SUPPLEMENTARY MATERIAL

**Prevalence of sleep disordered breathing in an African general population: the Benin Society and Sleep (BeSAS) study**

Ablo Prudence Wachinou1,2,3, Corinne Houehanou3,4, Serge Ade5, Terence Totah3, Mathieu Berger6, Geoffroy Solelhac6, Salmane Amidou3, Attanon Arnauld Fiogbe2, Frederic Alovokpinhou2, Philipe Lacroix7, Pierre-Marie Preux7, Pedro Marques-Vidal 8, Gildas Agodokpessi1,2, Dismand Houinato1,3, Raphael Heinzer6

1Faculty of Health Sciences, University of Abomey-Calavi, Cotonou, Benin

2National Teaching Hospital for Tuberculosis and Pulmonary Diseases, Cotonou, Benin

3Laboratory of Epidemiology of Chronic and Neurologic Diseases, Faculty of Health Sciences, University of Abomey-Calavi, Cotonou, Benin

4National School of Public Health (ENATSE), University of Parakou

5Faculty of Medicine, University of Parakou, Parakou, Benin

6Center of Investigation and Research on Sleep (CIRS), University Hospital of Lausanne (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland

7INSERM, University of Limoges, CHU Limoges, IRD, U1094 Tropical Neuroepidemiology, Institute of Epidemiology and Tropical Neurology, Limoges, France

8Department of Internal Medicine, University Hospital of Lausanne (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland

**Figure S1. Estimated risk for hypertension and diabetes associated with the severity of sleep-disordered breathing (SDB).**

Diamonds represent the odds ratio and bars the 95% confidence interval (CI). If bars cross the dotted line at 1·0, risk is not statistically significant. Groups with an apnoea-hypopnoea index (AHI) of 5–14 events/hour (mild SDB), 15–29 events/hour (moderate SDB) or ≥30 events/hour (severe SDB) were compared with the reference group (AHI <5 events/hour). p-values are for trend across SDB severity groups. Model 1 was adjusted for age, living area; model 2 = model 1 + alcohol and tobacco consumption; model 3 = Model 2 + BMI; and model 4 = Model 3 + neck circumference and abdominal obesity.



AHI

AHI

*0***·***842*

*p=0***·***689*

*p=0*·*289*

*p=0***·***2916*



*p=0*·*162*

*p=0*·*154*

***p<0*·*001***

***p<0*·*001***

**Table S1. Baseline clinical and demographic data for participants who underwent polygraphy compared with those without polygraphy data in the Benin Society and Sleep (BeSAS) study.**

|  |  |  |  |
| --- | --- | --- | --- |
|   | **Participants with polygraphy (n=1810)** | **Participants with no or invalid polygraphy (n=1099)** | **p-value** |
| Male participants | 647 (35·8%) | 482 (43·9%) | <0·001a |
| Age (years), mean (SD) | 45·7 (14·8) | 44·7 (14·5) | 0·076 |
| BMI (kg/m2), median (IQR) | 23·6 (20·6-27·8) | 24·2 (21·3-28·6) | 0·005b |
| Neck circumference (cm), median (IQR) | 34 (32-37) | 35 (33-38) | <0·001b |
| Waist circumference (cm), median (IQR) | 86 (79-97) | 87 (79-98) | 0·045b |
| Alcohol use, n (%) | 200 (11·0%) | 128 (11·6) | 0·331 |
| Current smoking, n (%) | 146 (8·1%) | 51 (4·6%) | <0·001a |
| Snoring, n (%) | 492 (27·2%) | 322 (29·3%) | 0·117 |
| Hypertension, n (%) | 836 (46·2%) | 492 (44·8%) | 0·456 |
| Diabetes, n (%) | 74 (4·2%) | 39 (5·1%) | 0·298 |
| ESS>10, n (%) \* | 75 (37·3%) | 36 (22·0%) | 0·002a |
| PSQI score median (IQR) | 5 (3-7) | 5 (3-7) | 0·439 |
| Berlin score≥2, n (%) | 259 (14·3%) | 152 (13·8%) | 0·380 |
| NoSAS score ≥8, n (%) | 223 (12·3%) | 145 (13·2%) | 0·260 |

BMI, Body Mass Index ; IQR, Interquartile Range ; ESS, Epworth Sleepiness Scale; NoSAS, Neck-Obesity-Snoring-Age-Sex; PSQI, Pittsburg Sleep Quality Index. N= 2909 for all variables except for neck circumference (n=2895), diabetes (n=2533) and ESS (n=210). aCramer’s v calculated for sex, smoking, ESS were respectively -0.08, 0.06, 0.16 while bCohen’s d calculated for BMI, neck circumference, waist circumference were respectively 0·11, 0·22, 0·09, both suggesting a small effect size on the prevalence estimates.

