Do the Symptoms of Obstructive Sleep Apnea Syndrome Exist in Highly Trained Malay Security Personnel?

Hashim H[1], Samsudin AR[2]

[1]Advanced Medical and Dental Institute, Universiti Sains Malaysia, 13200 Kepala Batas Penang, Malaysia and Dental Institute, Universiti Sains Malaysia, Malaysia. [2]College of Dentistry, University of Sharjah, Sharjah, United Arab Emirates.

Abstract

Objective: Obstructive Sleep Apnea Syndrome (OSAS) has been associated with excessive daytime sleepiness, which may lead to reduced alertness. This study determines the distribution of OSAS among highly trained Malay male security personnel, an occupation that requires constant alertness.

Methods: Berlin questionnaires (Malay version) were distributed and the body mass index (BMI) and neck circumference were measured. This questionnaire asked for symptoms indicative of OSAS and consists of three categories: snoring, excessive daytime sleepiness/fatigue, and the presence of obesity or hypertension.

Results: In total, 661 respondents were involved in this study. There was a range of prevalence of the main symptoms of OSAS with 45 subjects (6.8%, 95%CI: 5.0-9.0) categorized in the high risk group for OSAS. There was no significant difference in age, but the BMI and neck circumference were significantly higher in the high risk group ($p<0.001$).

Conclusion: The presence of OSAS symptoms in highly trained security personnel found in this study suggests the need to screen for this syndrome in individuals involved in high risk occupations.

Key Words: Obstructive sleep apnea, Screening, Berlin questionnaire, High-risk occupation

Introduction

Obstructive Sleep Apnea (OSA) is described as repeated complete or partial upper airway obstruction during sleep, causing the cessation of breathing (apnea) or reduction of airflow (hypopnea) despite persistent respiratory efforts [1]. Obstructive Sleep Apnea Syndrome (OSAS) is a clinical entity that defines OSA, which coexists with excessive daytime sleepiness or related problems in daytime function. In particular, it is associated with loud snoring, apneic events such as choking and gasping during sleep (usually noticed by the bed partner), and chronic sleep disruption. However, on many occasions, loud snoring and excessive daytime sleepiness are the only two symptoms that patients with OSAS are aware of when they present for clinic examination.

Excessive daytime sleepiness associated with OSAS has been increasingly recognized as an important public health problem. Studies have demonstrated individuals with OSAS to be at a higher risk of being involved in road traffic accidents, possibly as a result of the combination of drowsiness and lack of concentration [2,3]. This is even more alarming as individuals with at least moderate OSAS have been reported to have impaired neurocognitive function in a manner similar to five years' additional age or equivalent to about 50% of the effect of administering a sedative hypnotic [4].

Studies have revealed relationships between OSAS and depressive disorder [5], as well as adverse social consequences on patients and their spouses [6]. Various clinical effects of OSAS have also been described in the literature. Among these are hypertension [7], coronary heart disease [8], and stroke [9].

Diagnosing OSAS, particularly in individuals working in occupations requiring high alertness, is crucial as untreated sleep disorders may lead to unintentional injuries and fatalities not only to the affected individuals, but also to others [10,11]. Security personnel are generally involved in various high risk tasks requiring mental clarity. Unfortunately, information on sleep disorders among individuals in this profession in Malaysia is lacking. Early identification and treatment can lead to improved sleep hygiene and thus, better mental alertness and cognition, as well as long-term health outcomes.

This study therefore determines the prevalence of OSAS symptoms among highly trained security personnel in Malaysia.

Materials and Methods

The sample size employed in this study was calculated by using the single proportion sample size determination formula [12]. We estimated the prevalence of snoring to be 6.8% based on the rate reported by Ng et al. [13]. By setting a Confidence Interval (CI) of 95% and allowing a precision margin of 2%, the smallest sample size needed was 610 respondents. Ethical approval was provided by the Universiti Sains Malaysia Research and Human Ethics Committee (Approval no. 304/PPSG/6131334).

The presence of symptoms for OSAS was assessed using Berlin questionnaires. This questionnaire was developed during a conference on sleep medicine held in Berlin, Germany, in April 1996. It is a self-administered questionnaire enquiring about a set of known symptoms and clinical features of OSAS and has been suggested to predict important symptom distributions and permit risk grouping in the absence of the physician–patient encounter. Questions are presented in a simple, straightforward fashion without any medical terminology. This questionnaire has been shown to have a sensitivity of 0.86, specificity of 0.77, positive predictive value of 0.89, and likelihood ratio of 3.79 to predict the presence of OSAS with an Apnea-Hypopnea Index (AHI) of at least five [14].

