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SCIENTIFIC INVESTIGATIONS

Trends and Determinants of Time in Bed in Geneva, Switzerland

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Study Objectives: There is limited information regarding sleep duration and determinants in Switzerland. We aimed to assess the trends and determinants of time in bed as a proxy for sleep duration in the Swiss canton of Geneva.

Methods: Data from repeated, independent cross-sectional representative samples of adults (≥ 18 years) of the Geneva population were collected between 2005 and 2011. Self-reported time in bed, education, monthly income, and nationality were assessed by questionnaire.

Results: Data from 3,853 participants (50% women, 51.7 ± 10.9 years) were analyzed. No significant trend was observed between 2005 and 2011 regarding time in bed or the prevalence of short (≤ 6 h/day) and long (> 9 h/day) time in bed. Elderly participants reported a longer time in bed (year-adjusted mean ± standard error: 7.67 ± 0.02, 7.82 ± 0.03, and 8.41 ± 0.04 h/day for 35-50, 50-65, and 65+ years, respectively, p < 0.001), while shorter time in bed was reported by non-Swiss participants (7.77 ± 0.03 vs. 7.92 ± 0.03 h/day for Swiss nationals, p < 0.001), participants with higher education (7.92 ± 0.02 for non-university vs. 7.74 ± 0.03 h/day for university, p < 0.001) or higher income (8.10 ± 0.04, 7.84 ± 0.03, and 7.70 ± 0.03 h/day for < 5,000 SFr; 5,000-9,500 SFr, and > 9,500 SFr, respectively, p < 0.001). Multivariable-adjusted polytomous logistic regression showed short and long time in bed to be positively associated with obesity and negatively associated with income.

Conclusion: In a Swiss adult population, sleep duration as assessed by time in bed did not change significantly between 2005 and 2011. Both clinical and socioeconomic factors influence time in bed.

Keywords: sleep, trends, adult, population-based study, socioeconomic status, Switzerland.

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Short sleep duration has been associated with obesity, cardiovascular disease, and overall mortality.[1-3] A decrease in sleep duration in the general population has been reported in some studies but not in others.[4,5] A common assertion is that there is a trend toward fewer hours of sleep in most industrialized countries.[6,7] Still, a recent review showed that self-reported sleep duration increased in seven countries and decreased in six others, and that the absolute changes were very small: increases ranged from 0.1 to 1.7 min per night each year, while decreases ranged from 0.1 to 0.6 min per night each year.[8] Another study conducted in adults from 10 industrialized countries showed an increase in the percentage of long (> 9 h/day) but not of short (≤ 6 h/day) sleepers.[9] For instance, in the USA, the percentage of short sleepers fell from 11.7% in 1985 to 9.2% in 2007, while the corresponding values for long sleepers were 26.3% and 37.5%; in the Netherlands, the percentage of short sleepers increased from 0.4% in 1975 to 0.8% in 2005, while the corresponding values for long sleepers were 22.2% and 25.7%.[9]

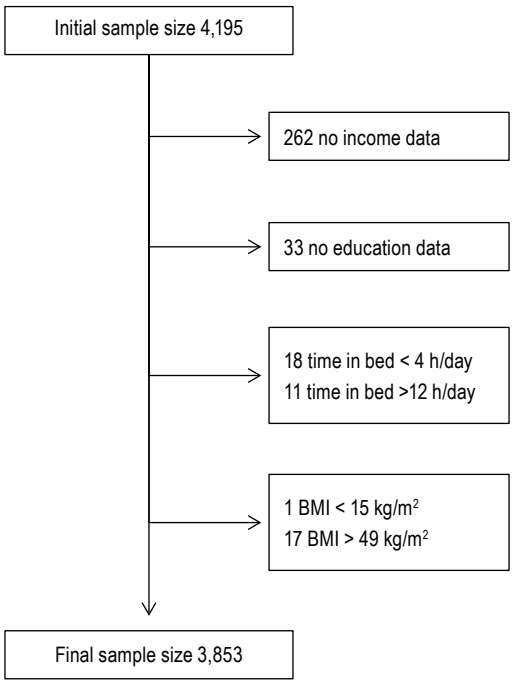
Many socioeconomic factors such as low income, low educational level, or belonging to a minority ethnic group are positively associated with short sleep.[10,11] A study conducted in the USA showed over one hour difference in sleep duration between whites and African/Caribbean immigrants.[12] Similarly, low household income people present more insomnia-related symptoms than others.[13] Switzerland is a European country characterized with a high socioeconomic status,[14] but little is known regarding how sleep has evolved and of its associations with socioeconomic status and obesity. Hence, we analyzed seven-year (2005-2011) trends in time in bed (as a proxy for sleep duration) and in the prevalence of short and long time in bed in a representative population sample. The clinical and socioeconomic determinants of time in bed were also assessed.

BRIEF SUMMARY

Current Knowledge/Study Rationale: There is conflicting data whether sleep duration has decreased in the general population. We aimed at assessing trends and socioeconomic determinants of time in bed (as a proxy for sleep duration) in a representative sample of an adult population of a Swiss canton.

Study Impact: This study adds further weight to the proponents that time in bed did not decrease in the general population. It also adds new information regarding the importance of socioeconomic traits in time in bed.

Figure 1—Exclusion procedure.



MATERIALS AND METHODS

Recruitment

The Bus Santé study is a cross-sectional, population-based study conducted in the Swiss Canton of Geneva. The study was approved by the Ethical Committee of the Canton of Geneva, and a complete description has been published elsewhere.[15] Each year, a representative sample of approximately 1,000 adults (500 men and 500 women) living in the Canton of Geneva is drawn. The study is conducted in 3 locations (2 in the Geneva University Hospitals and one medical mobile unit). Canton Geneva has a high frequency (41%) of non-Swiss nationals, and 40% of Swiss residents are from other cantons (www.ge.ch/statistique/domaines/apercu.asp?dom=01_02_1).

