Obstructive Sleep Apnea: Evaluation of high risk individuals, knowledge and associated factors among a representative sample of Lebanese adults

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Abstract

Background: To date, there has been no large population-based study about Obstructive Sleep Apnea (OSA) in Lebanon. Our study evaluated high risk individuals, knowledge and associated factors of OSA among a representative sample of Lebanese adults.

Methods: A cross-sectional study, conducted between June and August 2019, enrolled 472 people aged above 18. A proportionate random sample from all Lebanese Governorate was applied. Each governorate is divided into Caza (stratum), which in turn is divided into multiple villages. Two villages were selected randomly from the list of villages provided by the Central Agency of Statistics in Lebanon. Households were randomly selected from each village using an online software.

Results: The percentage of physician-diagnosed sleep apnea in our sample was 11%; 159 (33.7%) had poor knowledge (scores ≤11), whereas 165 (35.0%) and 148 (31.4%) had moderate (scores between 12 and 15) and good (scores ≥16) knowledge respectively.

The study results showed that -according to the Epworth Scale- having diabetes mellitus, myocardial infarction, arrhythmia, and hypertension were associated with higher daytime sleepiness. Furthermore, mild, moderate and severe excessive daytime sleepiness (EDS) percentages were 14.4%, 16.3% and 13.8% respectively. According to the STOP-BANG questionnaire, 31.6% of participants had an intermediate risk of OSA and 7.6% had a high risk. Diabetic patients and those with myocardial infarction were significantly associated with higher STOP BANG scores.

Concerning knowledge, having heard about sleep apnea was associated with a higher knowledge score. Overall, 31.4% of the participants had a good score.

Conclusion

The actual study proves that EDS which has adverse health effects, is associated with multiple morbidities. Besides, the general population isn't aware enough of this disease. Comparing the rate of high-risk individuals to the physician-diagnosed ones, we conclude that in Lebanon, OSA is likely prevalent but underdiagnosed. Ongoing health campaigns and screenings should be assigned to target the general community.

Background

Obstructive sleep apnea (OSA) is a common Sleep Disordered Breathing (SDB)[1] with various life-threatening impacts[2]. Described by the World Health Organization (WHO) as a complete or partial collapse of the airways[3], OSA is characterized by recurrent apnea or hypopnea during sleep, leading to a loss of saturated oxyhemoglobin[4]. Despite diaphragm contractions in opposition to this obstruction, hypoxemia occurs, provoking arousals and sleep deprivation[1]. According to the American Academy of

Sleep Medicine (AASM), undiagnosed sleep apnea costs $30 billion annually linked to the comorbid health risks of OSA[5].

Patients with OSA present symptoms of functional impairment and decrease cognitive performance, aside from snoring, morning headache, daytime hypersomnolence, nocturia, and fatigue[6,7]. The estimated prevalence of OSA ranges from 9 to 38% in community-screened populations, affecting 13 to 33% of men and 6 to 19% of women. A significantly higher prevalence is seen in older groups. It affects 88% of men and 66% of women aged between 65 and 69[8].

It is well known that OSA is tightly linked to multifactorial etiologies and physical attributes such as oropharyngeal narrowed airway, neck and waist circumference[9], body mass index (BMI) and obesity[10]. The Wisconsin Sleep Cohort proved a 32% rise in Apnea-hypopnea index (AHI) and a six-fold increased risk of developing OSA with every 10% weight gain[11]. Other factors also associated with OSA include hypertension (HTN)[12], smoking, and alcoholism [11] with a higher prevalence seen in those categories. Association of snoring with cardiovascular disease suggests that even a mild degree of SDB may have adverse health effects[13,14]. Sleep deprivation influences the immune, endocrine, and nervous systems[15]. It leads to poor glycemic control[16] and influences body metabolism[17].

Insightful that sleep plays a role in intellectual and academic attainments[18,19], OSA has been involved with impaired daytime function and psychiatric symptoms[20]. It has a an impact on road safety and contributes to the burden of road-related morbidity and mortality[21].

An awareness study done in Singapore showed a currently poor knowledge level among the general population[22]. Similar results were found in Lorraine-France as the complications and suggestive symptoms of OSA were still barely known[23]. In Riyadh, Primary Health Care physicians didn't completely recognize the importance and impact of OSA[24].

Patients today need to be aware of common pathologies and symptoms that should lead them to seek a consultation. Several research studies have shown a positive relationship between OSA knowledge, and the application of preventive measures. Patient education improves treatment compliance[23]. SDB is highly prevalent with important public health outcomes. Individuals at high-risk of incidence of SDB should be identified so their treatment may be given a high priority.

To date, there has been no large population-based study associated with public awareness in Lebanon about sleep apnea. Besides, SDB prevalence is still unknown. A study conducted in Beirut reported that although 31% participants had a high risk of sleep apnea, only 5% were diagnosed by a physician, which makes OSA likely prevalent in Lebanon, but still underdiagnosed[25]. Conscious of the medical comorbidities associated with OSA and its socioeconomic disadvantages, we developed a study to evaluate high risk individuals, knowledge and associated factors in OSA among a representative sample of Lebanese adults.

Methods

Study and population

A cross-sectional study was conducted between June and August 2019, which enrolled people aged above 18 using a proportionate random sample from all Lebanese governorates (Beirut, Mount Lebanon, North, South, and Beqaa). Each governorate is divided into Caza (stratum), which in turn is divided into multiple villages. Two villages per casa were selected randomly from the list of villages provided by the Central Agency of Statistics in Lebanon. Households were randomly selected from each village using an online software (Research Randomizer)[26]. The interviews were conducted inside the household and all adults living there were eligible to participate. Excluded were people unable to understand Arabic (n=1) - the national language- and people with cognitive impairment (n=5) (trouble remembering or concentrating)[27] as reported by a family member.