**Table S2. Baseline demographic and clinical characteristics of the BeSAS study population with polygraphy data stratified by sex.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | **Total** | **Men** | **Women** | **p-value** |
| Sample size | 1810 | 647 | 1163 |  |
| Area of residence, n (%) |  |  |  |  |
| Rural | 955 (52·8) | 330 (51·0) | 625 (53·7) | 0·260 |
| Urban | 855 (47·2) | 317 (49·0) | 538 (46·3) |  |
| Age, years | 46±15 | 46±15 | 45±15 | 0·374 |
| Age group, n (%) |  |  |  | 0·251 |
| 25–39 years | 767 (42·4) | 265 (41·0) | 502 (43·2) |  |
| 40–59 years | 702 (38·8) | 247 (38·2) | 455 (39·1) |  |
| ≥60 years | 341 (18·8) | 135 (21·8) | 206 (17·7) |  |
| Body mass index, kg/m2 | 23·6 (20·5–27·8) | 22·1 (19·7–25·4) | 24·6 (21·2–29·2) | <0·001 |
| Nutritional status, n (%)  |  |  |  | <0·001 |
| Normal/underweight | 1080 (59·7%) | 476 (73·6%) | 604 (51·9%) |  |
| Overweight | 420 (23·2%) | 118 (18·2%) | 302 (26·0%) |  |
| Obesity | 310 (17·1%) | 53 (8·2%) | 257 (22·1%) |  |
| Neck circumference, cm | 34 (32–37) | 37 (35–39) | 33 (32–35) | <0·001 |
| Waist circumference, cm | 86 (79–97) | 83 (77–94) | 88 (80–99) | <0·001 |
| Alcohol use, n (%) | 200 (11·1) | 145 (22·4) | 55 (4·7) | <0·001 |
| Smoking, n (%) | 146 (8·1) | 102 (15·8) | 44 (3·8) | <0·001 |
| Snoring, n (%) | 492 (27·2) | 227 (35·1) | 265 (22·8) | <0·001 |
| Hypertension, n (%) | 836 (46·2) | 277 (42·8) | 559 (48·1) | 0·018 |
| Diabetes, n (%) | 74 (4·6) | 26 (4·6) | 48 (4·6) | 0·538 |
| ESS score  |  |  |  |  |
| Median | 6 (4–9) | 7 (4–9) | 6 (3–90) | 0·003 |
| Score >10, n (%) | 75/201 (37·3) | 38/106 (35·9%) | 37/95 (39·0%) | 0·650 |
| PSQI score |  |  |  |  |
| Median | 5 (3–7) | 4 (3–7) | 5 (3–7) | *0·009* |
| Score >5, n (%) | 754 (41·7) | 243 (37·6) | 511 (43·9) | *0·005* |
| Berlin questionnaire score ≥2, n (%) | 259 (14·3) | 102 (15·8) | 157 (13·5) | 0·106 |
| NoSAS score ≥8, n (%) | 223 (12·3) | 137 (21·2) | 86 (7·4) | *<0·001* |

Values are mean ± standard deviation, median (interquartile range), or number of patients (%); p-value are for comparison between men and women using Student t test or Mann-Whitney test;

ESS, Epworth Sleepiness Scale; NoSAS, Neck-Obesity-Snoring-Age-Sex; PSQI, Pittsburg Sleep Quality Index. N= 1810 for all variables except for neck circumference (n=1805), diabetes (n=1770) and ESS (n=210).