Data Collected

Self-reported sleep duration was collected by questionnaire, where the participants indicated the usual time they went to bed and the usual time of waking up. All questionnaires were checked by trained collaborators. Sleep duration was computed as the time spent in bed, a method also used in other studies.[16-18] Indeed, time in bed is easier to report and has shown an adequate correlation with sleep time calculated by actigraphy.[19] Conversely, no information was available regarding time spent in bed without sleeping, and no data on depression, anxiety, or sleep complaints was collected. Time in bed was further classified as short (≤ 6 h/day) or long (> 9 h/day).[9,20] A second classification using different thresholds for short (≤ 7 h/day) and long (> 10 h/day) time in bed was also applied. The number of participants with a very short time in bed (< 5 h) was only 26 for the entire study period, and 44 after including participants with < 4 h of bed time. Hence, no category of very short time in bed was created.

Socioeconomic status included education (university level yes/no) and income, classified into < 5,000 SFr, 5,000-9,500 SFr, and > 9,500 SFr (to convert to US$, multiply by 1.137; to convert to European €, multiply by 0.8218). For comparison, a common definition of poverty in Switzerland corresponds to a monthly income < 2,243 CHF for a single adult or < 3,990 CHF for a couple with 2 children.[21] Demographic data included Swiss nationality (yes/no). Smoking status was classified into never, former (irrespective of time since quitting), and current smokers. Body mass index (BMI) was calculated from measured weight and height. Hypertension was defined as systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg and/or presence of antihypertensive drug treatment; dyslipidemia was defined as the presence of a hypolipidemic drug treatment; diabetes was defined as fasting glucose ≥ 7.0 mmol/L or non-fasting glucose ≥ 10 mmol/L and/or presence of an antidiabetic drug treatment. As participants were examined during the whole day, it was not possible to have them all in the fasting state.

Participants were excluded if they had missing data, if their self-reported time in bed was < 4 or > 12 h/day, or if their BMI was < 15 or > 49 kg/m^2.

Statistical Analysis

Statistical analyses were conducted using Stata version 12.0 for windows (Stata Corp, College Station, Texas, USA). Descriptive results were expressed as number of participants (percentage) or as average ± standard deviation. Bivariate analyses were performed using χ^2 or Fisher exact test for qualitative variables and Student t-test, analysis of variance, or Kruskal-Wallis test for quantitative variables. Trends were assessed using linear regression for quantitative data and logistic regression separately for short and long sleepers (*vs.* reference category) as reported previously.[9] Determinants of short or long time in bed were assessed using polytomous logistic regression (*mlogit* command of Stata) using the "normal" group as reference; the results were expressed as relative risk ratios (RRR) and 95% confidence interval (CI). For quantitative data, multivariable analysis was performed using analysis of variance and the results were expressed as multivariable-adjusted mean ± standard error. Statistical significance was assessed for $p < 0.05$.

RESULTS

Characteristics of Included and Excluded Participants

Of the initial 4,195 participants, 295 (7.0%) were excluded because of missing data for income or educational level, 29 (0.7%) because of self-reported time in bed < 4 or > 12 h/day, and 18 (0.4%) because of a BMI < 15 or > 49 kg/m^2 (**Figure 1**). Compared to participants retained for analysis, excluded participants were older, more frequently women, and had a lower educational level, while no differences were found regarding smoking status, nationality, or income (**Table S1**, supplemental material).

The clinical characteristics according to gender and survey year of the 3,853 participants retained for analysis are summarized in **Table 1**. No change occurred during the study period regarding the distribution of gender, age group, smoking status,

Table 1—Characteristics of non–excluded participants according to survey year.

	2005	2006	2007	2008	2009	2010	2011	p value
N	188.0	225.0	251.0	434.0	950.0	936.0	869.0	
Women (%)	50.5	45.3	49.0	49.5	51.6	49.6	50.6	0.78
Age (years)	51.8 ± 11.3	51.1 ± 11.2	51.7 ± 11.1	51.5 ± 11.1	51.4 ± 10.8	52.2 ± 11.1	51.5 ± 10.8	0.68
Body mass index (kg/m^2)	25.0 ± 4.2	25.1 ± 3.8	25.1 ± 4.3	24.9 ± 4.1	25.0 ± 4.0	25.5 ± 4.5	25.3 ± 4.3	0.15
Body mass index categories (%)								
Normal	54.3	52.9	55.8	56.5	53.4	51.7	53.5	
Overweight	36.2	37.3	34.3	31.3	36.2	33.6	32.9	0.15
Obese	9.6	9.8	10.0	12.2	10.4	14.7	13.6	
University level (%)	38.8	35.6	45.4	43.1	40.8	43.8	47.0	< 0.05
Smoking status (%)								
Never	45.2	41.8	48.6	44.9	44.3	47.2	45.8	
Former	30.9	33.8	29.9	33.4	33.9	32.5	34.4	0.85
Current	23.9	24.4	21.5	21.7	21.8	20.3	19.8	
Swiss (%)	53.7	56.9	50.6	55.1	51.3	50.8	49.5	0.49
Income category (%) §								
< 5,000 SFr	24.5	23.6	15.9	20.1	21.2	22.4	19.7	
5,000 – 9,500 SFr	46.3	41.3	41.4	42.9	39.8	41.0	39.4	0.12
> 9,500 SFr	29.3	35.1	42.6	37.1	39.1	36.5	41.0	

Results are expressed as mean ± standard deviation or as percentage. Statistical analysis by ANOVA or χ^2. § to convert to Euro, multiply by 0.8218; to convert to US$, multiply by 1.137.

Table 2—Trends in reported time in bed and in the prevalence of short and long time in bed for the Geneva canton, 2005-2011.