Sample size calculation

According to the Epi info, sample size calculations assuming a 31% frequency of OSA among the general population in the absence of similar studies in the country, a 95% confidence level, a power of 80%, and a sample of 329 contestants was required to fulfill the objectives and allow for adequate power for bivariate and multivariable analyses. We conducted the questionnaire on a total of 600 individuals. Eighty-seven were excluded from the study (14.5%), eighty-one refused to participate, one was unable to understand Arabic and five people had cognitive impairment; twelve terminated the interview before completion (2%). A total of 472 (83.5%) completed the interview and was included in the final analysis.

Data collection

A standardized method of a face-to-face interview was adopted by a trained and study-independent personnel. The questionnaire was divided into four parts:

The first part (Part 1: Socio-demographic characteristics) was collected through a multiple-choice format of 19 questions. The gender, the age, the weight, the height, the educational level (low (illiterate/primary), intermediate (complementary/ secondary) or high (university level) and the health insurance were mentioned. The governorate and the lifestyle (smoking, alcohol and coffee consumption) were also included, in addition to the number of traffic accidents per year. The monthly income was divided into 4 categories, as follows, based on the salary: none, low (<1000 USD), intermediate (1000–2000 USD), and high (>2000 USD). We asked about the last medical visit and its yearly frequency. The BMI was calculated from the measured weight and height of the individual.

The second part (Part 2: Personal diseases) evaluated whether the respondent had ever heard about OSA and if he/she had a prior physician diagnosis of OSA. If yes, the respondent was asked if he/she was currently on any sort of treatment. Questions about the history of personal diseases included HTN,

diabetes (DM), cerebrovascular accident (CVA), arrhythmia, and myocardial infarction (MI). Nocturia was also mentioned, by citing the number of times a participant gets out of bed, at night, to urinate.

The third part (Part 3: The Knowledge Scale) intended to get information concerning the knowledge of OSA, subdivided into two main focuses: suggestive characteristics and possible complications. There were 13 items concerning suggestive OSA symptoms and characteristics (10 correct, plus 3 distractors) and 13 possible complications (7 correct, plus 6 distractors), as mentioned in the Appendix1. This yielded an overall score ranging between 0 and 26.

Currently, the Obstructive Sleep Apnea and Attitudes Questionnaire (OSAKA) is a valid tool to assess OSA knowledge among physicians[28]. However, few scales consisted of questions addressed to the general population[22,23]. To collect data related to knowledge and to investigate disease-related beliefs among the general population, we used a questionnaire based on the previously published "Guidelines for clinical practice in OSAHS in adults"[29]. It has been translated from the Loraine's questionnaire[23] into Arabic. Forward and back method was adopted for the translation from French to Arabic then from Arabic to French by two different translators. The two French versions were compared; discrepancies were resolved by consensus between the authors and the translators.

We considered the following answers as acceptable for the symptoms and characteristics: Snoring, respiratory breaks, daytime fatigue, night suffocating sensation, non-restorative sleep, daytime somnolence, concentration disorder, morning headache, nocturia, and obesity. For health consequences, those were the right answers: stoke, DM, HTN, dementia, cardiac arrythmia, MI, and road accidents. Score details are mentioned in the Appendix2.

The fourth part (Part 4: Screening): A thorough literature review highlighted the presence of well-validated scales used in research studies to diagnose OSA: the Epworth Sleepiness Scale (ESS)[30] and the STOP-BANG questionnaire (SBQ)[31]. These two scales were chosen since the ESS is recommended to be included in screening evaluations[32,33], and the SBQ for being superior in detecting OSA in the general population[34,35].

ESS inquires about falling asleep in some circumstances, presenting a subjective measure of daytime sleepiness. A scale of 0–3 (0 means "would never doze" and 3 means "high chance of dozing"). The total score ranges between 0 and 24. Higher scores indicate more daytime sleepiness; the cutoff for normal daytime sleepiness is 10[30]. The Arabic form has been validated as an authentic tool[36]. The SBQ, also valid in Arabic, included the STOP questions: Snoring behavior, Tiredness, Obstruction (gasping) and Pressure (hypertension). From the BANG questions we included the Neck circumference[37]. BMI, Age, and Gender were included in the score based on previous answers to avoid repetition and redundancy. It is scaled as low, intermediate and high OSA Risk based on the number of positive answers[31] – Appendix3-.

A pilot study was run on about 20 subjects -not included in the study- to ensure the understanding and acceptability of the questions in the general population. Few linguistic modifications improved the

response rate in the final questionnaire.

Statistical analysis

Statistical Package for Social Science (SPSS) version 23 was used for the statistical analyses. Descriptive statistics were presented using mean and standard deviation for continuous measures, frequencies, and percentages for categorical variables.

The Student t-test and ANOVA test were used to assess the association between each continuous independent variable (ESS total score, SBQ total score, and knowledge score) and the sociodemographic and other variables. To calculate the p-value of the statistical significance, the Bonferroni correction compensates for that increase by testing each hypothesis at a significance level of α/m, where α is the desired overall alpha level and m is the number of hypotheses/tests conducted (23). Concerning the different scores, we tested 19 hypotheses/variables in each model, with a desired error α of 0.05; therefore, the Bonferroni correction would test each hypothesis at a p-value of 0.05/19=0.002.