Corresponding author: Hasnah Hashim, Advanced Medical and Dental Institute, Universiti Sains Malaysia, 13200 Kepala Batas Penang, Malaysia, Tel: 604-5622391; Fax: 604-5622349; e-mail: hasnah@amdi.usm.edu.my

It consists of a series of questions arranged into two symptom categories: snoring with witnessed apneas and daytime sleepiness. A third category asks about excessive daytime sleepiness and the history of hypertension. Our respondents were categorized in the high risk group if they provided positive responses in at least two categories, and the low risk group otherwise.

The Malay-translated version was previously pretested to ensure clarity and modified accordingly [15]. Assuming an approximate 50% non-response rate and the return of some incomplete questionnaires, we randomly selected 910 highly trained Malay male security personnel from a list provided by a professional security training center. They were individually approached and invited to participate in this study. The questionnaires were then distributed to those respondents that had provided written informed consent.

The Body Mass Index (BMI) was calculated with the standard formula: weight in kilograms divided by the square of height in meters. Neck circumference was measured in cm at the level of the cricothyroid membrane with respondents positioning their heads in a natural posture.

The opportunity to conduct a sleep study on all the respondents would have been ideal but was not logistically practical in this study. Therefore, we performed 22 overnight sleep studies with respondents from the high risk and low risk groups using the Embletta Diagnostic System (Flaga Medical Devices, Iceland). This recorder is a pocket-sized digital recording device designed to diagnose sleep-disordered breathing, including obstructive sleep apnea. This machine has been demonstrated to yield results that are excellently correlated (rho=0.98) with those of gold-standard polysomnography [16]. The sensors on the device were attached to the studied respondents and nasal and oral airflow pressures, thoracic and abdominal movements, snoring, oxygen saturation, body position, and pulse rate were measured and recorded over at least 6 hours of night sleep. Apneas were classified for complete cessation of airflow and hypopneas if there were ≥ 30% reduction in airflow (associated with ≥ 4% desaturation) or ≥ 50% reduction in airflow (associated with ≥ 3% desaturation) for at least 10 seconds [17]. The results were automatically scored with manual review by a trained technician, blind to the questionnaire outcome.

All data were analyzed using SPSS for Windows version 16 (SPSS Chicago, IL, USA). Mean and Standard Deviation (SD) were used to describe the continuous variables, while the categorical ones were described by using frequency and percentages. The prevalence of OSAS symptoms was calculated by dividing the number of positive responses by the total number of responses to a particular question. The 95% Confidence Interval (CI) was then determined for each prevalence.

Results

Of the 910 questionnaires distributed, 661 were returned (response rate of 72.6%). The age range of respondents was between 19.0 and 46.2 years with a mean of 31.3 (SD 5.76) years, while the range of the BMI of all respondents was between 15.2 and 45.6 kg/m^2 with a mean of 24.4 (SD 2.47) kg/m^2. Overall mean neck circumference was 37.6 cm (SD 2.38).

Of the 661 respondents, 45 (6.8%, 95%CI: 5.0, 9.0) were categorized in the high risk group for OSAS. The mean AHI in the high risk group was 15.9 (SD 20.78) events/hour with the highest AHI recording of 58.8, while the mean AHI in the low risk group was 2.6 (SD 0.50) events/hour. The sensitivity and specificity of the questionnaire in predicting OSAS with an AHI of at least five were 90% (95%CI: 55.5, 99.7) and 75% (95%CI: 42.8, 94.5), respectively, while its positive and negative predictive values were 81.8% (95%CI: 48.2, 97.7) and 90.9% (95%CI: 58.7, 99.8), respectively.

The distributions of symptoms are summarized in *Table* 1.

The mean age, BMI, and neck circumference stratified by the risk groups of all respondents are presented in *Table* 2.