	2005	2006	2007	2008	2009	2010	2011	p value
N	188	225	251	434	950	936	869	
Reported time in bed (h/day)	7.7 ± 1.1	7.8 ± 1.1	7.8 ± 1.2	7.9 ± 1.1	7.9 ± 1.1	7.8 ± 1.1	7.8 ± 1.1	0.54
Time in bed – classification 1								
Short (≤ 6 h/day)	16 (8.5)	21 (9.3)	16 (6.4)	29 (6.7)	51 (5.4)	71 (7.6)	64 (7.4)	0.69
Reference (> 6 and ≤ 9 h/day)	155 (82.5)	185 (82.2)	211 (84.0)	367 (84.5)	801 (84.3)	789 (84.3)	741 (85.3)	
Long (> 9 h/day)	17 (9.0)	19 (8.5)	24 (9.6)	38 (8.8)	98 (10.3)	76 (8.1)	64 (7.4)	0.25
Time in bed – classification 2								
Short (≤ 7 h/day)	70 (37.2)	64 (28.5)	75 (29.9)	115 (26.5)	243 (25.6)	252 (26.9)	235 (27.0)	0.03
Reference (> 7 and ≤ 10h/day)	116 (61.7)	158 (70.2)	171 (68.1)	311 (71.7)	692 (72.8)	672 (71.8)	623 (71.7)	
Long (> 10 h/day)	2 (1.1)	3 (1.3)	5 (2.0)	8 (1.8)	15 (1.6)	12 (1.3)	11 (1.3)	0.65

Results are expressed as mean ± standard deviation or as number of participants and (percentage). Statistical analysis of trends using linear regression for reported time in bed. Trends in short and long time in bed were assessed separately using logistic regression and the same reference category.

nationality, income category, or BMI group, while the percentage of participants with a university level tended to increase.

Trends in Time in Bed

Trends in reported time in bed, short and long time in bed are reported in **Table 2**. No significant change in reported time in bed was observed. Similarly, no significant trend was found for the prevalence of short (≤ 6 h/day), or long (> 9 h/day, p = 0.25) time in bed. When the thresholds for short and long time in bed were increased to ≤ 7 and > 10 h/day, respectively, a significant decrease in the prevalence of short time in bed was found (**Table 2**).

Determinants of Time in Bed

The associations between time in bed or prevalence of short and long time in bed and the participants' clinical and socioeconomic characteristics are summarized in **Table 3**. After adjusting for survey year, women, elderly, never smokers, and Swiss nationals reported longer time in bed, while participants with university level or with high income reported shorter time in bed.

Women, elderly participants, and Swiss nationals had a higher prevalence of long time in bed and a lower prevalence of short time in bed. Obese participants had a higher prevalence of both short and long time in bed. Participants with a university degree or a high income had a lower prevalence of long time in bed. These findings were replicated when the thresholds to define short and long time in bed were increased or after multivariable adjustment (**Table 4**). Further analysis of all participants with available data did not change the results (**Table S2**, supplemental material).

DISCUSSION

To our knowledge, this is one of the few studies assessing trends and determinants of time in bed in a representative

Table 3—Reported time in bed and prevalence of short and long time in bed according to the characteristics of the participants, Geneva canton.

	Time in bed		Classification 1 (h/day)				Classification 2 (h/day)			
	h/day	p	≤ 6	> 6 and ≤ 9	> 9	p	≤ 7	> 7 and ≤ 10	> 10	p
Overall	7.84 ± 1.10		268 (6.9)	3,249 (84.3)	336 (8.7)		1,054 (27.4)	2,743 (71.2)	56 (1.5)	
Gender										
Men (n = 1,924)	7.68 ± 0.02	< 0.001	188 (9.8)	1,612 (83.8)	124 (6.4)	< 0.001	637 (33.1)	1,263 (65.6)	24 (1.3)	< 0.001
Women (n = 1,929)	8.01 ± 0.02		80 (4.1)	1,637 (84.9)	212 (11.0)		417 (21.6)	1,480 (76.7)	32 (1.7)	
Age group										
35 – 50 (n = 1,858)	7.67 ± 0.02		153 (8.2)	1,606 (86.5)	99 (5.3)		569 (30.6)	1,277 (68.7)	12 (0.7)	
50 – 65 (n = 1,390)	7.82 ± 0.03	< 0.001	101 (7.3)	1,167 (83.9)	122 (8.8)	< 0.001	402 (28.9)	965 (69.4)	23 (1.7)	< 0.001
65+ (n = 605)	8.41 ± 0.04		14 (2.3)	476 (78.7)	115 (19.0)		83 (13.7)	501 (82.8)	21 (3.5)	
Body mass index categories										
Normal (n = 2,062)	7.84 ± 0.02		120 (5.8)	1,787 (86.7)	155 (7.5)		528 (25.6)	1,512 (73.3)	22 (1.1)	
Overweight (n = 1,318)	7.84 ± 0.03	0.69	105 (7.9)	1,087 (82.5)	126 (9.6)	< 0.001	376 (28.5)	924 (70.1)	18 (1.4)	< 0.001
Obese (n = 473)	7.88 ± 0.05		43 (9.1)	375 (79.3)	55 (11.6)		150 (31.7)	307 (64.9)	16 (3.4)	
Smoking status										
Never (n = 1,757)	7.88 ± 0.03		109 (6.2)	1,497 (85.2)	151 (8.6)		444 (25.3)	1,292 (73.5)	21 (1.2)	
Former (n = 1,279)	7.87 ± 0.03	< 0.001	87 (6.8)	1,072 (83.8)	120 (9.4)	0.13	346 (27.1)	907 (70.9)	26 (2.0)	< 0.01
Current (n = 817)	7.72 ± 0.04		72 (8.8)	680 (83.2)	65 (8.0)		264 (32.3)	544 (66.6)	9 (1.1)	
Educational level										
Non-university (n = 2,193)	7.92 ± 0.02	< 0.001	145 (6.6)	1,811 (82.6)	237 (10.8)	< 0.001	570 (26.0)	1,581 (72.1)	42 (1.9)	< 0.005
University (n = 1,660)	7.74 ± 0.03		123 (7.4)	1,438 (86.6)	99 (6.0)		484 (29.2)	1,162 (70.0)	14 (0.8)	
Income category (SFr) §										
< 5,000 (n = 808)	8.10 ± 0.04		59 (7.3)	619 (76.6)	130 (16.1)		196 (24.3)	586 (72.5)	26 (3.2)	
5,000 – 9,500 (n = 1,574)	7.84 ± 0.03	< 0.001	115 (7.3)	1,330 (84.5)	129 (8.2)	< 0.001	421 (26.7)	1,133 (72.0)	20 (1.3)	< 0.001
> 9,500 (n = 1,471)	7.70 ± 0.03		94 (6.4)	1,300 (88.4)	77 (5.2)		437 (29.7)	1,024 (69.6)	10 (0.7)	
Swiss national										
No (n = 1,812)	7.77 ± 0.03	< 0.001	158 (8.7)	1,512 (83.5)	142 (7.8)	< 0.001	545 (30.1)	1,241 (68.5)	26 (1.4)	< 0.001
Yes (n = 1,917)	7.92 ± 0.03		96 (5.0)	1,639 (85.5)	182 (9.5)		466 (24.3)	1,423 (74.2)	28 (1.5)	