Multivariable linear regression models were done to explore factors associated with the three scores as dependent variables and taking all variables that showed a $p \leq 0.002$ in the bivariate analysis as independent variables. A $p<0.05$ in the multivariable model was considered significant. Moreover, Cronbach's alpha was recorded for reliability analysis for each scale.

Results

The mean age of the participants was 39.39 ± 15.89. 51.7% of the respondents were men. Other descriptive results of our sample are summarized in Table 1. The percentage of physician-diagnosed sleep apnea in our sample was 11% [95% CI 0.082-0.138] (52 participants). The Cronbach's alpha values of the scales used were as follows: 0.833 for the Knowledge and 0.761 for the ESS.

Moreover, the mean knowledge score was 13.72 ± 3.86. When using the visual binning option in SPSS, the results showed that 159 (33.7%) had poor knowledge (scores ≤11), whereas 165 (35.0%) and 148 (31.4%) had moderate (scores between 12 and 15) and good (scores ≥16) knowledge respectively.

Bivariate analysis

A significantly higher mean Epworth score was found in those with a low level of education compared to the other categories, in those who have a BMI of 30 or higher, in those who smoke 20 cigarettes or more per day, in those who were diagnosed with HT, DM, CVA, arrhythmia, and MI compared to those who were not.

A notably higher mean SBQ score was found in those with a low level of education compared to the other categories, in those living in Beqaa compared to the other regions, in those who were diagnosed with HT, DM, CVA, and MI compared to those who were not and in those who have previously heard about sleep apnea compared to those who have not.

A remarkably higher mean knowledge score was found in those living in Mount Lebanon compared to all other regions and in those who have previously heard about sleep apnea compared to those who have not (Table 2).

Furthermore, higher age was significantly correlated with higher ESS total score (r=0.172; p<0.001).

Multivariable analysis

The results of a first linear regression, taking the ESS as the dependent variable, showed that having DM (B=2.21), MI (B=2.18), arrhythmia (B=1.73) and HTN (B=1.46) compared to the absence of those diseases were significantly associated with higher ESS total scores. (Table 3, Model 1).

The results of a second linear regression, taking the SBQ score as the dependent variable, showed that having DM (B=0.49) and MI (B=0.70) were significantly associated with higher SBQ scores (Table 3, Model 2).

The results of a third linear regression, taking the knowledge score as the dependent variable, showed that having heard about sleep apnea compared to those who have not (B=3.33) was significantly associated with higher knowledge scores (Table 3, Model 3).

Discussion

To the best of our knowledge, this study is the first large scale survey to assess high risk individuals for OSA among the general Lebanese population. In this representative sample of people aged above 18, 11% had already been diagnosed by a health care provider with OSA. Furthermore, according to the EES, mild, moderate, and severe EDS percentages were respectively 14.4%, 16.3% and 13.8%, whereas 31.6% had intermediate risk of occurrence of OSA according to the SBQ and 7.6% had high risk.

Multiple studies conducted worldwide have aimed to evaluate the prevalence of OSA. The proportion of Lebanese participants screening positive for OSA on the questionnaire is in harmony with the worldwide and regional estimated prevalence. It ranges from 9% to 38% in community-screened populations. An American study, published this year, estimated a prevalence of moderate to severe OSA of 37.0%[38].

This prevalence strongly increased during the last 20 years, depending on age, gender and, BMI[39]. The mean age of the respondents was 40 years (± 15.89). A significantly higher prevalence is seen in older groups. It affects 88% of men and 66% of women aged between 65 and 69[8].

Middle aged Lebanese people at risk for OSA might have other comorbidities.

This study was also able to shed light on some factors associated with EDS.

Having DM was significantly associated with higher daytime sleepiness according to the ESS. Mechanisms may include autonomic dysfunction and loss of upper airway innervations increasing

apnea/hypopnea over time[40]. Thus hypercapnic stimulus might lead to awakening and poor sleep quality, resulting in daytime doziness. On the other side, intermittent chronic hypoxia would alter the metabolism and the daily activity promoting insulin resistance.

Having arrhythmia and MI were both associated with EDS. The Journal of the American Heart Association investigated EDS as a poor prognostic factor post MI[41]. MI risk factors are known: obesity, DM, smoking, etc. [42]. A sedentary lifestyle is a shared risk factor for cardiovascular disease and to sleep disorders[43]. Laziness due to lack of sleep would induce cardiovascular diseases or contribute to their aggravation.

Also, OSA appears to play an important role in the recurrence of Atrial Fibrillation (AF), but its independent role in the incidence of new onset AF remains unclear[42]. This might be due to the activation of the nervous system. Repeated arousals from sleep would stimulate the sympathetic nervous system and hence cardioacceleration[44]. This would first cause tiredness and increase daytime sleepiness.

A higher daytime sleepiness score was seen in hypertensive people[45]. The journal of the American Society of HTN studied “the influence of hypertension on daytime sleepiness in obstructive sleep apnea” and showed that HTN decreased sleep efficiency. Even with lower ESS scores compared to normotensives, people with HTN must undergo further assessments[46]. In hypoxic situations, the body may increase blood flow to main organs, causing chronic damage to the vessels and the neurologic system. The accommodation to hypoxic situations may be the cause of higher blood pressure.

Sympathetic cardiac tone and pulmonary dilatation may increase oxygen needs and induce frequent arousals. Daytime sleepiness would likely try to compensate the sleep deprivation.

A resistant HTN, chronic fatigue, and headache might be simple alarming signs to screen for OSA.

