old male with diabetic retinopathy reports experiencing vivid hallucinations upon waking from sleep. He described

three recurrent hallucinations: a blonde woman standing across the room, large colorful spiders moving across the wall, and a Christmas tree rustling in his closet. There was no recall of associated dream content. He was not frightened by the visions and recognized they were not real. The images disappeared once the patient applied his glasses for closer examination. There was no previous history of psychiatric or neurologic diagnoses. Neurologic examination was normal; Short Test of Mental Status (Kokmen) score was 35/38. Corrected vision with glasses was 20/30 in the right eye and 20/60 in the left eye.
Conclusion: CBS is considered a benign disorder with a reported prevalence ranging from 11-27% in elderly patients with visual loss. CBS manifests with hallucinations occurring at night and in dim lighting. Images are often stereotyped, without personal meaning. Hallucinations are primarily visual in nature, without auditory or tactile components. The pathophysiology of CBS is thought to stem from sensory deprivation (from vision loss) resulting in a cortical release phenomenon. This allows endogenous activation of the visual cortex, leading to hallucinations. Reassurance and optimization of vision are the cornerstones of management. Pharmaceutical interventions may be used in cases where hallucinations are associated with fear or have a negative impact on quality of life. There may be a link between CBS and early dementia, thus follow-up over time is important.

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SEVERE OBSTRUCTIVE SLEEP APNEA IN A PREMATURE INFANT WITH PIERRE ROBIN SEQUENCE AND TETRALOGY OF FALLOT: A CASE REPORT

Chopra A, Lloyd R
Center for Sleep Medicine, Mayo Clinic, Rochester, MN, USA

Introduction: Pierre Robin sequence is characterized by a small mandible and glossoptosis with resultant potentially life threatening airway obstruction and feeding difficulties. We highlight challenges in management of severe OSA in a premature infant Tetralogy of Fallot (TOF).
Report of Case: The patient is a monochorionic-diamniotic twin B delivered via C-section at 33 weeks due to oligohydramnios. Immediately after birth, he was briefly intubated for management of respiratory distress syndrome. Physical examination was significant for 3/6 pansystolic murmur radiating to the axilla and back along with severe micrognathic and retrognathic mandible with posteriorly displaced tongue. He was diagnosed with Pierre Robin Sequence after ENT evaluation for feeding problems. Cardiac work-up revealed Tetralogy of Fallot (TOF). Sleep medicine was consulted for management of intermittent episodes of apnea accompanied by oxygen desaturations in the 50's and 60's (baseline 80's). Overnight diagnostic PSG findings were significant for sleep efficiency of 46%; TST =140 minutes in the supine position; AHI index=56/hr, mainly obstructive apneas and hypopneas and mean O2 saturation of 88%. End tidal CO2 <50 throughout the study and no EEG abnormalities were noted. AHI decreased significantly to 19/hr in prone position; 21/hr in prone position with nasal trumpet; and complete resolution of apnea (AHI=0) was noted on 0.25 LPM O2 supplementation in addition to prone position and nasal trumpet.
Conclusion: Prone positioning alone may be successful in treating sleep disordered breathing in 70% of the patients with Pierre Robin sequence whereas nasopharyngeal airway, tongue-lip adhesion (TLA), floor of mouth release and distraction osteogenesis (DA) may be considered when prone positioning is ineffective. Tracheostomy is performed in 10% of patients with subglottic obstructions from laryngomalacia, tracheomalacia, webs, and central apnea, although it can be associated with morbidity and mortality.