§ to convert to Euro, multiply by 0.8218; to convert to US$, multiply by 1.137. Results are expressed as calendar year-adjusted mean ± standard error or as number (row percentage). Statistical analysis by analysis of variance or χ^2.

sample of the Swiss canton of Geneva. Our results indicate that time in bed did not change during the study period (2005-2011) and that several clinical and socioeconomic factors significantly influence time in bed. The results add to the current knowledge of the association between time in bed and socioeconomic and demographic factors.

Trends in Time in Bed

Neither total time in bed nor the proportion of participants reporting short and long time in bed changed during the period 2005-2011. This finding is in agreement with some studies[8,22] but not with others.[4,23] A Finnish study found 18 minutes' decrease in self-reported sleep duration in a 33-year time interval, but the proportion of short sleep remained stable.[4] It is possible that our study spanned too few years to observe significant changes; the ongoing data collection of the Bus Santé study will allow a better assessment within several years.

Determinants of Time in Bed

The effect of gender on sleep duration is still a matter of debate.[11,13,24] In this study, women reported longer time in bed, reported less frequently a short time in bed, and more frequently a long time in bed than men. Our results thus suggest that women tend to report longer time in bed than men, although objectively measured sleep data are needed to confirm our findings.

Contrary to other studies,[25,26] elderly participants reported longer time in bed; they also had a lower frequency of short time in bed and a higher frequency of long time in bed. A lower prevalence of insufficient sleep among elderly subjects had also been reported in the behavioral risk factor surveillance system.[27] A possible explanation is that retired people stay longer in bed without sleeping, thus overestimating their true sleep time. Indeed, changes in quality, quantity, and architecture of the sleep appear during aging so that elderly are less able to initiate and maintain sleep.[28]

There is an ongoing debate on the association between obesity and short or long sleep.[29] Short sleep duration might be associated to endocrine and metabolic changes,[30] which in turn favor the development of obesity. In this study, no association was found between obesity and reported time in bed. Conversely, obesity was positively associated with both short and long time in bed irrespective of the thresholds used. This U-shaped association has been described previously for other cardiovascular risk factors, such as hypertension, type 2 diabetes,

Table 4—Multivariable analysis of determinants of reported time in bed and prevalence of short and long time in bed, Geneva canton.

	Time in bed		Classification 1 (h/day)				Classification 2 (h/day)			
	h/day	p	≤ 6 h/day	p*	> 9 h/day	p*	≤ 7 h/day	p*	> 10 h/day	p*
Year			0.99 (0.91–1.07)	0.75	0.98 (0.91–1.05)	0.55	0.95 (0.90–0.99)	< 0.05	0.96 (0.81–1.13)	0.64
Gender										
Men	7.69 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Women	8.00 ± 0.02	< 0.001	0.44 (0.33–0.58)	< 0.001	1.74 (1.35–2.24)	< 0.001	0.58 (0.50–0.68)	< 0.001	1.15 (0.64–2.04)	0.64
Age group										
35 – 50	7.71 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
50 – 65	7.83 ± 0.03	< 0.001	0.95 (0.72–1.25)	0.70	1.53 (1.15–2.04)	< 0.005	0.94 (0.80–1.11)	0.49	2.04 (0.99–4.19)	0.06
65+	8.35 ± 0.05		0.30 (0.17–0.53)	< 0.001	2.82 (2.06–3.87)	< 0.001	0.38 (0.29–0.50)	< 0.001	2.54 (1.17–5.50)	< 0.05
p value for trend			< 0.001		< 0.001		< 0.001		< 0.01	
BMI categories										
Normal	7.85 ± 0.02		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Overweight	7.86 ± 0.03	0.83	1.24 (0.92–1.67)	0.15	1.30 (0.99–1.70)	0.06	1.11 (0.94–1.32)	0.21	1.11 (0.57–2.17)	0.76
Obese	7.82 ± 0.05		1.60 (1.08–2.37)	< 0.05	1.35 (0.95–1.92)	0.10	1.51 (1.19–1.91)	0.001	2.57 (1.28–5.16)	< 0.01
p value for trend			< 0.05		< 0.05		0.001		0.01	
Smoking status										
Never	7.89 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Former	7.86 ± 0.03	0.02	1.14 (0.84–1.55)	0.42	1.10 (0.84–1.44)	0.48	1.11 (0.93–1.31)	0.26	1.69 (0.92–3.10)	0.09
Current	7.75 ± 0.04		1.40 (1.00–1.95)	0.05	0.98 (0.71–1.35)	0.89	1.34 (1.10–1.62)	< 0.005	1.05 (0.46–2.35)	0.92
p value for trend			< 0.05		0.96		< 0.005		0.52	
Educational level										
Non-university	7.88 ± 0.02		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
University	7.81 ± 0.03	0.07	1.20 (0.90–1.59)	0.21	0.75 (0.57–0.98)	< 0.05	1.08 (0.92–1.27)	0.33	0.70 (0.36–1.36)	0.29
Income category (SFr.)										
< 5,000	7.98 ± 0.04		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
5,000 – 9,500	7.84 ± 0.03	< 0.001	0.82 (0.58–1.16)	0.26	0.58 (0.44–0.77)	< 0.001	0.99 (0.80–1.22)	0.92	0.54 (0.29–1.02)	0.06
> 9,500	7.78 ± 0.03		0.63 (0.43–0.93)	< 0.05	0.46 (0.33–0.64)	< 0.001	1.06 (0.85–1.32)	0.63	0.37 (0.16–0.86)	< 0.05
p value for trend			< 0.05		< 0.001		0.29		< 0.05	
Swiss national										
No	7.78 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Yes	7.91 ± 0.02	< 0.001	0.62 (0.47–0.81)	< 0.001	1.18 (0.93–1.51)	0.17	0.77 (0.66–0.90)	0.001	0.97 (0.55–1.68)	0.90

