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ORIGINAL ARTICLE

Our Sleep Laboratory Results: Etiological Investigation of Snoring

Süleyman Erdoğdu

Department of Otorhinolaryngology, University of Health Sciences Türkiye, Haydarpasa Numune Training and Research Hospital, Istanbul, Türkiye

Abstract

Introduction: I aimed to investigate the presence of obstructive sleep apnea syndrome (OSAS), body mass index (BMI), hypertension (HT), diabetes mellitus (DM), and obesity in patients with snoring complaints and to determine the relationships between them.

Methods: I detected the people with HT and DM and Apnea-Hypopnea Index (AHI) found by detecting apnea and hypopneas, BMI calculated in the light of age, height, and weight data of patients admitted to our hospital with snoring complaints between January 2019 and January 2021.

Results: A total of 501 patients, 330 (65.9%) of the patients were male. One hundred and seventy-one (34.1%) were female. Thirty-nine of the patients (7.78%) simple snoring; 134 of them (26.75%) mild OSAS; 108 (21.56%) of them were determined as moderate OSAS and 220 (43.91%) of them were determined as severe OSAS. In the total study group, 98 (19.56%) HT and 170 (33.93%) DM patients were determined.

Discussion and Conclusion: No significant difference was found between AHI and age. As BMI increases, so does AHI, and this relationship was significant. The patients with severe OSAS have higher BMI. As BMI and AHI increase, the number of HT and DM patients also increases. In this study, no patients with weak BMI and snoring were found.

Keywords: Apnea-hypopnea index; obstructive sleep apnea syndrome; polysomnography; snoring.

Obstructive sleep apnea syndrome (OSAS) is a syndrome that causes recurrent upper respiratory tract obstruction while asleep, leading to a decrease in blood oxygen saturation. This obstruction occurs at different severity levels, varying from partial obstruction to complete airways obstruction[1]. Whereas a partial obstruction leads to simple snoring, complete obstruction causes apnea. As a result of this obstruction, patients with OSAS were observed to have daytime sleepiness, daytime fatigue, headache, and attention deficit, consequently increasing the possibility of vehicle accidents and decreasing work performance. Due to these reasons, OSAS is the cause of serious morbidity and mortality[2]. Age, gender, neck circumference, obesity, smoking, use of alcohol, intake of sedative drugs, and presence of certain systemic diseases are the main risk factors for OSAS[3].

Apnea is defined as the cessation of respiration for a period equal to or longer than 10 s. Hypopnea, however, is a reduction in the airflow to the extent of 30% or greater that lasts 10 s or longer. Subsequently, the apnea-hypopnea index (AHI) is the number of apnea and hypopneas recorded per hour during sleep. According to this index, an apnea-hypopnea level of 5 or more is classified as OSAS. Furthermore, AHI is divided into three categories

Correspondence (İletişim): Süleyman Erdoğdu, M.D. Türkiye Sağlık Bilimleri Üniversitesi,Haydarpaşa Numune Eğitim ve Araştırma Hastanesi, Kulak Burun Boğaz Bölümü, Istanbul, Türkiye
Phone (Telefon): +90 532 287 50 71 **E-mail (E-posta):** suleymanerdogdu@gmail.com
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regarding the severity, consisting of mild (5<AHI<15), moderate (15<AHI<30), and severe (AHI<30) apnea-hypopnea[4,5].

To diagnose patients with obstructive sleep apnea, a polysomnography (PSG) test is required. Since obesity is the most significant predisposing factor that increases the risk of developing OSAS, the BMI was taken into account in this study[6]. Body mass index (BMI) is a ratio obtained by dividing the body weight by the square of height. BMI is evaluated according to six categories: Underweight (0–19), normal or healthy weight (20–24:), overweight (25–29.9), obese (30–34.9), severely obese (35–39.9), and morbidly obese (≥40).

Materials and Methods

Between January 2019 and January 2021, patients who applied to Beykoz State Hospital with snoring complaints were monitored through a PSG device (Compumedics E-Series, 64 Channel System. 2007 Victoria, Australia) for one night in the sleep laboratory department of the hospital to detect the presence of OSAS. The AHI was calculated by determining the number of apnea and hypopneas per hour; an AHI of 5 was accepted as OSAS. In accordance with the AHI, the patients were divided into four groups concerning their OSAS severity: Simple snoring (AHI<5), mild sleep apnea (5<AHI<15), moderate sleep apnea (15<AHI<30), and severe sleep apnea (AHI>30). While BMI was calculated, the World Health Organization obesity classification values were taken as reference.