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EFFECTS OF ALCOHOL INGESTION ON HOME SLEEP TESTING, A POTENTIAL CONFOUNDER

Johnson S
University of Wisconsin School of Medicine and Public Health, Madison, WI, USA

Introduction: Alcohol dependence and abuse are common clinical problems and can effect the severity of snoring, sleep disordered breathing and nocturnal hypoxemia. These effects are typically not observed during attended in-lab polysomnography. However, with the advent of home sleep testing, the effects of alcohol on sleep studies may become more commonplace. Here we report a case of un-reported alcohol consumption altering a home cardiopulmonary sleep study assessment.
Report of Case: A 36-year-old man with a past medical history of seasonal allergic rhinitis, mild asthma and depression is referred for evaluation of socially disruptive snoring. The patient did not report complaints of witnessed apnea or daytime sleepiness and his Epworth Sleepiness Scale score was 7/24 and BMI was 29 kg/m2. He was referred for home sleep testing to rule out obstructive sleep apnea. Home sleep testing revealed a respiratory disturbance index (RDI) of 10.7 events per hour of recording, nadir SaO2 of 81% and time with SaO2 ≤ 88% of 65.3 minutes all of which occurred within the first 90 minutes of recording. Given the level of nocturnal hypoxemia in an otherwise healthy individual, follow-up attended polysomnogram was performed which revealed an apnea + hypopnea index (AHI) of 1.7 per hour of sleep, average SaO2 of 94%, nadir SaO2 of 89% and no time spent with SaO2 ≤ 88%. Clinical history taken during follow-up revealed previously unreported regular nightly alcohol intake of 3-6 standard alcoholic beverages prior to sleep, including the night of the home sleep test, which was the likely cause of discrepant findings between in-laboratory and home testing.
Conclusion: The use of alcohol during home sleep testing is a potentially significant confounding factor and may alter diagnostic results and treatment decisions with regard to sleep disordered breathing. Careful screening for alcohol consumption is essential for patients undergoing home sleep testing.

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CENTRAL SLEEP APNEA IN A 24-YEAR-OLD MALE

De Cruz S[1], Wang T[1], Pope W[2], Zeidler M[1]
[1]Division of Pulmonary, Critical Care, and Sleep Medicine, University of California at Los Angeles, Los Angeles, California, USA, [2]Division of Neuroradiology, University of California at Los Angeles, Los Angeles, California, USA

Introduction: Central sleep apnea (CSA) is a complex disorder associated with neurologic and cardiac diseases as well as narcotic use. Chiari malformation, a rare cause of CSA, is characterized by herniation of the cerebellum with variable severity through the foramen magnum. While CSA is well recognized in this disease, it rarely occurs independent of other neurological symptoms (1). We present the case of a patient with central CSA as the sole symptom of Chiari malformation who received definitive treatment with surgical decompression.
Report of Case: A 24-year-old male was seen in sleep consultation for excessive daytime sleepiness and nocturnal apneic episodes. Two years prior he complained of loud snoring and daytime sleepiness. Outside polysomnogram (PSG) showed severe CSA with few obstructive events. Central events increased with positive airway pressure. The patient underwent uvulopalatopharyngoplasty. Repeat PSG showed persistent CSA. Physical examination revealed a thin male with mallampati of I. Neurologic exam was normal. Magnetic resonance imaging of the brain was performed showing Chiari I malformation. The patient underwent posterior fossa decompression with resolution of his CSA and improvement in daytime functioning.
Conclusion: During sleep, autonomic respiratory control is essential. This system relies on the brainstem which generates ventilatory patterns

and processes input from respiratory afferents, chemoreceptors, intrapulmonary and upper airway receptors. Additionally, the efferent nervous system involving cranial nerves IX and X in the brainstem control muscles related to inspiration and expiration (2). It is speculated that CSA in Chiari malformation is related to compression of the brainstem resulting in depression of respiratory afferents, and efferents leading to sleep disordered breathing. This case illustrates that central sleep apnea in young otherwise healthy adults should raise concern for brainstem compression. When recognized, surgical intervention can lead to cure of CSA in Chiari malformations.

