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Prevalence of Snoring and High Risk of Obstructive Sleep Apnea Syndrome in Young Male Soldiers in Korea

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There are little information on prevalence of obstructive sleep apnea syndrome (OSAS) and clinical features in the young military population. The purpose of this study was to estimate the prevalence of snoring and high risk of OSAS in young male soldiers in Korea and to identify the risk factors of OSAS. A total of 665 participants (aged 20-23 yr) who visited the Armed Forces Ildong Hospital for regular physical examination were enrolled. All participants completed the Berlin Questionnaire and underwent a physical examination. The participants with high risk for OSAS completed portable sleep monitoring. The prevalence of snoring and high risk of OSAS in young male soldiers in Korea was 13.5% and 8.1%, respectively. The prevalence of high arched palate, tongue indentation, long uvula, large tonsil and retrognathia was significantly higher in the high risk OSAS group. High arched palate, long uvula or low lying soft palate, tonsil size III or IV, Epworth Sleepiness Scale score > 10 and obesity (BMI > 27 kg/m^2) were found to independently predict OSAS. For early identification and treatment of young soldiers with OSAS in a military environment, a precise screening by questionnaire and physical examination is needed.

Key Words: Prevalence; Snoring; Sleep Apnea Syndrome; Sleep Apnea, Obstructive; Military Personnel; Korea

INTRODUCTION

Snoring and sleep disordered breathing (SDB) are common among middle-aged adults and are characterized by repeated cessations of breathing during sleep. Obstructive sleep apnea syndrome (OSAS), the most common form of SDB, can cause serious adverse consequences including an increased risk of cardiovascular diseases and neurocognitive morbidities (1,2). In a large population study, the prevalence of SDB was 4% in men and 2% in woman (3).

Several reports showed that OSAS was associated with higher risks of traffic accidents and involvement in occupational accidents due to excessive daytime sleepiness (EDS) and cognitive impairment (4-6). Due to the nature of group accommodation in military environment, sleep deprivation can result in EDS for the patients with OSAS and persons sharing the same room. However, there are little information on prevalence of OSAS and clinical features in the military population. Therefore, it is necessary to determine the associated risk factors of OSAS in active duty military personnel for early diagnosis and treatment. The purpose of this study was to estimate the prevalence of snoring and high risk of OSAS in young male soldiers in Korea and identify the risk factors of OSAS.

MATERIALS AND METHODS

Subjects

A total of 665 participants aged 20 to 23 yr who went to the Armed Forces Il Dong Hospital for their regular physical examination were studied from July to September 2011. All participants completed the Korean version of the Berlin Questionnaire and Epworth Sleepiness Scale (ESS). They underwent otorhinolaryngologic evaluation by a specialist. Fifty participants who were identified as high-risk for OSAS by the Berlin Questionnaire completed portable sleep monitoring, Stardust II (Respironics Inc., Murraysville, PA, USA).

Symptom measurement

The questionnaire used to evaluate the risk of OSAS was the Korean version of the Berlin questionnaire. It has been previously validated in several surveys. The content of the Berlin questionnaire has been previously described in detail (7). Briefly, the questionnaire is divided into three sections. In section 1, respondents are asked whether they snore. Those who respond affirmatively are asked how loud the snoring is, how often it occurs, and whether their snoring bothers other people. Respondents are also asked whether anyone has ever noticed cessation of their breathing during sleep. In section 2, respondents are asked

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how often they feel tired or fatigued right after sleep, how often they feel tired, fatigued, or not up to par during wake time, and whether they ever fall asleep driving a car. In section 3, respondents are asked about a personal history of hypertension, as well as their height, weight, age, and sex. Body mass index (BMI) was calculated from the information in section 3. A section was considered positive if there were two affirmative answers in either section 1 or 2, or one affirmative response in section 3. Individuals who had positive scores in two of the three sections were considered to be at risk for OSAS. Daytime sleepiness was estimated using the Epworth sleepiness scale (8). Habitual snoring was defined as a snoring frequency ≥ 4 days per week.