BMI, body mass index; SFr, Swiss Francs. Results are expressed as multivariate-adjusted relative risk ratio and (95% confidence interval) using the reference group (non-short, non-long time in bed). * Test for the individual relative risk. Statistical analysis of trends by polytomous logistic regression.

and also for cardiovascular disease and overall mortality.[31-34] It is possible that these associations between obesity and sleep might be due to different mechanisms: longer sleep durations might be a marker of low physical activity (which is associated with obesity), while short sleep durations might influence obesity via endocrine and metabolic changes.[30] Overall, our results suggest a U-shaped association between obesity and time in bed.

Smoking status has been associated with both short[11,24] and long[24] sleep. In this study, current smokers reported shorter time in bed and had a higher likelihood of reporting short time in bed. Possible explanations are the impact of nicotine on sleep duration[35] or that smoking is a surrogate marker of stress, which has also been associated with short sleep time.[24]

Low educational level has been associated with lower sleep duration[13,36]; another study found low educational level to be negatively associated with both short and long sleep.[26] In this study, participants with a university degree had a lower likelihood of reporting long time in bed, but this association was no longer significant when the threshold to define long time in bed was increased. Overall, our results suggest that educational level does not influence time in bed in the Geneva population.

Lower income has been associated with poor sleep quality[37] and a higher prevalence of sleep complaints.[20] In this study, income was negatively associated with reported time in bed in both bivariate and multivariable analyses. Interestingly, participants with an income > 9,500 SFr had lower prevalence of short and long time in bed, but no difference was found when the threshold to define short time in bed was set at ≤ 7 hours/day. Our results do not confirm previous findings from a Finnish study,[13] where a lower income was associated with short sleep duration, but are in agreement with a Chinese study,[26] where higher income was inversely associated with both short and long sleep duration. It is possible that participants with a higher income have longer working hours or adopt a lifestyle that leads to shorter time in bed.[38] After further adjusting for cardiovascular risk factors, a similar trend between income and time in bed was observed, i.e., participants in the highest income group tended to report less time in bed, although some RRRs were no longer significant (**Table S3**, supplemental material). Still, these results should be considered with some caution due to possible health care renunciations in the lowest income group[39,40] and to misclassification for some cardiovascular risk factors due to non-fasting status.

There are few studies focusing on sleep duration or sleep quality among migrants.[41] In this study, Swiss nationals reported longer time in bed than foreigners; Swiss nationals also had a lower likelihood of reporting short time in bed, irrespective of the threshold applied. These findings are in agreement with two studies conducted in the USA where minority ethnic groups (African Americans) had shorter sleep duration,[10,12] although this statement has been questioned.[20] Possible explanations include living in a noisy environment, shift work, or higher work demands.[41] Still, as there was no information regarding the living environment of the participants, further studies are needed to identify the factors associated with shorter reported time in bed among migrants in Switzerland.

In this study, most factors associated with short time in bed were non-modifiable. Still, participants reporting short time in bed with a high income could be sensitized to the fact that poor sleep is associated with annual productivity losses of almost 2,000 US$,[42] and that increasing sleep duration could actually lead to a further increase in their wealth.

Study Limitations

This study has several limitations. First, time in bed was self-reported, and a reporting bias cannot be excluded, such as participants with a higher income tending to report shorter periods in bed as a long time in bed might not be socially acceptable. It has also been shown that the correlation between objectively and subjectively measured sleep duration is rather weak,[43] and direct data on sleep quantity and quality were not available. Second, time in bed (and not sleep duration) was used; still, time in bed seems to be an adequate proxy for sleep duration as reasonable correlation between sleep time calculated by actigraphy and reports for bedtimes and wake times has been shown.[19] Other studies also assessed sleep duration using the same methodology[16-18]; this method might also be less prone to bias, as it does not require mental calculations (contrary to calculating sleep duration) and no normative values exist.[44] Furthermore, as the evaluation method for time in bed was the same for all participants and did not change during the study period, it is unlikely that our results regarding the lack of trend or the determinants of time in bed are biased. Finally, no data were collected on sleepiness, insomnia, or obstructive sleep apnea, so it was not possible to assess their prevalence or to associate time in bed with other sleep related symptoms.

CONCLUSION

Between 2005 and 2011, no changes were found regarding time in bed (as a proxy for sleep duration) or the prevalence of short or long sleepers in the adult Geneva population. Several clinical (gender, age, body mass index), behavioral (smoking), and socioeconomic (income, migrant status) factors significantly influence time in bed.