**Table S3.** **Adjusted risk of diabetes according to sleep-disordered breathing (SDB) severity stratified by sex.**

|  |  |  |
| --- | --- | --- |
|   | **Men** | **Women** |
|   | **OR (95% CI)** | **p-value** | **OR (95% CI)** | **p-value** |
| **Model 1** |  |  |  |  |
| Mild SDB | 1·89 (0·72–5·01) | 0·199 | 1·83 (0·95–3·52) | 0·071 |
| Moderate SDB | 2·41 (0·72–8·13) | 0·153 | 1·77 (0·68–4·59) | 0·240 |
| Severe SDB  | 3·65 (0·80–16·60) | 0·093 | 0·81 (0·10–6·56) | 0·842 |
| **Model 2** |  |  |  |  |
| Mild SDB | 1·99 (0·75–5·31) | 0·167 | 1·83 (0·95–3·53) | 0·071 |
| Moderate SDB | 2·35 (0·69–8·03) | 0·174 | 1·77 (0·68–4·59) | 0·240 |
| Severe SDB  | 3·73 (0·81–17·28) | 0·092 | 0·80 (0·99–6·52) | 0·838 |
| **Model 3** |  |  |  |  |
| Mild SDB | 1·83 (0·67–5·00) | 0·238 | 1·59 (0·80–3·17) | 0·187 |
| Moderate SDB | 2·05 (0·57–7·39) | 0·270 | 1·49 (0·55–4·02) | 0·434 |
| Severe SDB  | 2·79 (0·50–15·46) | 0·239 | 0·50 (0·05–4·65) | 0·543 |
| **Model 4** |  |  |  |  |
| Mild SDB | 1·78 (0·65–4·90) | 0·258 | 1·52 (0·75–3·06) | 0·241 |
| Moderate SDB | 1·89 (0·52–6·89) | 0·334 | 1·39 (0·51–3·84) | 0·518 |
| Severe SDB  | 2·84 (0·50–16·02) | 0·236 | 0·43 (0·05–4·07) | 0·468 |

SDB, sleep disordered breathing; OR, odd ratio; CI, confidence interval. groups with an apnoea-hypopnoea index (AHI) of 5–14 events/hour (mild SDB), 15–29 events/hour (moderate SDB) or ≥30 events/hour (severe SDB) were compared with the reference group (AHI <5 events/hour). Model 1 was adjusted for age, living area; model 2 = model 1 + alcohol and tobacco consumption; model 3 = Model 2 + BMI; and model 4 = Model 3 + neck circumference and abdominal obesity.

**Description of the selection process of 9 districts in the 3rd subcity of Cotonou, Benin**

There are 13 districts in the 3rd sub-city of Cotonou and the total number of households according to the 2013 census was 16,674. Our field ressources allowed us to study nine districts, representing approximately 70% of the 13 districts.

The nine districts were selected using a systematic randomization, which was conducted as follows: 1) the total number of households was divided by 9 to get a sampling interval (SI) of 1853; 2) A random number (Random Start or RS) was chosen between 1 and the SI using Excel command =rand()\*SI. The resulting number was 1050; 3) The first district was the one which cumulative size contains the RS (*column 3, Table S4*); 4) Then we calculated the following series: RS; RS+SI; RS+2SI; RS+3SI...RS+8SI (*column 4, Table S4*). The districts selected were those for which the cumulative size contains one of the serial numbers previously calculated. For example, taking the third cumulative addition of the SI to the RS number, the resulting value (i.e. 1050+ 3\*1853=6609) is included within the households of Segbeya Nord district, which was selected.

The number of households to survey within each district was proportional to the number of households of the district relative to the total number of households of the selected districts. For example, the Hlacomey district has 1106 households, and the total number of households of the nine selected districts is 13,771. For a final sample size of 300, then the number of households to sample in the Hlacomey district would be 300\*1106/13,771=24.09~24 (See *table S4*).

**Table S4.** Process of systematic random selection of 9 clusters proportionally to the size.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **District** | **Number of households\*** | **Cumulative number of households** | **Selection process** | **District selected** | **Number of households by selected district** |
| ADJEGOUNLE | 630 | 630 | - | - | - |
| ADOGLETA | 1 652 | 2 282 | 1 050 | 01 | 36 |
| GBENONKPO | 533 | 2 815 |  - |  - | -  |
| HLACOMEY | 1 106 | 3 921 | 2 903 | 02 | 24 |
| KPANKPAN | 1 130 | 5 051 | 4 756 | 03 | 25 |
| MIDOMBO | 1 242 | 6 293 |  - |  - | -  |
| SEGBEYA NORD | 947 | 7 240 | 6 609 | 04 | 21 |
| SEGBEYA SUD | 1 502 | 8 742 | 8 462 | 05 | 33 |
| AGBATO | 2 125 | 10 867 | 10 315 | 06 | 46 |
| AGBODJEDO | 2 377 | 13 244 | 12 168 | 07 | 52 |
| AYELAWADJE I | 987 | 14 231 | 14 021 | 08 | 22 |
| AYELAWADJE II | 1 945 | 16 176 | 15 874 | 09 | 42 |
| FIFATIN | 498 | **16 674** | - | - | **300** |

\* Data from Census 2013; Selected districts in blue.