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ATYPICAL TREATMENT FOR REM BEHAVIOR DISORDER

De Dios JA, Hardin, KA
Department of Internal Medicine, Division of Pulmonary, Critical Care, and Sleep, University of California–Davis, Sacramento, CA, USA

Introduction: REM behavior disorder (RBD) is a neuro-pathologic disorder characterized by loss of REM atonia with violent behavior during sleep. There is limited evidence describing the efficacy of a wide range of medications. Usual treatment includes REM suppressing medications and inhibition of motor neurons with clonazepam. However in patients who fail therapy, additional treatment may require atypical medications.
Report of Case: A 62-year-old man with RBD, obstructive sleep apnea (OSA), and severe depression on venlafaxine was referred for persistent violent behavior despite usual drug therapy with tricyclic antidepressant (TCA), melatonin, and clonazepam. Each of these therapies exacerbated his symptoms. Venlafaxine dosage was reduced and clonazepam was increased from 0.5mg to 2 mg with decreased violent behaviors, but increased daytime sleepiness. Carbamazepine was subsequently initiated. Clonazepam is postulated to inhibit the brainstem locomotor generators. The mechanism of melatonin is unknown, but decreases REM without atonia. SSRI's and TCA's activate REM-off cells, which inhibit REM-on cells and alter the balance between the two systems. Depending on the combined effect of their various neurotransmitters (NT), this can result in a decrease in REM without atonia or decreased inhibition of motor neurons and worsen RBD in some individuals. Alternative drugs may be useful. Carbamazepine can also change NT and is most useful in patients with co-existing depression. Yin-Gan San is an herbal medication that seems to exert its' effect via $GABA_A$ and serotonergic properties. GABA leads to REM-on cells activation resulting to increased motor inhibition. Lastly, sodium oxybate may decrease RBD through its $GABA_B$ enhancement of N3 sleep.
Conclusion: RBD is a complex neuro-pathologic process involving a balance between serotonin, dopamine, and acetylcholine. Commonly used agents for REM suppression may not be effective and necessitate other medications, such as carbamazepine, herbal medication, and sodium oxybate.

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TREATING INSOMNIA USING COGNITIVE-BEHAVIORAL THERAPY IN PARKINSON'S DISEASE: A CASE STUDY

Kay D
Clinical Psychology, University of Florida, Gainesville, FL, USA

Introduction: Insomnia is twice as prevalent among patients with Parkinson's disease (PD) as age-matched peers. Debate persists on whether cognitive-behavioral treatment of insomnia (CBTi) can treat insomnia in neurological conditions believed to predispose insomnia such as PD. Nevertheless, CBTi may be effective in these patients.
Report of Case: Patient was a 72-year-old, married, Caucasian male who presented at a behavioral sleep medicine clinic in an academic medical setting with a 10-year history of chronic insomnia (DSM-IV-TR: 307.42) and adjustment disorder-mixed emotions (DSM-IV-TR: 309.28) associated with recent PD diagnosis. Treatment goals were to reduce daytime sleepiness, improve sleep initiation, and help patient manage emotional difficulties surrounding his PD diagnosis. Treatment involved 4 sessions of CBTi including sleep hygiene, stimulus control, sleep restriction, and relaxation. Treatment for adjustment disorder included psychoeducation on PD, facilitation of communication with caregiver, and cognitive therapy. Patient was motivated and adhered to treatment recommendations as prescribed. Patient self-initiated a tapered withdrawal from chronic use of a sleep aid. Although he reported gradual improvement to sleep onset latency, quality, and efficiency during treatment, changes were not observed in sleep diary and actigraphy measures immediately following treatment. Patient's sleep medications withdrawal may have obscured observable sleep improvements. He also reported improved adjustment to his PD diagnosis. At 2-month follow-up, patient reported continued satisfaction with treatment outcomes. In addition, sleep diaries showed a 6% increase in sleep efficiency and clinically significant reduction in insomnia events (<2 nights per week).
Conclusion: Many PD patients require numerous medications but are amenable to behavioral treatments for non-motor symptoms (e.g., insomnia) to minimize taking "another pill". A modified-CBTi approach may be effective in treating co-morbid insomnia and concurrent emotional difficulties common to PD. Dopamine depletion may disrupt sleep homeostatic and arousal processes. Nevertheless, CBTi may mitigate the impact of these predisposing factors in PD.