Physical examination

A single otorhinolaryngologist performed all examinations. Tonsillar size and palatal position were classified into 4 grades according to Friedman's grade. The uvula was considered long if it was more than 1.5 cm in length. The soft palate was considered low lying if greater than one-third of the uvula extended below the level of the mandibular occlusal plane. Subjects were evaluated for tongue indentation by oral cavity examination. The mandible retrognathia was investigated by placing the patient seated in the Frankfort horizontal position with a virtual vertical line dropped from the vermilion border of the lower lip to the chin. If the anterior prominence of the chin (soft tissue pogonion) is great than 2 mm behind this line, mandibular retrodisplacement may be present (9). High arched palate was defined by the presence of all the following features: 1) a narrow and high palatal vault, 2) a corresponding narrow arch form, and 3) unilateral or bilateral buccal tilting of the maxillary alveolar arches with posterior teeth in crossbite (10). A BMI ≥ 27 was defined as obesity.

Portable sleep monitoring

The Stardust II (STD II) (Respironics Inc., Murraysville, PA, USA) is a type 3 portable monitoring (PM) that is designed to measure and record 5 diagnostic parameters: SpO2 (via finger probe), pulse rate (from the oximeter probe), airflow (pressure based airflow through a nasal cannula), respiratory effort (piezoelectric sensor in a belt placed mid-thorax), and body position (mercury switch built into the STD II unit and worn mid-sternum). An internal 9 V battery powers the STD II and allows up to 10 hr of data collection. Data are collected and stored on internal memory in the device. The data are then downloaded to a computer for automated analysis by the host software (Stardust Host Software, Respironics, Inc.). Manual review and validation of the automatically scored data can be performed. A research assistant instructed the participants how to use the STD II at home. The explanation consisted of consistent verbal and written instructions illustrating the correct hook-up of the STD II, and included diagrams and a brief demonstration (11).

For STD II scoring, hypopnea was defined as more than a 50% discernable decrement in airflow lasting ≥ 10 sec with a 3% reduction in SpO2. Apneas were required to show cessation of airflow ≥ 10 sec (whether central, obstructive, or mixed). The total recording time was used in the denominator to calculate the apnea-hypopnea index (AHI).

Statistical analysis

Statistical analyses were performed using SPSS version 18.0 for Windows (SPSS Inc., Chicago, IL, USA). Categorical data were analyzed using the chi-square test, and continuous data using the independent t test. Logistic regression analysis was used to identify variables independently correlated with OSAS. Results were presented as mean ± SD or as an adjusted odds ratio and corresponding 95% confidence intervals. *P* values of < 0.05 were considered as having statistical significance.

Ethics statement

This study protocol was reviewed and approved by the institutional review board of the Armed Forces Medical Command (AFMC-11-IRB-024). Informed consent was obtained from all participants according to the Declaration of Helsinki.

RESULTS

Ninety subjects (13.5%) of all participants reported habitual snoring. Fifty subjects (8.1%) were predicted to be at high risk of OSAS by the questionnaire (Table 1). All subjects classified as being at high risk of OSAS underwent portable monitoring. Among the 50 subjects, 45 persons were found to have AHI ≥ 5. The distribution of the AHI in subjects at high risk of obstructive sleep apnea syndrome shows in Table 2. Table 3 shows the clinical differences between the groups of non-snorers and habitu-

Table 1. Distribution of habitual snorers and high risk of obstructive sleep apnea syndrome

	No.	%
Total	665	
Habitual snorer*	90	13.5
High risk of OSAS	50	8.1

*Habitual snoring was defined as a snoring frequency ≥ 4 days per week. OSAS, obstructive sleep apnea syndrome.

Table 2. Distribution of the AHI in subjects at high risk of obstructive sleep apnea syndrome

AHI	No.	%
< 5	5	10
5-15	22	44
15-30	19	38
> 30	4	8

AHI, apnea hypopnea index.