REFERENCES

1. Xiao Q, Arem H, Moore SC, Hollenbeck AR, Matthews CE. A large prospective investigation of sleep duration, weight change, and obesity in the NIH-AARP Diet and Health Study Cohort. *Am J Epidemiol* 2013;178:1600-10.
2. Chandola T, Ferrie JE, Perski A, Akbaraly T, Marmot MG. The effect of short sleep duration on coronary heart disease risk is greatest among those with sleep disturbance: a prospective study from the Whitehall II cohort. *Sleep* 2010;33:739-44.
3. Mesas AE, Lopez-Garcia E, Leon-Munoz LM, Guallar-Castillon P, Rodriguez-Artalejo F. Sleep duration and mortality according to health status in older adults. *J Am Geriatr Soc* 2010;58:1870-7.
4. Kronholm E, Partonen T, Laatikainen T, et al. Trends in self-reported sleep duration and insomnia-related symptoms in Finland from 1972 to 2005: a comparative review and re-analysis of Finnish population samples. *J Sleep Res* 2008;17:54-62.
5. Aadahl M, Andreasen AH, Hammer-Helmich L, Buhelt L, Jorgensen T, Glumer C. Recent temporal trends in sleep duration, domain-specific sedentary behaviour and physical activity. A survey among 25-79-year-old Danish adults. *Scand J Public Health* 2013; 41:706-11.
6. Akerstedt T, Nilsson PM. Sleep as restitution: an introduction. *J Intern Med* 2003;254:6-12.
7. Ferrie JE, Shipley MJ, Cappuccio FP, et al. A prospective study of change in sleep duration: associations with mortality in the Whitehall II cohort. *Sleep* 2007;30:1659-66.
8. Bin YS, Marshall NS, Glozier N. Secular trends in adult sleep duration: a systematic review. *Sleep Med Rev* 2012;16:223-30.
9. Bin YS, Marshall NS, Glozier N. Sleeping at the limits: the changing prevalence of short and long sleep durations in 10 countries. *Am J Epidemiol* 2013;177:826-33.
10. Stamatakis KA, Kaplan GA, Roberts RE. Short sleep duration across income, education, and race/ethnic groups: population prevalence and growing disparities during 34 years of follow-up. *Ann Epidemiol* 2007;17:948-55.
11. Magee CA, Iverson DC, Caputi P. Factors associated with short and long sleep. *Prev Med* 2009;49:461-7.
12. Ertel KA, Berkman LF, Buxton OM. Socioeconomic status, occupational characteristics, and sleep duration in African/Caribbean immigrants and US White health care workers. *Sleep* 2011;34:509-18.
13. Lallukka T, Sares-Jaske L, Kronholm E, et al. Sociodemographic and socioeconomic differences in sleep duration and insomnia-related symptoms in Finnish adults. *BMC Public Health* 2012;12:565.
14. Central Intelligence Agency. The World Factbook 2013-14. Washington, DC: Central Intelligence Agency, 2013.
15. Guessous I, Bochud M, Theler JM, Gaspoz JM, Pechere-Bertschi A. 1999-2009 Trends in prevalence, unawareness, treatment and control of hypertension in Geneva, Switzerland. *PLoS One* 2012;7:e39877.
16. Gale C, Martyn C. Larks and owls and health, wealth, and wisdom. *BMJ* 1998;317:1675-7.
17. Amagai Y, Ishikawa S, Gotoh T, et al. Sleep duration and mortality in Japan: the Jichi Medical School Cohort Study. *J Epidemiol* 2004;14:124-8.
18. Cohen-Mansfield J, Perach R. Sleep duration, nap habits, and mortality in older persons. *Sleep* 2012;35:1003-9.
19. Monk TH, Buysse DJ, Kennedy KS, Pods JM, DeGrazia JM, Miewald JM. Measuring sleep habits without using a diary: the sleep timing questionnaire. *Sleep* 2003;26:208-12.
20. Grandner MA, Patel NP, Gehrman PR, et al. Who gets the best sleep? Ethnic and socioeconomic factors related to sleep complaints. *Sleep Med* 2010;11:470-8.
21. Office Fédéral de la Statistique. La pauvreté en Suisse. La pauvreté monétaire de la population résidante de la Suisse, de 2008 à 2010. Federal Office of Statistics, 2012.
22. Bin YS, Marshall NS, Glozier NS Secular changes in sleep duration among Australian adults, 1992-2006. *Med J Aust* 2011;195:670-2.
23. Rowshan Ravan A, Bengtsson C, Lissner L, Lapidus L, Bjorkelund C. Thirty-six-year secular trends in sleep duration and sleep satisfaction, and associations with mental stress and socioeconomic factors--results of the Population Study of Women in Gothenburg, Sweden. *J Sleep Res* 2010;19:496-503.
24. Ryu SY, Kim KS, Han MA. Factors associated with sleep duration in Korean adults: results of a 2008 community health survey in Gwangju metropolitan city, Korea. *J Korean Med Sci* 2011;26:1124-31.
25. Bjorkelund C, Bengtsson C, Lissner L, Rodstrom K. Women's sleep: longitudinal changes and secular trends in a 24-year perspective. Results of the population study of women in Gothenburg, Sweden. *Sleep* 2002;25:894-6.
26. Tu X, Cai H, Gao YT, et al. Sleep duration and its correlates in middle-aged and elderly Chinese women: the Shanghai Women's Health Study. *Sleep Med* 2012;13:1138-45.
27. Liu Y, Croft JB, Wheaton AG, et al. Association between perceived insufficient sleep, frequent mental distress, obesity and chronic diseases among US adults, 2009 behavioral risk factor surveillance system. *BMC Public Health* 2013;13:84.