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RESOLUTION OF CENTRAL SLEEP APNEAS DUE TO CHEYNE STOKES BREATHING PATTERN AFTER TREATMENT WITH TOPIRAMATE

Vaou O, Pyatkevich-Gorfinkel Y, Vendrame M, Auerbach S
Neurology, Boston Medical Center, Boston, MA, USA

Introduction: Cheyne-Stokes breathing pattern is characterized by recurrent apneas, hypopneas, or both apneas and hypopneas alternating with prolonged hyperpneas with crescendo decrescendo pattern. It is often encountered in patients with heart failure. Several different treatments aimed at central sleep apnea include positive airway pressure, adaptive servo ventilation (ASV), oxygen, added dead space, carbon dioxide inhalation, and overdrive atrial pacing.
Report of Case: We present a 64 year old male with a past medical history of coronary artery disease, congestive heart failure and hypertension who was diagnosed with central sleep apnea due to Cheyne-Stokes and obstructive sleep apnea (OSA) after a baseline polysomnogram. He did not tolerate CPAP or ASV titration. Based on anecdotal case reports of Topiramate's effectiveness on treating central apnea, the patient was started on Topiramate 50mg before bedtime. Shortly after Topiramate was initiated, the patient reported that his sleep had improved with decreased daytime somnolence. A follow up polysomnogram was performed 3 months following initiation of Topiramate and revealed complete resolution of central apnea as well as mild improvement of OSA. His baseline polysomnogram recorded 124 central apneas and the follow up polysomnogram showed 0 central apneas.
Conclusion: Carbonic anhydrase inhibitors (CAI), such as Acetazolamide, can be effective therapy in central sleep apnea. It presumably acts by inducing bicarbaturia and metabolic acidosis, which may shift the apneic threshold of PaCO2 to a lower level. Topiramate also has CAI properties. It is therefore our hypothesis that it may act in a similar way to treat central apneas. Further clinical studies are needed to study the effects of Topiramate on central sleep apnea in patients with congestive heart failure as well as patients with opiate use.

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ELECTRO CONVULSION THERAPY (ECT) IMPROVES SLEEP EFFICIENCY IN AN AUTISTIC CHILD: A CASE REPORT OF ACTIGRAPHY MONITORING.

Marambage K[1,2], Zafarlotfi S[1,2], Sun Y[1], Caracci G[1]
[1]Psychiatry, New Jersey Medical School, Newark, NJ, USA, [2]Sleep Medicine, Hackensack University Medical Center, Hackensack, NJ, USA

Introduction: Sleep problems in children with Autism Spectrum Disorder (ASD) occur in an estimated 40–80% of patients. Clinical manifestations of such sleep disruptions are: (1) resistance to going to bed on time, (2) difficulty initiating sleep, (3) frequent / prolonged night-time awakenings or early morning awakenings (4) irregularity in sleep / wake cycles, and (5) poor sleep efficiency. Currently, there is no highly effective treatment in the management of self injurious behavior or sleep problems in Autistic children. We report a case that describes ECT efficacy for both self-injurious behavior and sleep efficiency in childhood ASD.
Report of Case: A 13-year-old Caucasian male with ASD, received extended ECT every two weeks to control severe self injurious behavior. Actigraphy monitoring was done to assess both daytime and sleep activity. Actigraphic analysis over a two week period revealed that the patient's sleep was improved by the ECT. Sleep efficiency peaked at 97.26% on the night right after ECT. His sleep efficiency gradually declined to 86.10% at the night right before his next ECT session. The number of awakenings and wake-time after sleep onset (WASO) were consistent with this same pattern.
Conclusion: ECT appears to improve sleep efficiency in autistic children as measured by Actigraphy monitoring. ECT may be another option in treating an Autistic patient's behavior and sleep problems, in extreme cases. Further studies of Actigraphy monitoring and related measures are warranted.

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PARADOXICAL INSOMNIA: A PRECURSOR TO MANIA?