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Table 3. Clinical difference between non-snorers and habitual snorers

Variables	Non-snorer	Habitual snorer	*P* value
No. of subjects	575	90	
Age (yr)	21.78 ± 1.21	21.61 ± 1.02	0.211
Body mass index (kg/m^2)	22.85 ± 2.68	23.93 ± 2.99	< 0.001
Epworth Sleepiness Scale (ESS) score	6.85 ± 4.08	9.97 ± 4.32	< 0.001
High arched palate (%)	3.1	18.9	< 0.001
Tongue indentation (%)	2.0	11.1	0.001
Long uvula or low lying soft palate (%)	17.0	46.7	< 0.001
Retrognathia (%)	2.6	7.8	0.018
Palatal position (%)			< 0.001
Grade I or II	65.8	40.0	
III or IV	33.3	66.7	
Tonsil size (%)			< 0.001
Grade 0, I or II	97.1	84.3	
III or IV	2.9	15.7	

al snorers. The mean ages were 21.7 and 21.6 yr in the non-snorers and habitual snorers, respectively. There was no significant difference between the groups in age. BMI and ESS score were significantly higher in habitual snorers. The prevalence of high arched palate, tongue indentation, long uvula or low lying soft palate and retrognathia was significantly higher in habitual snorers. In addition, the prevalence of grade III or IV in palatal position and tonsil size was higher in habitual snorers. Table 4 shows the clinical differences between the high risk OSAS group and non-high risk OSAS group. The results of the comparison between the two groups showed that they were similar results in Table 3.

To identify predictive factors associated with OSAS in subjects, we divided the subjects into two groups according to the presence of OSAS. We utilized the backward stepwise method of multiple logistic regression analysis. Finally, high arched palate (odds ratio [OR] = 5.300; $P = 0.005$), long uvula or low lying soft palate (OR = 2.579; $P = 0.022$), tonsil size III or IV (OR = 5.351; $P = 0.012$), ESS > 10 (OR = 4.152; $P < 0.001$) and obesity (BMI > 27 kg/m^2) (OR = 3.157; $P = 0.039$) were found to independently predict OSAS in subjects (Table 5).

Table 4. Clinical differences between the high risk OSAS group and non-high risk OSAS group

Parameters	Non-high risk OSAS	High risk OSAS	*P* value
No.	620	45	
Age (yr)	21.77 ± 1.19	21.50 ± 1.09	0.112
Body mass index (kg/m^2)	22.88 ± 2.67	24.51 ± 3.64	< 0.001
Epworth Sleepiness Scale (ESS) score	6.87 ± 4.05	11.37 ± 4.51	< 0.001
High arched palate (%)	3.8	17.8	< 0.001
Tongue indentation (%)	2.6	11.1	0.003
Long uvula or low lying soft palate (%)	18.9	42.2	< 0.001
Retrognathia (%)	2.9	11.1	0.007
Palatal position (%)			< 0.001
Grade I or II	63.1	35.6	
III or IV	36.9	64.4	
Tonsil size (%)			0.025
Grade 0, I or II	96.2	88.9	
III or IV	3.8	11.1	

OSAS, Obstructive Sleep Apnea Syndrome.

Table 5. Logistic regression analysis for prediction of obstructive sleep apnea syndrome

Variables	OR	95% CI for OR		*P* value
		Lower	Upper	
High arched palate	5.300	1.635	17.175	0.005
Long uvula or low lying soft palate	2.579	1.146	5.801	0.022
Tonsil size III or IV	4.516	1.439	19.894	0.012
ESS > 10	4.241	1.931	9.317	< 0.001
Obesity (BMI ≥ 27 kg/m^2)	3.157	1.057	9.428	0.039

ESS,Epworth Sleepiness Scale; BMI, Body mass index; CI, Confidence Interval; OR, Odds Ratio.

DISCUSSION

The aim of this study was to estimate the prevalence and risk factors of snoring and high risk of OSAS in young male soldiers in Korea. The prevalence of habitual snoring was 13.5% and high risk of OSAS by the Berlin questionnaire was 8.1%.