The mean±standard deviation (SD) values were calculated by computing the minimum and maximum values according to patients' age, BMI, AHI, weight, and height data. According to AHI values, patients were distributed into four categories composed of simple, mild, moderate, and severe. Alongside analyzing the relation between the patient number and AHI, the distribution of patients according to their BMI values and age was evaluated according to AHI. In addition, a correlation between hypertension (HT), diabetes mellitus (DM), and AHI was investigated.

Statistical Analysis

All statistical analyses were executed using the SPSS 15.0 package program. Frequency and percentage distributions were used in the descriptive statistics of the data. All values are represented as mean±SD. One-way ANOVA test and Independent t-test were applied in the data analysis. Test results for which p<0.05 were considered to be significant.

Results

A total of 501 patients participated in the study; 330 (65.9%) of the patients were male, and 171 (34.1%) were female. Frequency and percentage distributions were used in the descriptive statistics of the data The age of patients varied between 19 and 87; the mean age was 49.25±11.39. The patients' weight ranged between 47 and 150 kg and the average weight was 91.31±1.70 kg (Table 1). Statistical method was used mean and SD.

According to the AHI, 39 of the patients (7.78%) had simple snoring, 134 (26.75%) were diagnosed with mild OSAS, 108 (21.56%) were determined to have moderate OSAS, and 220 (43.91%) were diagnosed with severe OSAS. Thus, the majority of patients is composed of patients with severe OSAS (Table 2). Frequency and percentage distributions were used in the descriptive statistics of the data.

When the BMI data were examined, 300 patients (59.88%) were deduced to be obese, constituting the majority of patients. Subsequently, 156 patients (31.14%) were classified as overweight, and 45 patients (8.98%) were found to be normal weight. Notwithstanding, no underweight patient was found among the patient group. A significant correlation was discovered concerning the number of patients and the BMI; as BMI increases, the number of OSAS patients also increases (Table 3). Frequency and percentage distributions were used in the descriptive statistics of the data.

The mean age of the patients among the AHI categories was found to be close to each other; no statistically significant correlation between AHI and age (p=0.054) was

Table 1. Patients' min-max range and average values (n=501)

	Min-Max	Mean±SD
Age (Year)	19–87	49.25±11.39
BMI (kg/m^2)	18.80–54.70	32.05±5.77
AHI	0.60–121.20	31.41±24.85
Height	1.44–1.93	1.69±9.53
Weight (kg)	47–150	91.31±1.70

AHI: Apne-hipopne index; BMI: Body mass index; SD: Standart deviation.

Table 2. Distribution of patients according to apnea-hypopnea index values (n=501)

AHI classification	n	%
Simple Snoring	39	7.78
Mild OSAS	134	26.75
Middle OSAS	108	21.56
Severe OSAS	220	43.91

Table 3. Distribution of patients according to their body mass index values(n=501)

BMI	n	%
Weak	0	0.00
Normal	45	8.98
Overweight	156	31.14
Obese	300	59.88

BMI: Body Mass Index.

observed. However, as BMI increased, the AHI severity increased as well. Subsequently, the relationship between AHI and BMI (p=0.011) was found to be statistically significant (Table 4). One-way ANOVA test was applied in the data analysis.

Considering the AHI classifications, a correlation between the AHI classes and the presence of DM and HT was found. The relationship between the AHI and patients' DM status (p=0.000) was determined as significant. Likewise, the relationship between AHI and HT was found to be significant (p=0.000) as well. It was determined that 33.93% (n=170) of the patients had HT and 19.56% (n=98) had DM (Table 5). Independent t-test was applied in the data analysis.

In the distribution analysis regarding the age groups, most patients between the ages of 40–59 were determined to be obese (n=192) and had severe AHI (n=132). Similar to these findings, 59 (11.78%) HT and 101 (20.16%) DM cases were seen in the 40–59 age group, whereas there were a total of 98 HT and 170 DM cases detected, indicating that HT and DM were observed most frequently among the 40–59 age group as well. Another observation suggested that as the patients' BMI increased, the severity of AHI also increased. In addition, the presence of HT and DM followed the increase in BMI. Due to the fact that no underweight patient had applied to our hospital with the complaint of snoring, such an evaluation between the OSAS and underweight BMI requires further investigation (Table 6).

Discussion

PSG is a test based on a simultaneous and continuous recording of neurophysiological, cardiac, respiratory, physiological, and other physical parameters during sleep for a certain period[7]. Frequent wakings followed by oxygen desaturation and arousals cause excessive daytime sleepiness, resulting in consequences such as snoring, apnea, fatigue, and excessive daytime sleepiness: The major symptoms of OSAS[8,9]. Due to these factors, OSAS affects the quality of life by impairing professional and social responsibilities[6].