Kumar M, Stanley JJ
Michael S. Aldrich Sleep Disorders Center, University of Michigan, Ann Arbor, MI USA

Introduction: Paradoxical insomnia may predate the development of manic mood disturbance and serve as an early warning sign of future mania or bipolar affective disorder, as outlined by this case.
Report of Case: Patient L, a 57-year-old married male presented to the sleep clinic with a chief concern regarding a reduction in his total sleep time (TST) to 4hours/night over the last one year. He also described a highly variable sleep onset latency and wake after sleep onset time with previous normal sleep duration. He reported several periods of up to 72 hours without any sleep. His wife stated she had observed him in bed, quietly sleeping, during these periods of self-described environmental awareness. There were no complaints of daytime somnolence and daytime impairment was limited to mild changes in his short term memory. Two weeks before his evaluation, he described a period of suicidal ideation followed by several days of expansive mood and hyperactivity, resulting in psychiatric hospitalization and a diagnosis of mania.
Physical examination: BMI 22.9; Friedman palate position II; Neck circumference 15 inches. Polysomnography: No sleep disordered breathing. TST - 279min, Stage N1 - 8%, Stage N2 - 50%, Stage N3 - 0%, Stage R - 21%.The patient reported no subjective sleep. A diagnosis of paradoxical insomnia was given to the patient.
Conclusion: Subjective lack of sleep is a common complaint and insomnia is a useful clinical indicator of the onset of new (or relapse of existing) mood disorders, particularly depression. Paradoxical insomnia is an uncommon condition characterized by a subjective complaint of severe insomnia without evidence of objective sleep disturbance and without daytime impairment commensurate with the degree of the reported sleep deficit. The significance of this condition remains poorly understood. Paradoxical insomnia may serve as a marker for the future development of mania, as observed in this patient.

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VAGUS NERVE STIMULATION AND SLEEP: AN INDICATION FOR POLYSOMNOGRAM?

Lowenstein H, Shamim-Uzzaman A
Michael S. Aldrich Sleep Disorders Center, University of Michigan, Ann Arbor, MI, USA

Introduction: Epilepsy and obstructive sleep apnea (OSA) frequently coexist and use of vagus nerve stimulation (VNS) as adjunctive treatment for partial epilepsy is typically well tolerated. Recent evidence suggests that VNS affects nocturnal respirations and has been shown to worsen pre-existing OSA. Our case outlines how it can also complicate treatment of OSA.
Report of Case: Patient R is a 22-yo man with mild static encephalopathy and medically intractable partial epilepsy who experiences excessive daytime sleepiness, witnessed apneas, and snoring. He was diagnosed with OSA in 2001, apnea-hypopnea index (AHI) 6.1, and underwent adenotonsillectomy with uvuloplasty. Repeat polysomnogram (PSG) with esophageal manometry in 2003 demonstrated persistent sleep-disordered breathing (SDB)--AHI 1.3 and excessively negative esophageal pressures. Continuous positive airway pressure (CPAP) of 5 cm of water was initiated based on titration study results. Subsequently, he underwent VNS implantation in 2008 for intractable epilepsy. PSG in 2010 (post VNS implantation) demonstrated OSA (AHI 22.3), with obstructive apneas occurring almost exclusively during VNS activation, set at 30s on-3 min off-20 Hz. Subsequent titration study performed with the VNS firing rate reduced to 30s on-5 min off-20 Hz did not find an effective pressure between 4-12 cm of water to treat the SDB; however, most of the scored respiratory events were now hypopneas (in contrast to obstructive apneas noted on the previous study), still in a 1:1 association with VNS firing.
Conclusion: VNS activation worsens sleep disordered breathing and makes CPAP titration a challenge. Apneas and hypopneas are found to occur more frequently during VNS activation than during non-activation. This may also lead to difficulty in treating the sleep disordered breathing. Therefore, baseline PSG prior to and following VNS implantation should be considered. Further investigation is needed regarding CPAP titration in patients with VNS.