The SBQ showed that people suffering from DM had higher scores. A diabetic patient is more eligible to develop OSA. A high BMI, being a part of this scale, can be the cause. Obesity is a common factor of DM and OSA[47], leading insulin resistance, decreased muscle activity, and chest compliance. The diabetic nephropathy can be manifested by HTN[48]. Diabetic patients have also defected microcirculation which might affect the pulmonary vasculature and lead to impaired oxygen exchange. Hypoxia and hypercapnia would stimulate the respiratory center and lead to arousal.

Having MI was associated with a higher SBQ score. A systematic literature review proved an association between OSA and cardiovascular events [49]. In fact to 65% of patients who suffer from cardiovascular diseases are diagnosed with OSA[50]. A low cardiac output following a MI would cause arterial hypoxia[49]. This would influence small pulmonary vasculature and airways diffusion capacity.

People who suffered from a MI might have lost the integrity of their vasculature. A lower cardiac output would affect the pulmonary circulation and damage the gas exchange barrier. On the other side, a good

coronary oxygenation would prevent cardiac events[1].

Our study provided data of present OSA awareness level in Lebanon. The results showed that the Lebanese population was not properly aware of this disease. Only 31.4% of the participants had good OSA knowledge. Characteristics, symptoms, and complications of OSA were barely known. The studies conducted in France and Singapore -also aiming to evaluate the knowledge of OSA among the population- showed that about 2/3 of the participants were familiar with some symptoms. Though, there was a lack of knowledge regarding OSA complications[22,23]. People might tend to give more importance to other common pathologies. The more people are diagnosed early with OSA, the more likely it is they share their experience with others. Moreover, “sleep disorders” is somehow an embarrassing topic that people avoid to discuss.

Previous studies insisted on the need for further education[22,23,51,52,53,54]. This helps increase awareness and promotes early OSA detection thus decreasing comorbid health risks.

Moreover, the results showed higher knowledge scores in people who have heard about OSA, in comparison with those who have not heard about it. Same findings were shown after a survey carried out in Lorraine, in which people with this trait were more aware of OSA[23]. The survey results can be related to an easier access to information. Having heard about OSA from a family member, a neighbor or a friend would have increased people’s familiarity with this pathology and its associated symptoms. In fact, this would have pushed people to ask more about sleep apnea and its complications.

These findings show the importance of patient educational programs to raise OSA awareness.

Limitations

This cross-sectional research project has multiple limitations. Since it’s a single point in time measurement, it cannot infer a causality relationship. The major respondents were form North Lebanon, so the sample being studied may not be representative of the whole population. In addition to that, relying on closed-ended questions may have limited the amount of information received The monthly individual income was included in the collected data but the household-equivalent income could not be calculated. This could lead to over or under evaluated symptoms and characteristics. Moreover, investigators were available for any clarifications if needed. However, social bias should be minimal as the anonymity was assured. Individuals may have chosen to misrepresent self-reported behaviors and pick a more socially acceptable answer to avoid negative judgment. Furthermore, the Arabic translation of the existing questionnaire[23] was not specifically validated in Lebanon. Despite those limitations, we believe that the data found in this study will be useful in future surveys to examine trends of OSA awareness.

Conclusion

The actual study proves that EDS, having adverse health effects, is associated with multiple morbidities. Besides, the general Lebanese population isn’t aware enough of this disease. Comparing the rate of high

risk individuals to the physician-diagnosed ones, we conclude that in Lebanon, OSA is likely prevalent but underdiagnosed. Ongoing health campaigns and screenings should be assigned to target the general community. People today need to be reasonably aware of common pathologies and the associated symptoms that should lead them to seek a consultation. Accordingly, future research is needed to assess primary health care providers' knowledge. Physicians should carry the responsibility for providing adequate screening and diagnosis.

Declarations

Ethics Approval and Consent to Participate

The study protocol was approved by the Holy Spirit University of Kaslik (USEK) ethics committee. A written informed consent was obtained from each participant.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are not publicly available to maintain the privacy of the individuals' identities. The dataset supporting the conclusions is available upon request to the corresponding author.

Competing interests

The authors have nothing to disclose.

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None.

Author contributions

AC and DM were responsible for the data collection and design of the study; AC drafted the manuscript; SH carried out the analysis and interpreted the results, assisted in drafting and reviewing the manuscript; ED was the project supervisor. All authors reviewed the final manuscript and gave their consent.

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Abbreviations

OSA=Obstructive Sleep Apnea

EDS=Excessive daytime sleepiness

SDB=Sleep Disordered Breathing

WHO=World Health Organization

AASM=American Academy of Sleep Medicine

BMI=body mass index

AHI=Apnea-hypopnea index

HTN=hypertension

DM=diabetes mellitus

CVA=cerebrovascular accident

MI=myocardial infarction

OSAKA= Obstructive Sleep Apnea and Attitudes Questionnaire

OSAHS=Obstructive sleep apnea hypopnea syndrome

ESS=Epworth Sleepiness Scale

SBQ=STOP-BANG questionnaire

SPSS= Statistical Package for Social Science

AF= Atrial Fibrillation

References

1. Maeder MT, Schoch OD, Rickli H. A clinical approach to obstructive sleep apnea as a risk factor for cardiovascular disease. *Vasc Health Risk Manag*. 2016;12:85-103. doi:10.2147/VHRM.S74703
2. Maspero C, Giannini L, Galbiati G, Rosso G, Farronato G. Obstructive sleep apnea syndrome: a literature review. *Minerva Stomatol*. 2015;64(2):97-109. https://www.ncbi.nlm.nih.gov/pubmed/25747430.
3. Global surveillance, prevention and control of CHRONIC RESPIRATORY DISEASES. *World Heal Organ*. 2007;Obstructiv:32. https://www.who.int/gard/publications/GARD Book 2007.pdf.