28. Espiritu JR. Aging-related sleep changes. *Clin Geriatr Med* 2008;24:1-14.
29. Marshall NS, Glozier N, Grunstein RR. Is sleep duration related to obesity? A critical review of the epidemiological evidence. *Sleep Med Rev* 2008;12:289-98.
30. Bjorvatn B, Sagen IM, Oyane N, et al. The association between sleep duration, body mass index and metabolic measures in the Hordaland Health Study. *J Sleep Res* 2007;16:66-76.
31. Wang Q, Xi B, Liu M, Zhang Y, Fu M. Short sleep duration is associated with hypertension risk among adults: a systematic review and meta-analysis. *Hypertens Res* 2012;35:1012-8.
32. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Quantity and quality of sleep and incidence of type 2 diabetes: a systematic review and meta-analysis. *Diabetes Care* 2010;33:414-20.
33. Cappuccio FP, Cooper D, D'Elia L, Strazzullo P, Miller MA. Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. *Eur Heart J* 2011;32:1484-92.
34. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. *Sleep* 2010;33:585-92.
35. Jaehne A, Unbehaun T, Feige B, Lutz UC, Batra A, Riemann D. How smoking affects sleep: a polysomnographical analysis. *Sleep Med* 2012;13:1286-92.
36. Gellis LA, Lichstein KL, Scarinci IC, et al. Socioeconomic status and insomnia. *J Abnorm Psychol* 2005;114:111-8.
37. Patel NP, Grandner MA, Xie D, Branas CC, Gooneratne N. "Sleep disparity" in the population: poor sleep quality is strongly associated with poverty and ethnicity. *BMC Public Health* 2010;10:475.
38. Nathan N, Zeitzer J. A survey study of the association between mobile phone use and daytime sleepiness in California high school students. *BMC Public Health* 2013;13:840.
39. Guessous I, Gaspoz JM, Theler JM, Wolff H. High prevalence of forgoing healthcare for economic reasons in Switzerland: a population-based study in a region with universal health insurance coverage. *Prev Med* 2012;55:521-7.
40. Wolff H, Gaspoz JM, Guessous I. Health care renunciation for economic reasons in Switzerland. *Swiss Med Wkly* 2011;141:w13165.
41. Tsai SY. A study of the health-related quality of life and work-related stress of white-collar migrant workers. *Int J Environ Res Public Health* 2012;9:3740-54.
42. Rosekind MR, Gregory KB, Mallis MM, Brandt SL, Seal B, Lerner D. The cost of poor sleep: workplace productivity loss and associated costs. *J Occup Environ Med* 2010;52:91-8.
43. Lauderdale DS, Knutson KL, Yan LL, Liu K, Rathouz PJ. Self-reported and measured sleep duration: how similar are they? *Epidemiology* 2008;19:838-45.
44. Kurina LM, McClintock MK, Chen JH, Waite LJ, Thisted RA, Lauderdale DS. Sleep duration and all-cause mortality: a critical review of measurement and associations. *Ann Epidemiol* 2013;23:361-70.

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SUPPLEMENTAL MATERIAL

Table S1—Characteristics of included and excluded participants.

	Included	Excluded	p value
N	3,853.0	342.0	
Women (%)	50.1	60.5	< 0.001
Age (years)	51.7 ± 10.9	54.2 ± 10.9	< 0.001
University level (%)	43.1	33.0	0.001
Smoking status (%)			
Never	45.6	50.3	
Former	33.2	29.8	0.24
Current	21.2	19.9	
Swiss (%)	51.4	50.8	0.82
Income category (%)			
< 5,000 SFr	21.0	25.0	
5,000 – 9,500 SFr	40.9	31.2	0.22
> 9,500 SFr	38.2	43.8	

Results are expressed as mean ± standard deviation or as percentage. Statistical analysis by t-test or χ^2.

Table S2—Multivariable analysis of determinants of reported time in bed and prevalence of short and long time in bed, Geneva canton, all participants with available data.

	Time in bed		Classification 1 (h/day)				Classification 2 (h/day)			
	h/day	p	≤ 6 h/day	p*	> 9 h/day	p*	≤ 7 h/day	p*	> 10 h/day	p*
Year			0.99 (0.91–1.07)	0.76	0.98 (0.92–1.05)	0.61	0.95 (0.90–0.99)	0.02	0.95 (0.82–1.11)	0.54
Gender										
Men	7.68 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Women	7.98 ± 0.03	< 0.001	0.46 (0.35–0.60)	< 0.001	1.68 (1.31–2.16)	< 0.001	0.58 (0.5–0.68)	< 0.001	1.02 (0.61–1.72)	0.94
Age group										
35 – 50	7.69 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
50 – 65	7.82 ± 0.03	< 0.001	0.94 (0.72–1.23)	0.65	1.53 (1.16–2.03)	0.003	0.94 (0.80–1.11)	0.46	1.92 (1.01–3.64)	0.05
65+	8.32 ± 0.05		0.37 (0.22–0.61)	< 0.001	2.83 (2.07–3.85)	< 0.001	0.40 (0.30–0.51)	< 0.001	2.47 (1.23–4.94)	0.011
p value for trend			0.001		< 0.001		< 0.001		0.004	
BMI categories										
Normal	7.84 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Overweight	7.84 ± 0.03	0.94	1.23 (0.93–1.64)	0.15	1.26 (0.96–1.64)	0.09	1.12 (0.94–1.32)	0.21	0.94 (0.51–1.74)	0.84
Obese	7.82 ± 0.06		1.55 (1.05–2.27)	0.03	1.35 (0.96–1.90)	0.09	1.49 (1.18–1.89)	0.001	2.22 (1.17–4.21)	0.02
p value for trend			0.02		0.04		0.002		0.03	
Smoking status										
Never	7.86 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Former	7.87 ± 0.03	0.06	1.08 (0.80–1.46)	0.63	1.13 (0.87–1.47)	0.371	1.09 (0.92–1.29)	0.33	1.72 (0.97–3.06)	0.07
Current	7.74 ± 0.04		1.47 (1.07–2.02)	0.02	1.06 (0.78–1.46)	0.701	1.36 (1.12–1.65)	0.002	1.60 (0.81–3.16)	0.18
p value for trend			0.02		0.58		0.001		0.09	
Educational level										
Non-university	7.86 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
University	7.81 ± 0.03	0.21	1.14 (0.86–1.50)	0.36	0.75 (0.58–0.98)	0.04	1.07 (0.91–1.26)	0.38	0.75 (0.42–1.37)	0.35
Income category (SFr.)										
< 5,000	7.96 ± 0.05		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
5,000 – 9,500	7.83 ± 0.03	0.01	0.81 (0.58–1.13)	0.22	0.58 (0.44–0.77)	< 0.001	0.98 (0.80–1.21)	0.86	0.56 (0.31–1.00)	0.05
> 9,500	7.78 ± 0.03		0.62 (0.43–0.90)	0.02	0.46 (0.33–0.64)	< 0.001	1.04 (0.84–1.30)	0.71	0.41 (0.19–0.86)	0.02
p value for trend			0.02		< 0.001		0.36		0.02	
Swiss national										
No	7.78 ± 0.03		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Yes	7.89 ± 0.03	0.005	0.64 (0.49–0.83)	0.001	1.16 (0.92–1.47)	0.21	0.77 (0.67–0.90)	0.001	0.89 (0.54–1.49)	0.67