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ANOREXIA AS A FEATURE IN KLEINE-LEVIN SYNDROME

Gangal KS, Hoban T
Michael S. Aldrich Sleep Disorders Center, Department of Neurology, University of Michigan, Ann Arbor, MI, USA

Introduction: Kleine-Levin syndrome (KLS) is a rare disorder characterized by recurrent episodic hypersomnia with associated behavioral abnormalities[1]. It predominantly affects males, causing symptoms for 2 days to 4 weeks, and classically includes features of hyperphagia, hypersexuality, autonomic symptoms, cognitive impairment, altered perception, and psychological changes.
Report of Case: The patient is an otherwise healthy 22-year-old man with attention deficit hyperactivity disorder (ADHD) who presented with cyclical episodes of hypersomnolence at age 15. During his episodes, he spends 7-20 days sleeping 20-23 hours a day. He is preoccupied with sex. He fears darkness and seeks comfort from his parents. He has a difficult time maintaining oral intake must be coaxed into eating; normally, he has a healthy appetite. He was on methylphenidate for ADHD but reports that taking it during the episodes triggered anxiety, while other symptoms remained unchanged. The patient had an extensive work-up. Evaluation with an MRI of the brain with specific attention to the hypothalamus was normal. Prolonged monitoring with electroencephalogra-

phy during an episode did not show epileptiform discharges. When the patient was at his baseline, he had a polysomnogram that showed an apnea-hypopnea index (AHI) of 0.10 events/hour and multiple sleep latency testing (MSLT) that demonstrated three sleep-onset REM (SOREM) periods with a sleep onset latency (SOL) of 10.4 minutes. During one of his hypersomnia episodes, he had another polysomnogram that revealed an AHI of 5.8 events/hour and MSLT performed that demonstrated five SOREMs and a SOL of 2.2 minutes.
Conclusion: KLS is classically linked with hyperphagia, but a case series showed that 34% of KLS patients had associated anorexia[2]. Atypical features within a global pattern of recurrent hypersomnia should not deter clinicians from a diagnosis of KLS[3]. Furthermore, polysomnography, while not diagnostic, can provide useful information to assess for other sleep disturbances and highlight ictal and interictal differences.

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A CASE OF HYPERSOMNOLENCE IN CHROMOSOME 8P23 DUPLICATION SYNDROME

Lysenko L, Riar S, Bhat S, Chokroverty S
NJ Neuroscience Institute at JFK Medical Center, Edison, NJ, USA

Introduction: We report a case of hypersomnolence in chromosome 8p23 duplication syndrome in a 13 year-old boy.
Report of Case: A 13-year-old boy, born prematurely, who was later found to have mental retardation, right sided hemiparesis, and bilateral sensorineural hearing loss, presented with hypersomnolence with sudden, uncontrollable urges to sleep, vivid nightmares, hypnapompic hallucinations and sleep paralysis without cataplexy, that he had had for many years. He had a prior history of sleepwalking, as well as night terrors, which had resolved. His physical exam was remarkable for tachycardia, noted on several occasions. His neurological examination was remarkable for difficulty with tracking and convergence, spasticity of the lower extremities (right more than left), mild cogwheel rigidity at the wrists, athetoid movements noticed in outstretched hands with occasional jerking component, intention tremor and cerebellar dysmetria in the upper extremities. MSLT findings were consistent with hypersomnolence without sleep onset REM periods; there was no evidence of obstructive sleep apnea on polysomnography. MRI of the brain was unremarkable. 12 lead EKG was normal. Echocardiogram revealed some stranding in the myocardium (nonspecific finding). Genetic test revealed 8p23 duplication. The patient's mother also tested positive for this and had hearing loss, but no mental deficits.
Conclusion: 8p23 duplication, initially believed to be a benign euchromatic variant with no clinical manifestation, was later found to have variable clinical manifestations, including congenital heart defects. Some individuals with 8p23 duplication remain phenotypically normal. Hypersomnolence has never yet been described as a feature of 8p23 duplication syndrome. We propose that hypersomnolence could be one of the presenting features of 8p23 duplication syndrome.