4. Olson LG, King MT, Hensley MJ, Saunders NA. A community study of snoring and sleep-disordered breathing. Prevalence. *Am J Respir Crit Care Med*. 1995;152(2):711-716. doi:10.1164/ajrccm.152.2.7633731
5. Watson NF. Health Care Savings: The Economic Value of Diagnostic and Therapeutic Care for Obstructive Sleep Apnea. *J Clin Sleep Med*. 2016;12(08):1075-1077. doi:10.5664/jcsm.6034
6. Malhotra A, White DP. Obstructive sleep apnoea. *Lancet (London, England)*. 2002;360(9328):237-245. doi:10.1016/S0140-6736(02)09464-3
7. Chervin RD. Sleepiness, fatigue, tiredness, and lack of energy in obstructive sleep apnea. *Chest*. 2000;118(2):372-379. doi:10.1378/chest.118.2.372
8. Senaratna C V, Perret JL, Lodge CJ, et al. Prevalence of obstructive sleep apnea in the general population: A systematic review. *Sleep Med Rev*. 2017;34:70-81. doi:https://doi.org/10.1016/j.smrv.2016.07.002
9. Jordan AS, McSharry DG, Malhotra A. Adult obstructive sleep apnoea. *Lancet*. 2014;383(9918):736-747. doi:https://doi.org/10.1016/S0140-6736(13)60734-5
10. Semelka M, Wilson J, Floyd R. Diagnosis and Treatment of Obstructive Sleep Apnea in Adults. *Am Fam Physician*. 2016;94(5):355-360. https://www.ncbi.nlm.nih.gov/pubmed/27583421.
11. Peppard PE, Young T, Palta M, Dempsey J, Skatrud J. Longitudinal study of moderate weight change and sleep-disordered breathing. *JAMA*. 2000;284(23):3015-3021. doi:10.1001/jama.284.23.3015
12. Calhoun DA, Harding SM. Sleep and hypertension. *Chest*. 2010;138(2):434-443. doi:10.1378/chest.09-2954
13. Drager LF, McEvoy RD, Barbe F, Lorenzi-Filho G, Redline S. Sleep Apnea and Cardiovascular Disease: Lessons From Recent Trials and Need for Team Science. *Circulation*. 2017;136(19):1840-1850. doi:10.1161/CIRCULATIONAHA.117.029400
14. Kapoor M, Greenough G. Home Sleep Tests for Obstructive Sleep Apnea (OSA). *J Am Board Fam Med*. 2015;28(4):504-509. doi:10.3122/jabfm.2015.04.140266
15. Knutson KL. Sleep duration and cardiometabolic risk: a review of the epidemiologic evidence. *Best Pract Res Clin Endocrinol Metab*. 2010;24(5):731-743. doi:10.1016/j.beem.2010.07.001
16. Pallayova M. Diabetes, sleep apnea, and glucose control. *Am J Respir Crit Care Med*. 2010;182(2):287. doi:10.1164/ajrccm.182.2.287a
17. Chaput J-P, Despres J-P, Bouchard C, Tremblay A. Short sleep duration is associated with reduced leptin levels and increased adiposity: Results from the Quebec family study. *Obesity (Silver Spring)*. 2007;15(1):253-261. doi:10.1038/oby.2007.512
18. Ficca G, Salzarulo P. What in sleep is for memory. *Sleep Med*. 2004;5(3):225-230. doi:10.1016/j.sleep.2004.01.018
19. Diekelmann S, Wilhelm I, Born J. The whats and whens of sleep-dependent memory consolidation. *Sleep Med Rev*. 2009;13(5):309-321. doi:10.1016/j.smrv.2008.08.002