To our knowledge, this study is the first report on the prevalence and risk factors of OSAS in the young military population in Korea. There have been many previous epidemiologic studies of the prevalence of SDB, but there is little data on its prevalence in young adults.

In a study on the prevalence of snoring and SDB in a university student population using a questionnaire survey followed by home sleep monitoring, overall, 25.7% of subjects reported snoring, and the prevalence of SDB in monitored subjects was 2.3% (12). The questionnaire used in this study was the Sleep and Health Questionnaire. In this questionnaire, questions are categorized into mild, moderate, and severe according to the severity of snoring. Therefore, it did not estimate the frequency of snoring. In our study, the habitual snorer was defined as a person who snores frequently (4-5/week) or always (6-7/week). In addition, the female to male ratio in the population was 1.8:1. Therefore, it is likely that our results of the young adult male population show a higher prevalence rate compared with that of the university student population. According to results from the National Sleep Foundation Sleep in America 2005 poll, of the 1,506 respondents, 26% (31% of the men and 21% of the women) met the Berlin questionnaire criteria (13). Particularly, 18% of those persons 18 to 29 yr of age were at high risk. Moreno et al. (14) applied the Berlin Questionnaire to 10,101 truck drivers and reported that 26% were high risk for OSAS. When our results are compared with those of the previous two studies, the prevalence of high risk for OSAS in our study shows a lower rate. The possible reason for having a lower prevalence of high risk for OSAS compared with western studies may be due to the difference in the prevalence of obesity, a strong risk factor for OSAS.

Moreover, the mean BMI of our subjects was 21.98 ± 2.5 which was lower than that of the Korean adult population (15).

The significance of physical examination for detection of OSAS is controversial. While Viner et al. (16), Friedman et al. (17), and Zonato et al. (18) concluded that it is possible to identify patients with OSAS based on the history and anatomical findings, Dreher et al. (19) claimed that medical history and anatomical findings are insufficient to adequately predict the presence or absence of OSAS (19). However, for the otorhinolaryngologist, routine physical examination and history taking are essential to identify OSAS in patients seeking treatment for snoring. These examinations allow for better treatment prioritisation and a more evidence-based approach in patient management. In our results, all variables of upper airway bony and soft tissue structural abnormalities that we checked were significantly more frequent in subjects with a higher risk of OSAS.

If there were any obstructions in the nasal or nasopharyngeal pathways such as adenotonsillar hypertrophy or allergic rhinitis in childhood, the nasal breathing pattern might be changed to a mouth breathing pattern (20). Mouth-breathing individuals have been classically described as having a narrow, V-shaped maxillary arch, a high palatal vault, proclined upper incisors and a Class II occlusal relationship (21). High arched palate from among these can be a major reason for high nasal airway resistance that may contribute to the development of obstructive sleep apnea (OSA). Also, Cistulli et al. (22) observed modest correlations between indexes of maxillary constriction and sleep apnea severity. It is known that a long uvula or low lying soft palate and enlarged tonsil can be lead to airway obstruction by decreasing airway caliber. Previous pathologic studies have demonstrated thickening, fibrosis and fat deposition in the uvula and soft palate of the patient with OSA (23). Tonsil hypertrophy is the most common risk factor for sleep-disordered breathing in children (24). But in previous studies, in which the study population was mainly middle aged, enlarged tonsil was more infrequent than in our study (19, 25). A possible reason for this might be that enlarged tonsil was an independent predictive value in our study unlike other studies.

Overall, we found that the prevalence of snoring and high risk of OSAS in young male soldiers in Korea was 13.5% and 8.1%, respectively. It is not a low prevalence, considering the populations are young and non-overweight individuals. High arched palate, long uvula or low lying soft palate, tonsil size III or IV, ESS >10 and obesity were independent predictive factors of OSAS. For early identification and treatment of young soldiers with OSAS in a military environment, a precise screening by questionnaire and physical examination is needed.

DISCLOSURE

The authors have no conflicts of interest to disclose.

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