Kapur et al. [10] found daytime drowsiness in 46% of 1149 patients with a mild and moderate sleep disorder (AHI>15). In addition, the subjects also had respiratory obstruction, sleep restriction, insomnia, nocturnal leg complaints, and leg cramps.

According to the PSG results, patients presented with simple snoring (AHI<5) constituted the minor group in terms of patient number, with a ratio of 7.78% in this study. On the other hand, patients with severe sleep apnea (AHI>30) were the most common group, with a ratio of 43.91%. Moreover, severe OSAS patients were more common in the middle age group (40–59 years), and the number of severe OSAS patients decreased as the age increased, showing an inverse pattern. However, there was no significant relationship between AHI and age (p=0.054) statistically. In a simi-

Table 5. Evaluation of hypertension and diabetes mellitus status of patients according to apnea-hypopnea ındex classification (n=501)

	n	%	AHI Mean±SD	p
HT				
Yes	170	33.93	37.86±23.11	0.000*
No	331	66.07	28.80±25.54	
DM				
Yes	98	19.56	39.75±24.68	0.000*
No	403	80.44	29.96±24.84	

AHI: Apne-hipopne ındex; DM: Diabetes mellitus; SD: Standart deviation; Independent t-test, *p<0.05.

Table 4. Evaluation of Age and Body Mass Index according to Apnea-Hypopnea Index classification (n=501)

	AHI				p
	Simple Snoring Mean±SD	Mild OSAS Mean±SD	Middle OSAS Mean±SD	Severe OSAS Mean±SD	
Age (Year)	43.66±10.83	46.85±7.80	50.06±6.51	51.28±10.51	0.054
BMI (kg/m^2)	27.74±2.87	31.44±4.38	32.02±3.88	33.34±3.78	0.011*

AHI: Apne-hipopne index; BMI: Body mass index; SD: Standart deviation; Oneway ANOVA *p<0.05.

Table 6. Distribution of patients with age groups

Age	AHI										BMI						HT				DM			
	Simple		Mild		Middle		Severe		Weak		Normal		Overweight		Obese		Yes		No		Yes		No	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
19–39	13	2.59	33	6.59	19	3.79	33	6.59	-	-	12	2.40	38	7.58	48	9.58	6	1.20	92	18.36	4	0.80	94	18.76
40–59	21	4.19	86	17.17	68	13.57	132	26.35	-	-	23	4.59	92	18.36	192	38.32	59	11.78	248	49.50	101	20.16	206	41.12
60–79	5	1.00	15	2.99	21	4.19	54	10.78	-	-	10	2.00	25	4.99	60	11.98	32	6.39	63	12.57	64	12.77	31	6.19
80–87	-	-	-	-	-	-	1	0.20	-	-	-	-	1	0.20	-	-	1	0.20	-	-	1	0.20	-	-
Total	39	7.78	134	26.75	108	21.56	220	43.91	0	0	45	8.98	156	31.14	300	59.88	98	19.56	403	80.44	170	33.93	331	66.07

AHI: Apne-hipopne index; BMI: Body mass index; HT: Hypertension; DM: Diabetes mellitus.

lar study, the OSAS was accepted to be the most common in the 40–65 age range and its prevalence decreases after 65 years of age. As a result, age was shown to be a risk factor for OSAS[11].

As another matter of fact, Bloom et al. [12] stated that the major risk factors for snoring are being a male, being over 40 years old, presence of obesity, smoking, and alcohol use. Köktürk et al.[13] calculated the AHI as <5 in 9.4% of the patients in accordance with the PSG examination performed on patients only with snoring complaints. Considering that the regular snoring rate varies between 10 and 20%, they estimate that the frequency of OSAS in Turkey lies between 0.9% and 1.9%. In this study, the simple snoring rate with AHI <5 was 39 (7.78%). Nevertheless, Senaratna et al.[14] stated that the prevalence of patients with OSAS is high in the population; their estimation suggested that 9–38% of the adult population had OSAS. The prevalence among men (13–33%) was more common than women (13–33%). Nonetheless, being elderly and having a high BMI were associated with more frequent prevalence.

In other words, advanced age, high BMI (obesity), alcohol and cigarette use, and male gender are risk factors for OSAS[15]. Therefore, obesity has an essential role in the pathogenesis of patients with OSAS[16]. For this reason, Schwartz et al.[17] followed 13 obese patients with diet and weight loss methods for 1.5 years. The results of the study showed a decrease in their BMI (from 42 to 35=17% decrease) accompanied by a decline in their AHI (from 83 to 33=60% decrease).