Table 1. *The prevalence of the main OSAS-related symptoms among 661 respondents.*

Symptom	N	% (95%CI)
Do you snore? (total response=660)		
Yes	186	28.2 (24.8, 31.8)
Snoring loudness (total response=645)		
Louder than talking	5	0.8 (0.2, 1.8)
Very loud	12	1.9 (0.9, 3.2)
Snoring frequency(total response=650)	650	
Almost every day	66	10.2 (7.9, 12.7)
3–4 times a week	38	5.8 (4.2, 7.9)
Does your snoring bother others? (total response=645)		
Yes	89	13.6 (11.1, 16.5)
Has anyone noticed that you quit breathing during your sleep? (total response=646)		
Almost every day	28	4.3 (2.9, 6.2)
3–4 times a week	15	2.3 (1.3, 3.8)
How often do you feel tired or fatigued after your sleep? (total response=658)		
Almost every day	71	10.8 (8.4, 13.4)
3–4 times a week	37	5.6 (4.0, 7.7)
How often do you feel tired or fatigued during wake time? (total response=654)		
Almost every day	75	11.5 (9.1, 14.1)
3–4 times a week	34	5.2 (3.6, 7.2)
Fallen asleep while driving a vehicle (total response=660)		
Yes	81	12.3 (9.9, 15.0)

Table 2. *The distributions and comparison of the mean age and BMI of the high risk and low risk respondents.*

Variable	High risk of OSAS (*n*=45) Mean (SD)	Low risk of OSAS (*n*=616) Mean (SD)	Mean difference (95%CI)	*t*-statistic (*df*)[a]	p-value
Age (years)	31.9 (5.85)	31.2 (6.50)	0.8 (-1.2,2.7)	0.77 (654)	0.441
BMI (kg/m^2)	26.5 (4.51)	23.2 (3.31)	3.4 (2.0,4.7)	4.90b (48)	< 0.001
Neck circumference (cm)	38.9 (2.40)	36.4 (2.37)	2.5 (1.3,3.6)	4.14 (70)	< 0.001

[a]Degrees of freedom

[b]Population variances were significantly different, therefore t-statistics without assuming equal variances were used

The independent *t*-test result showed no significant difference in age but the mean BMI and neck circumference of high risk respondents were significantly higher compared with low risk respondents.

Discussion

One of the basic symptoms inevitably linked to OSAS is snoring. Studies have shown that approximately 20-40% of the adult population snore loudly on a regular basis [18]. Highly trained security personnel are generally physically fit compared with the general population. This group of individuals would naturally be expected not to have trivial health problems. Nonetheless, our results did not fully support this view.

In this study, the prevalence of our respondents categorized in the high risk group of having OSAS was 6.8%. The overnight sleep study conducted on a subset of the high and low risk subjects showed good validity (sensitivity, specificity, positive and negative predictive values) of the risk classification with a cut-off AHI of five. The prevalence is comparable to the reported 8.1% high risk for OSAS among Korean soldiers screened via the Berlin questionnaire [19]. In contrast, a study involving American military personnel reported a prevalence of 51.2% [20] while another study reported 33.6% of police officers in North America were screened positive [21]. The possible explanation for the lower prevalence of high risk for OSAS in our study compared with Western studies may be due to the higher BMI among their subjects, which is a risk factor of OSAS.

Nevertheless, at 26.5 (SD 4.51) kg/m^2 and 38.9 (SD 2.40) cm, respectively, the mean BMI and neck circumference in our study were significantly higher in the high risk group. It has been reported that Asians have proportionally more fat than Caucasians with a comparable BMI, and therefore the World Health Organization has suggested lower cut-off points for overweight (23 kg/m^2) and obesity (25 kg/m^2) for Asians [22]. Although the BMI remains among the most commonly reported markers for OSAS in the general population, it is important to emphasize the growing evidence of a significant association between craniofacial characteristics and OSAS in Asian respondents [23-25].

The prevalence of snoring among our study respondents was 28.2%, with 16.0% self-reporting snoring of at least 3–4 times a week, only slightly higher than the prevalence of 13.5% reported among Korean military personnel [19]. Interestingly, snoring was previously perceived by the community as a mere social nuisance that creates irritation and loss of sleep for their bed partners. Additionally, patients who suffered only from snoring (primary snorers) were not considered to have a severe problem. However, a previous study suggested that snoring is associated with significant sleep disturbances and excessive sleepiness [26]. Furthermore, it may increase the risk of developing medical conditions such as cardiovascular disease [27]. Because of these factors, snoring is now regarded as part of a complex continuum of disease states culminating in, among others, OSAS. Although not necessarily present, it is indisputably one of the prime predictors of this syndrome. The earliest description of a person with a sleep disorder was made by Charles Dickens in *The Posthumous Papers of the Pickwick Club*, in which the character Joe was portrayed as an obese individual who was always sleepy during the day and snored loudly when asleep. This gave rise to the “Pickwickian syndrome”, which today might be referred to as OSAS. Pickwickians have a combination of being male, obese, sleepy, snoring, and middle-aged.