20. Knechtle B, Economou N-T, Nikolaidis PT, et al. Clinical Characteristics of Obstructive Sleep Apnea in Psychiatric Disease. *J Clin Med*. 2019;8(4):534. doi:10.3390/jcm8040534
21. Quera-Salva MA, Hartley S, Sauvagnac-Quera R, et al. Association between reported sleep need and sleepiness at the wheel: comparative study on French highways between 1996 and 2011. *BMJ Open*. 2016;6(12):e012382. doi:10.1136/bmjopen-2016-012382
22. Sia CH, Hong Y, Tan LWL, van Dam RM, Lee CH, Tan A. Awareness and knowledge of obstructive sleep apnea among the general population. *Sleep Med*. 2017;36:10-17. doi:10.1016/j.sleep.2017.03.030
23. Arous F, Boivin JM, Chaouat A, Rumeau C, Jankowski R, Nguyen DT. Awareness of obstructive sleep apnea-hypopnea syndrome among the general population of the Lorraine Region of France. *Eur Ann Otorhinolaryngol Head Neck Dis*. 2017;134(5):303-308. doi:10.1016/j.anorl.2017.02.010
24. Bahammam A. Knowledge and attitude of Primary Health Care Physicians towards sleep disorders. *Saudi Med J*. 2001;21:1164-1167.
25. Chami HA, Bechnak A, Isma'eel H, et al. Sleepless in Beirut: Sleep Difficulties in an Urban Environment With Chronic Psychosocial Stress. *J Clin sleep Med JCSM Off Publ Am Acad Sleep Med*. 2019;15(4):603-614. doi:10.5664/jcsm.7724
26. Urbaniak, G. C., & Plous S. Research Randomizer. *[Computer software]*. (Version 4. http://www.randomizer.org/.
27. Health W organization. Evidence profile: cognitive impairment. *Integr care older people*. 2017. https://www.who.int/ageing/health-systems/icope/evidence-centre/ICOPE-evidence-profile-cognitive.pdf?ua=1.
28. Schotland HM, Jeffe DB. Development of the obstructive sleep apnea knowledge and attitudes (OSAKA) questionnaire. *Sleep Med*. 2003;4(5):443-450.
29. Pneumologie organe officiel de la société de langue francaise. Recommandations pour la pratique clinique du syndrome d'apnées hypopnées obstructives du sommeil de l'adulte. *Rev Mal Respir*. 2010;3(octobre). http://www.sfrms-sommeil.org/wp-content/uploads/2012/10/HS3_reco_sas2010-1.pdf.
30. Johns M. Epworth Sleepiness Scale. 1990. https://epworthsleepinessscale.com/.
31. Toronto Western Hospital UHN, Toronto U of. Stop-Bang Questionnaire. 2012. http://www.stopbang.ca/osa/screening.php.
32. Ulasli SS, Gunay E, Koyuncu T, et al. Predictive value of Berlin Questionnaire and Epworth Sleepiness Scale for obstructive sleep apnea in a sleep clinic population. *Clin Respir J*. 2014;8(3):292-296. doi:10.1111/crj.12070
33. Panchasara B, Poots AJ, Davies G. Are the Epworth Sleepiness Scale and Stop-Bang model effective at predicting the severity of obstructive sleep apnoea (OSA); in particular OSA requiring treatment? *Eur Arch oto-rhino-laryngology Off J Eur Fed Oto-Rhino-Laryngological Soc Affil with Ger Soc Oto-Rhino-Laryngology - Head Neck Surg*. 2017;274(12):4233-4239. doi:10.1007/s00405-017-4725-2

34. Chiu H-Y, Chen P-Y, Chuang L-P, et al. Diagnostic accuracy of the Berlin questionnaire, STOP-BANG, STOP, and Epworth sleepiness scale in detecting obstructive sleep apnea: A bivariate meta-analysis. *Sleep Med Rev*. 2017;36:57-70. doi:https://doi.org/10.1016/j.smrv.2016.10.004
35. Luo J. STOP-Bang questionnaire is superior to Epworth sleepiness scales, Berlin questionnaire, and STOP questionnaire in screening obstructive sleep apnea hypopnea syndrome patients. *Chin Med J (Engl)*. 2014;127(17):3065-3070. insights.ovid.com.
36. Riachy M, Juvelikian G, Sleilaty G, Bazarbachi T, Khayat G, Mouradides C. Validation de la version arabe de l'échelle de somnolence d'Epworth : étude multicentrique. *Rev Mal Respir*. 2012;29(5):697-704. doi:https://doi.org/10.1016/j.rmr.2011.12.017
37. STOPBANG Questionnaire □□□□□□□ □□□□□□. *Univ Heal Netw*. http://stopbang.ca/translation/pdf/arabic.pdf.
38. Malhotra A, Ayas N, Patel SR, Peppard PE. 0477 Americas Prevalence of OSA in Adults: Estimation Using Currently Available Data. *Sleep (New York, NY)*. 4AD;42(supplement_1):A191-A191. doi:10.1093/sleep/zsz067.475
39. Heinzer R, Vat S, Marques-Vidal P, et al. Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study. *Lancet Respir Med*. 2015;3(4):310-318. doi:10.1016/S2213-2600(15)00043-0
40. 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*. 2AD;33(2):414-420. doi:10.2337/dc09-1124
41. Xie J, Sert Kuniyoshi FH, Covassin N, et al. Excessive Daytime Sleepiness Independently Predicts Increased Cardiovascular Risk After Myocardial Infarction. *J Am Heart Assoc*. 2018;7(2):e007221. doi:10.1161/JAHA.117.007221
42. Kwon Y, Koene RJ, Johnson AR, Lin G-M, Ferguson JD. Sleep, sleep apnea and atrial fibrillation: Questions and answers. *Sleep Med Rev*. 2018;39:134-142. doi:10.1016/j.smrv.2017.08.005
43. Geovanini GR, Wang R, Weng J, et al. Association between Obstructive Sleep Apnea and Cardiovascular Risk Factors: Variation by Age, Sex, and Race. The Multi-Ethnic Study of Atherosclerosis. *Ann Am Thorac Soc*. 2018;15(8):970-977. doi:10.1513/AnnalsATS.201802-121OC
44. Kimura T, Kohno T, Nakajima K, et al. Effect of Nocturnal Intermittent Hypoxia on Left Atrial Appendage Flow Velocity in Atrial Fibrillation. *Can J Cardiol*. 2015;31(7):846-852. doi:10.1016/j.cjca.2014.12.032
45. Floras JS. Hypertension and Sleep Apnea. *Can J Cardiol*. 2015;31(7):889-897. doi:10.1016/j.cjca.2015.05.003
46. Martynowicz H, Skomro R, Gac P, et al. The influence of hypertension on daytime sleepiness in obstructive sleep apnea. *J Am Soc Hypertens*. 2017;11(5):295-302. doi:10.1016/j.jash.2017.03.004
47. Hamilton GS, Joosten SA. Obstructive sleep apnoea and obesity. *Aust Fam Physician*. 2017;46(7):460-463.