BMI, body mass index; SFr, Swiss Francs. Results are expressed as multivariable-adjusted relative risk ratio and (95% confidence interval) using the reference group (non-short, non-long time in bed). * Test for the individual relative risk. Statistical analysis of trends by polytomous logistic regression.

Table S3—Multivariable analysis of determinants of prevalence of short and long time in bed, Geneva canton, adjusting for cardiovascular risk factors.

	Classification 1 (h/day)				Classification 2 (h/day)			
	≤ 6 h/day	p*	> 9 h/day	p*	≤ 7 h/day	p*	> 10 h/day	p*
Year	0.95 (0.81–1.11)	0.49	1.05 (0.92–1.19)	0.46	0.90 (0.82–0.98)	0.02	0.98 (0.72–1.34)	0.92
Gender								
Men	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Women	0.58 (0.32–1.05)	0.07	2.34 (1.49–3.68)	< 0.001	0.52 (0.38–0.71)	< 0.001	0.86 (0.30–2.50)	0.78
Age group								
35 – 50	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
50 – 65	0.88 (0.49–1.57)	0.65	2.17 (1.10–4.29)	0.03	1.02 (0.73–1.44)	0.90	NA	
65+	0.47 (0.18–1.24)	0.13	3.33 (1.58–7.04)	< 0.001	0.49 (0.30–0.81)	0.01	NA	
p value for trend	0.13		< 0.001		0.03			
BMI categories								
Normal	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Overweight	1.14 (0.62–2.10)	0.68	1.82 (1.11–3.00)	0.02	1.07 (0.76–1.50)	0.68	1.82 (0.43–7.70)	0.42
Obese	2.03 (0.98–4.21)	0.06	1.33 (0.72–2.47)	0.36	1.60 (1.04–2.47)	0.03	3.67 (0.84–16.1)	0.08
p value for trend	0.09		0.20		0.054		0.06	
Smoking status								
Never	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Former	1.31 (0.70–2.48)	0.40	1.10 (0.69–1.75)	0.68	1.36 (0.98–1.91)	0.07	3.59 (0.95–13.6)	0.06
Current	2.45 (1.26–4.80)	0.01	0.91 (0.50–1.67)	0.77	1.77 (1.20–2.62)	0.00	4.30 (0.88–20.9)	0.07
p value for trend	0.008		0.90		0.003		0.051	
Educational level								
Non-university	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
University	1.27 (0.72–2.25)	0.41	0.83 (0.51–1.34)	0.44	1.00 (0.73–1.38)	0.98	0.52 (0.14–2.02)	0.35
Income category (SFr.)								
< 5,000	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
5,000 – 9,500	0.68 (0.34–1.39)	0.29	0.56 (0.34–0.92)	0.02	1.17 (0.78–1.76)	0.45	0.87 (0.28–2.71)	0.81
> 9,500	0.90 (0.43–1.86)	0.77	0.55 (0.30–1.00)	0.05	1.48 (0.95–2.29)	0.08	0.45 (0.08–2.58)	0.37
p value for trend	0.96		0.04		0.03		0.49	
Swiss national								
No	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Yes	0.52 (0.30–0.90)	0.02	1.04 (0.68–1.58)	0.86	0.79 (0.59–1.05)	0.11	1.12 (0.40–3.15)	0.83
Hypertension								
No	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Yes	1.18 (0.64–2.17)	0.59	1.19 (0.74–1.90)	0.48	0.83 (0.59–1.17)	0.29	3.85 (1.01–14.8)	0.05
Diabetes								
No	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Yes	0.40 (0.11–1.42)	0.16	1.33 (0.70–2.51)	0.38	0.81 (0.46–1.43)	0.47	0.87 (0.22–3.44)	0.85
Hypolipidemic drug treat.								
No	1.00 (ref.)		1.00 (ref.)		1.00 (ref.)		1.00 (ref.)	
Yes	0.72 (0.38–1.36)	0.31	1.40 (0.87–2.24)	0.16	0.88 (0.62–1.25)	0.49	0.49 (0.16–1.48)	0.21

BMI, body mass index; SFr, Swiss Francs. Results are expressed as multivariable-adjusted relative risk ratio and (95% confidence interval) using the reference group (non-short, non-long time in bed). * Test for the individual relative risk. Statistical analysis of trends by polytomous logistic regression.