Snoring loudness or intensity has been among the key predictors of this syndrome [28]. Those with a snoring intensity higher than normal talking or extremely loud have been demonstrated to have a combined likelihood ratio of 4.9 for OSAS [29]. This is further supported by a study on a military population in England which showed snoring loudness to be significantly associated with breathing pauses during sleep [30]. Physiologically, loud snoring happens when the lateral pharyngeal walls collapse inward and the tongue falls backward. The only structure that can give way to improve air entry is the soft palate, which rattles upon air entry producing loud snoring. In our study, the prevalence of those who reported their snoring to be at least as loud as talking was 11.1%. Of these respondents, 13.6% admitted that their snoring bothered other people as opposed to the 54.9% reported in the Cleveland study. Among the possible reasons for the higher prevalence in their study is the higher voluntary symptom reporting among urban, Western societies compared with our examined society, related to the more conservative cultural attitude in the latter. Hence, we speculate that some respondents in our study may not want to admit to snoring, as they considered it embarrassing to report, particularly as they were in an occupation that requires them to be physically fit.

Forty-three respondents (6.6%) reported that they have had breathing pauses observed by others at least 3–4 times a week. Witnessed apnea is due to the “Venturi effect” where the rush of airflow causes the tongue to collapse toward the posterior pharyngeal wall, causing the complete cessation of airflow and a sudden increase in carbon dioxide retention that finally results in choking and arousal. A group of authors suggested that choking and sleep arousals are among the fundamental symptoms predictive of OSAS severity [31].

In our study, the prevalence of respondents claiming not to feel rested after a night’s sleep at least 3-4 times a week was 16.4%. Approximately the same percentage experienced excessive daytime tiredness at least 3-4 times a week, as well. The study involving police officers in North America that had also employed the Berlin questionnaire found those who screened positive for a sleep disorder had a significantly higher mean score on the Epworth Sleepiness Scale as well as higher adverse safety and performance outcomes compared to those screened negative [21]. Although Dixon et al. [31] reported that excessive daytime sleepiness is not an important predictor of OSAS severity, many reports have argued that it is in fact among the principle features of this syndrome.

Excessive daytime sleepiness is actually because of the phenomenon of sleep debt caused by sleep fragmentation and it may even lead to depression in severe cases. A multi-center study that involved 40 offices and clinics in the United States and Europe reported the prevalence of drowsy driving in these two continents to be 17% and 7%, respectively [32]. Another study found that while a number of respondents with OSAS were as good as their normal counterparts on driving simulators, over half of the former demonstrated poorer performance on simulators than control respondents [33]. Of our respondents, 12.3% admitted that they have fallen asleep behind the wheel in the past. This is alarming as reduced mental alertness and cognitive impairment associated with excessive sleepiness while on duty could lead to devastating consequences. A review article further reinforced the importance of this symptom in OSAS in that it may amplify the severity of this syndrome over time [34].

Nevertheless, it is important to note that the recognition and awareness of the symptoms of OSAS are important to both healthcare personnel and the public alike. This is because the condition is often under-diagnosed, perhaps due to the lack of training in the recognition of sleep disorders or the uncertainty of how to manage patients or where to refer them for further management. Another possible reason for under-diagnosis may be the commonly held belief that OSAS does not pose any imminent health risks to the patient, thus placing it low in the diagnosis and treatment priorities in healthcare systems [35]. For example, a survey conducted among otolaryngologists showed that many practitioners fail to ask patients with OSAS whether they have suffered sleepiness-related road traffic accidents or impaired performance at work, while few advise patients with severe OSAS not to drive before being treated for the condition [36]. Patients themselves may also fail to discuss their sleep problem symptoms with the attending physician because of an inadequate knowledge of the symptoms of snoring and excessive daytime sleepiness.

We acknowledge that our study had no female respondents or no racial diversity and that the age range was limited. Thus, we could not test the influence of these factors on the risk of OSAS. We also used a working population, which may reflect a healthy worker effect in that we may miss those who have already left work due to ill health.

Conclusion

This study determines the prevalence of OSAS symptoms among highly trained Malaysian security personnel. The principle symptoms of OSAS such as loud snoring, witnessed apnea and excessive daytime sleepiness were present, and the prevalence of respondents categorized in the high risk group of having OSAS in this study was 6.8%. Thus, it would be prudent to screen OSAS in individuals involved in occupations that require them to be constantly vigilant so that early diagnosis and treatment can be undertaken.

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