48. Siwasaranond N, Nimitphong H, Manodpitipong A, et al. The Relationship between Diabetes-Related Complications and Obstructive Sleep Apnea in Type 2 Diabetes. *J Diabetes Res*. 2018;2018:9269170. doi:10.1155/2018/9269170
49. Porto F, Sakamoto YS, Salles C. Association between Obstructive Sleep Apnea and Myocardial Infarction: A Systematic Review. *Arq Bras Cardiol*. 2017;108(4):361-369. doi:10.5935/abc.20170031
50. Garcia-Rio F, Alonso-Fernandez A, Armada E, et al. CPAP effect on recurrent episodes in patients with sleep apnea and myocardial infarction. *Int J Cardiol*. 2013;168(2):1328-1335. doi:10.1016/j.ijcard.2012.12.015
51. Reuveni H, Tarasiuk A, Wainstock T, Ziv A. Awareness Level of Obstructive Sleep Apnea Syndrome During Routine Unstructured Interviews of a Standardized Patient by Primary Care Physicians. *Sleep (New York, NY)*. 12AD;27(8):1518-1524. doi:10.1093/sleep/27.8.1518
52. Shaw R, McKenzie S, Taylor T, et al. Beliefs and attitudes toward obstructive sleep apnea evaluation and treatment among blacks. *J Natl Med Assoc*. 2012;104(11-12):510-519. doi:10.1016/s0027-9684(15)30217-0
53. Swapna LA, Alotaibi NF, Falatah SA, Joaithen MS Al, Koppolu P. Knowledge of Obstructive Sleep Apnea among Dental Fraternity in Riyadh. *Open access Maced J Med Sci*. 2019;7(15):2508-2512. doi:10.3889/oamjms.2019.654
54. Wang CL, Li XZ, Cai XL, Pan XL, Min J. Anesthesiologist's knowledge and attitudes about obstructive sleep apnea: a survey study. *Sleep Breath*. 2012;16(1):41-46. doi:10.1007/s11325-011-0482-4

Tables

Table 1. Sociodemographic and other characteristics of the participants (N=472).	
Variable	**N (%)**
Gender	
Male	244 (51.7%)
Female	228 (48.3%)
Age: mean ± SD (in years)	**39.39 ± 15.89**
Governorate	
Beirut	87 (18.4%)
Mount Lebanon	83 (17.6%)
North Lebanon	169 (35.8%)
South Lebanon	47 (10.0%)
Beqaa	86 (18.2%)
Health coverage	
No	96 (20.3%)
Yes	376 (79.7%)
Monthly income	
None	101 (21.4%)
Low	203 (43.0%)
Intermediate	93 (21.1%)
High	44 (10.0%)
Education level	
Low (illiteracy/primary)	51 (10.8%)
Intermediate (complementary/ secondary)	188 (39.8%)
High (university)	233 (49.4%)
Body Mass Index categories (Kg/m^2)	
≤ 24.99	243 (51.5%)
25-29.99	166 (35.2%)
30 and above	63 (13.3%)
Mean ± SD	**25.43 ± 5.21**
Physician-diagnosed sleep apnea	
No	420 (89.0%)
Yes	52 (11.0%)
Epworth score categories	
Normal daytime sleepiness	261 (55.4%)
Mild excessive daytime sleepiness	68 (14.4%)
Moderate excessive daytime sleepiness	77 (16.3%)
Severe excessive daytime sleepiness	65 (13.8%)
Mean ± SD	**9.51 ± 5.86**
Stop Bang categories	
Low OSA risk	287 (60.8%)
Intermediate OSA risk	149 (31.6%)
High OSA risk	36 (7.6%)
Mean ± SD	**2.20 ± 1.51**
Knowledge score: mean ± SD	**13.72 ± 3.86**