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COMPLEX BEHAVIOR IN OBSTRUCTIVE SLEEP APNEA (OSA) IN A PATIENT WITH MEDICAL COMORBIDITIES; A DIAGNOSTIC DILEMMA

Lysenko L, Bhat S, Patel D, Chokroverty S
NJ Neuroscience Institute at JFK Medical Center, Edison, NJ, USA

Introduction: We report a case of complex behavior in sleep with multiple etiologies in a patient with medical comorbidities.
Report of Case: A 49-year-old diabetic woman with a prior history of OSA, noncompliant with continuous positive airway pressure (CPAP) use, was referred for an episode of sleep violence. She had been dreaming that she was stuck in a barrel as the world was ending, and was trying to escape; in a state of confusion she got out of bed and destroyed property in five rooms, ran out of the house and threw stones at a neighbor's windows and then ran back upstairs at which point she awoke amazed, without recollection of the event. Her eyes were open during the event. During polysomnography (PSG), she displayed complex movements at the termination of respiratory events. These consisted of rotation, abduction-adduction, flexion-extension and ballistic posturing of the limbs and flexion-extension of the trunk, as well as sitting up confused, drinking soda, pulling wires, fiddling with clothing, tapping her abdomen and scratching limbs. On her second PSG study, these movements were eliminated with CPAP treatment. However, towards the end of that night, she became confused, pulled off her CPAP mask, had dystonic-ballistic limb movements, and then developed diaphoresis and tachycardia. Her EEG showed theta-delta slowing. She was found to be severely hypoglycemic and responded satisfactorily to intravenous dextrose. She had no subsequent recall of these events. She later admitted to frequent nocturnal hypoglycemia, caused by taking higher doses of insulin in the evenings when she forgot her afternoon doses.
Conclusion: This case illustrates that complex movements and sleep violence may have multiple etiologies, causing acute and urgent events during PSG studies that necessitate immediate interventions.

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ANALYSIS OF SLEEP STATE DEPENDENCY AND DURATION OF PARTIAL SEIZURES FROM INTRACRANIAL EEG RECORDINGS

Chopra A[1], Brinkman B[2], Worell G[2], St. Louis E[1,2]
[1]Sleep Medicine, Mayo Clinic, Rochester, MN, USA, [2]Neurology, Mayo Clinic, Rochester, MN, USA

Introduction: Intracranial electroencephalography is utilized to identify cortical regions critical for seizure onset for surgical localization, and yields precise information concerning seizure onset and offset, lending toward more confident estimation of seizure duration. NREM sleep may activate both interictal epileptiform discharges (IEDs, "spikes") and ictal events (seizures), while REM sleep typically restricts these phenomena. Previous studies have also suggested that sleep state influences seizure duration, and that seizures arising from NREM sleep last longer than wake or REM sleep state seizures. We aimed to analyze sleep stages and seizure durations related to partial seizures from intracranial EEG recordings.
Report of Case: Intracranial EEG recordings were obtained from a patient with medically refractory partial seizures with surgically implanted depth electrodes stereotactically targeted to clinically relevant brain areas. Sleep–wake stages recorded through scalp EEG were categorized as wake, N1, N2, N3, and REM sleep per AASM criteria, and seizure onset/offset were estimated by an epileptologist. The patient had 4 partial onset seizures recorded from the right hemisphere. One seizure arose from wakefulness at 1300 hours, lasting 36 seconds in duration. The remaining three seizures arose from light NREM sleep, one from N1 at 2120 hours of 38 second duration, and two from N2 at 0140 and 0240 hours, lasting 230 and 46 seconds, respectively.
Conclusion: In this preliminary analysis, partial seizures arose most frequently from NREM sleep, and NREM sleep seizures lasted longer than a seizure from wakefulness. Further analyses of more patients is planned to confirm this finding, with additional analysis of other epileptogenic phenomena seen only during intracranial EEG recordings, including high frequency oscillations (HFOs) and microseizure events.

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