BMI is the most commonly used indicator to determine the degree of obesity. Obesity is a major public health problem, and its prevalence is increasing. Hence, OSAS also follows an increasing pattern. OSAS in obese people may also have an impact on the pathogenesis of HT. Moreover, it is also associated with cardiovascular and metabolic abnormalities. In obese and OSAS patients, insulin resistance develops, sympathetic activity increases, renal function decreases, the renin-angiotensin system increases, baroreflex deteriorates, hyperleptinemia and endothelial dysfunction develop, oxidative stress increases, and systemic inflammation occurs[18,19].

A study by Andersen et al. [20] conducted on 62 children and adolescents with a mean age of 13.4 years revealed a decrease both in AHI and BMI in 6 months of weight loss treatment in obese or overweight patients. Another study performed by Noseda et al. [21] showed decreased respiratory distress in obese patients following a low-calorie diet.

Overall, obesity is associated with an increase in AHI. Fur-

thermore, high BMI, such as overweight and obesity, is an indispensable risk factor for OSAS in both adults and children; thus, the results were statistically significant[22]. Hence, obesity and OSAS generally share a similar pattern; 60%–90% of OSAS patients have a BMI >28[23]. Parallel to these findings, 59.88% of the patients presented with OSAS were determined to be obese in this study.

Typically, systemic blood pressure decreases by 20–23% during sleep and regains its normal levels when the person wakes up. Nevertheless, it has been found that systemic blood pressure increases during day and night sleep in patients with severe snoring and OSAS[24]. In case of apnea and hypopnea episodes during sleep, temporary blood pressure changes take place in the body, leading to an increase in arterial blood pressure of 30 mm-Hg or more. Changes in renin-angiotensin and vasoactive peptides may increase the occurrence of HT in insulin resistance syndrome, which is mainly seen in patients with overweight sleep apnea[25]. Obstructive sleep apnea is often associated with recurrent episodes of apnea and hypopnea and cardiovascular complications resulting from upper airway obstruction during sleep. In addition, it is also shown to be the underlying cause of cerebrovascular system diseases[6,26].

Javaheri et al. [27] have shown that sleep apnea syndrome has adverse effects on the incidence and morbidity of HT, coronary heart disease, arrhythmia, heart failure, and stroke. Knauert et al.[28] concluded that patients with undiagnosed and untreated OSAS could develop cardiovascular diseases, stroke, metabolic diseases, daytime sleepiness, workplace errors, traffic accidents, and death due to physiological abnormalities. These results come along with a burden in the economic aspect as well. Therefore, the negative impact on health, social elements, and costs can be reduced by the diagnosis and treatment of OSAS. However, sleep disorders are often undiagnosed, resulting in a negative development affecting patients' health and life quality, according to a study published by Rajaratnam et al. [29] As a result, screening programs should be performed to detect sleep disorders to prevent and decrease these risks through treatment.

Supporting these works, Gonzaga et al.[30] stated that there is a high rate of OSAS in the general population and emphasized the necessity of diagnosis and treatment of hypertensive patients by performing sleep apnea screening to reduce cardiovascular risk, especially for patients with obesity and resistance to hypertensive treatment. In addition, Shah and Roux discovered that treating obesity reduces the severity of obstructive sleep apnea and vice versa[18].

Limitation of the Study

My paper is organized in sample collected from a unique center. A multicenter study would be more valuable to analyze osas and coexistent comorbidities in all age groups. In addition, no patient with a BMI corresponding to underweight participated in the study.

Conclusion

Evidently, as patients' BMI increases, their AHI increases as well. It has also been revealed that patients with severe OSAS have higher BMI. A statistically significant correlation was found between the severity of AHI and BMI. In addition, as BMI and AHI increase, the frequency of HT and DM presence also increases; the relationship between them was statistically significant. The mean age of the patients was similar in all AHI groups; nonetheless, the overall trend suggested that as age increases, the severity of AHI also slightly increases. However, no statistically significant relationship was obtained between the severity of AHI and age. In this study, patients with severe AHI were more common in the 40–59 age group. Moreover, since no underweight patient applied to our hospital with a snoring complaint, no OSAS, HT, and DM cases were studied among underweight patients. Consequently, obesity appears to play a major role in OSAS development.

Ethics Committee Approval: The study was approved by the Istanbul Haydarpasa Numune Training and Research Hospital Ethics Committee (Date: April 21, 2021; No: 3307).

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