OSA=Obstructive sleep apnea

Table 2. Bivariate analysis of factors associated with the Epworth, Stop Bang and knowledge scores.			
Variable	**Epworth score**	**Stop Bang score**	**Knowledge score**
Gender			
Male	10.05 ± 5.33	-	13.47 ± 3.94
Female	8.93 ± 6.35	-	13.97 ± 3.77
p-value	0.038	-	0.103
Education level			
Low (illiteracy/primary)	11.78 ± 9.25	2.55 ± 1.59	12.45 ± 3.54
Intermediate (complementary/ secondary)	9.31 ± 5.06	2.23 ± 1.54	12.52 ± 3.39
High (university)	9.17 ± 5.42	2.10 ± 1.45	14.96 ± 3.90
p-value	**<0.001**	**0.002**	0.243
Monthly income			
No income	8.90 ± 7.98	1.95 ± 1.55	13.76 ± 3.72
Low	9.33 ± 5.06	2.13 ± 1.53	13.14 ± 3.79
Intermediate	9.52 ± 5.39	2.41 ± 1.41	14.78 ± 4.03
High	12.11 ± 4.98	2.65 ± 1.36	14.54 ± 4.05
p-value	0.022	0.01	0.005
Region			
Beirut	11.13 ± 4.62	2.49 ± 1.37	13.31 ± 3.50
Mount Lebanon	9.21 ± 5.52	2.27 ± 1.46	14.61 ± 4.04
North Lebanon	8.34 ± 7.11	1.68 ± 1.31	13.79 ± 3.97
South Lebanon	10.04 ± 5.20	2.40 ± 1.61	12.76 ± 3.55
Bekaa	10.16 ± 4.34	2.75 ± 1.69	13.64 ± 3.88
p-value	0.004	**<0.001**	**<0.001**
Body Mass Index categories (Kg/m^2)			
≤ 24.99	8.64 ± 6.13	1.97 ± 1.40	14.06 ± 3.98
25-29.99	10.27 ± 5.32	2.39 ± 1.58	13.06 ± 3.78
30 and above	10.86 ± 5.73	2.60 ± 1.56	14.11 ± 3.42
p-value	**<0.001**	0.005	0.016
Health Insurance			
No	9.03 ± 7.81	2.06 ± 1.51	12.61 ± 3.29
Yes	9.63 ± 5.26	2.24 ± 1.51	14.00 ± 3.95
p-value	0.144	0.251	0.003
Cigarette smoking			
No	9.08 ± 5.41	2.13 ± 1.50	13.75 ± 3.76
Yes, light-moderate (<20 cig/day)	9.01 ± 5.14	2.11 ± 1.49	13.83 ± 3.73
Yes, heavy (20 or more per day)	12.07 ± 7.76	2.60 ± 1.51	13.48 ± 4.40
p-value	**<0.001**	0.042	0.532
Waterpipe smoking			
No	9.32 ± 5.51	2.28 ± 1.51	13.79 ± 3.90
Yes, mild (<3 waterpipes/week)	10.59 ± 8.03	1.81 ± 1.50	13.21 ± 3.92
Yes, moderate (3-6 waterpipes/ week)	9.63 ± 4.22	2.26 ± 1.56	13.20 ± 2.73
Yes, heavy (7 or more waterpipes/ week)	9.00 ± 5.65	2.05 ± 1.32	15.10 ± 4.41
p-value	0.783	0.082	0.211
Alcohol drinking			
Low (At least once a month or less)	9.11 ± 5.40	2.14 ± 1.47	13.41 ± 3.67
Moderate (At least once a week)	10.68 ± 7.53	2.32 ± 1.55	14.98 ± 4.12
Heavy (Daily)	11.68 ± 4.62	2.89 ± 1.79	13.84 ± 5.17
p-value	0.038	0.196	0.008
Coffee intake			
Low (At least once a month or less)	9.44 ± 6.46	2.09 ± 1.49	12.99 ± 3.82
Moderate (At least once a week)	10.28 ± 4.36	2.59 ± 1.68	14.09 ± 4.22

Heavy (Daily)	9.38 ± 5.68	2.19 ± 1.46	14.19 ± 3.74
p-value	0.510	0.139	0.003
Hypertension			
No	8.45 ± 5.97	1.91 ± 1.40	13.86 ± 3.83
Yes	11.86 ± 4.87	2.85 ± 1.54	13.41 ± 3.92
p-value	**<0.001**	**<0.001**	0.144
Diabetes mellitus			
No	8.73 ± 5.92	2.07 ± 1.44	13.91 ± 3.89
Yes	12.47 ± 4.58	2.72 ± 1.63	12.99 ± 3.70
p-value	**<0.001**	**<0.001**	0.03
Cerebrovascular accidents			
No	9.28 ± 5.87	2.15 ± 1.51	13.84 ± 3.87
Yes	13.11 ± 4.56	3.00 ± 1.25	11.71 ± 3.20
p-value	**<0.001**	**0.002**	0.003
Arrhythmia			
No	8.74 ± 5.94	2.12 ± 1.50	13.74 ± 3.86
Yes	12.28 ± 4.63	2.49 ± 1.49	13.63 ± 3.89
p-value	**<0.001**	0.025	0.757
Myocardial infarction			
No	9.06 ± 5.85	2.11 ± 1.47	13.80 ± 3.85
Yes	13.55 ± 4.20	3.02 ± 1.55	13.02 ± 3.97
p-value	**<0.001**	**<0.001**	0.191
Heard about sleep apnea			
No	9.33 ± 5.34	2.15 ± 1.51	12.47 ± 3.40
Yes	9.82 ± 6.70	2.61 ± 1.46	15.93 ± 3.65
p-value	0.391	0.034	**<0.001**

Numbers in bold indicate significant p-values after Bonferroni corrections.

Table 3. Multivariable analysis.					
Model 1: Stepwise linear regression taking the Epworth total score as the dependent variable.					
Variable	**Unstandardized Beta**	**Standardized Beta**	**p-value**	**95% Confidence Interval**	
Diabetes mellitus (Yes vs no*)	2.21	0.15	0.003	0.77	3.66
Myocardial infarction (Yes vs no*)	2.18	0.11	0.024	0.29	4.08
Arrhythmia (Yes vs no*)	1.73	0.12	0.017	0.32	3.15
Hypertension (yes vs no*)	1.46	0.11	0.026	0.18	2.74
Model 2: Stepwise linear regression taking the Stop Bang total score as the dependent variable.					
Variable	**Unstandardized Beta**	**Standardized Beta**	**p-value**	**95% Confidence Interval**	
Diabetes mellitus (Yes vs no*)	0.49	0.13	0.005	0.15	0.84
Myocardial infarction (Yes vs no*)	0.70	0.14	0.004	0.23	1.17
Model 3: Stepwise linear regression taking the knowledge score as the dependent variable.					
Variable	**Unstandardized Beta**	**Standardized Beta**	**p-value**	**95% Confidence Interval**	
Heard about sleep apnea (yes vs no*)	3.33	0.42	<0.001	2.68	3.99

Variables entered in model 1: education level, body mass index categories, hypertension, diabetes mellitus, cerebrovascular accidents, myocardial infarction, arrhythmia, age.

Variables entered in model 2: education level, diabetes mellitus, cerebrovascular accidents, myocardial infarction.

Variables entered in model 3: having heard about sleep apnea.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix1.pdf