

# Relationship between obesity with symptoms and findings of obstructive sleep apnea syndrome

## Obstrüktif uyku apne sendromu semptom ve bulguları ile obezite arasındaki ilişki

Murat Ünlü<sup>1</sup>, Ayşe Iriz<sup>2</sup>, Berçem Ayçiçek Doğan<sup>3</sup>, A. Seçil Kayalı Dinç<sup>2</sup>, Engin Dursun<sup>4</sup>, Adil Eryılmaz<sup>2</sup>, Aydın Acar<sup>2</sup>

<sup>1</sup>Department of Otorhinolaryngology, Medline Hospital, Aydın, Turkey

<sup>2</sup>Department of Otorhinolaryngology, Ankara Numune Training and Research Hospital, Ankara, Turkey

<sup>3</sup>Division of Endocrinology and Metabolism, Department of Internal Medicine, Ankara Numune Training and Research Hospital, Ankara, Turkey

<sup>4</sup>Department of Otorhinolaryngology, Recep Tayyip Erdoğan University, Rize, Turkey

### Abstract

**Objective:** To evaluate the effect of obesity on obstructive sleep apnea syndrome (OSAS) by means of objective and subjective data.

**Methods:** A total of 70 patients were divided into obese (n=38; BMI>35 kg/m<sup>2</sup>) and non-obese patient groups (n=32; BMI<30 kg/m<sup>2</sup>). The Epworth sleepiness scale scores, modified Mallampati index scores, levels of obstruction in the oropharynx and soft palate, neck circumference and polysomnography findings between two groups were compared.

**Results:** Obese patients had an average Mallampati score of Class III while the non-obese study participants had an average score of Class II, with a statistically significant intergroup difference. In Muller's maneuver, the levels of obstruction in both the soft palate and oropharynx were higher in the obese patients with a statistically significant difference between two groups. When polysomnography results were examined, the average apnea-hypopnea index (AHI) score was determined to be 22.5 in the obese and 6.4 in the non-obese groups, respectively. Furthermore, average scores of rapid eye movement (REM) AHI in the non-obese and obese patients were 4.6 and 17.2 with a statistically significant difference between the groups. The average lowest oxygen saturation was 75.5% in the obese and 88% in the non-obese group, which represented a statistically significant difference between groups. In the obese group, the number of patients with REM-dependent OSAS was higher than in the non-obese group which attained a level of statistical significance.

**Conclusion:** Our study indicated that obesity increases the severity of OSAS, in part due to significant narrowing of the airway at the level of the soft palate and oropharynx. Additionally, our study has shown that the risk of supine position-dependent OSAS and especially REM-dependent OSAS were notably higher in obese patients.

**Keywords:** Obesity, obstructive sleep apnea syndrome.

### Özet

**Amaç:** Bu çalışmanın amacı obezitenin obstrüktif uyku apne sendromu (OUAS) üzerindeki etkilerini objektif ve subjektif veriler eşliğinde değerlendirmektir.

**Yöntem:** Toplam 70 hasta obez (n=38; VKİ>35 kg/m<sup>2</sup>) ve obez olmayan (n=32; VKİ<30 kg/m<sup>2</sup>) olmak üzere iki gruba ayrıldı. Gruplar, Epworth uykululuk skalası, modifiye Mallampati indeks skoru, orofarenks ve yumuşak damaktaki tıkanıklığın seviyesi, boyun çevresi ve polisomnografi sonuçları açısından karşılaştırıldı.

**Bulgular:** Obez hastalarda ortalama Mallampati skoru Sınıf II-III iken obez olmayan hastalarda ortalama Mallampati skoru Sınıf II idi ve gruplar arasında istatistiksel olarak anlamlı fark mevcut idi. Müller manevrasında, hem yumuşak damakta hem de orofarenksteki tıkanıklığın şiddeti obez hastalarda daha yüksek idi ve gruplar arasındaki fark istatistiksel olarak anlamlı idi. Polisomnografi sonuçları incelendiğinde, ortalama apne-hipopne indeksi (AHI) puanı obez grupta 22.5 iken obez olmayan grupta 6.4 idi. Ayrıca, obez olmayan ve obez hastalarda hızlı göz hareketi (REM) AHI ortalama skorları 4.6 ve 17.2 idi ve gruplar arasında istatistiksel olarak anlamlı bir fark mevcuttu. Ortalama en düşük oksijen doyumluğu açısından gruplar arasında istatistiksel olarak anlamlı bir fark vardı ve doyumluk obez grupta %75.5 iken, obez olmayan grupta %88 idi. Obez gruptaki REM bağımlı OUAS'lı hasta sayısı obez olmayan gruptan istatistiksel olarak anlamlı düzeyde daha yüksekti.

**Sonuç:** Bu çalışmada, obezitenin, kısmi olarak yumuşak damak ve orofarenks seviyesinde havayolunun anlamlı derecede daralmasına neden olarak, OUAS şiddetini arttırdığı ortaya konmuştur. Ek olarak, çalışmamızda, supin pozisyon bağımlı OUAS ve REM bağımlı OUAS'ın obez hasta grubunda anlamlı olarak daha yüksek düzeyde olduğu ortaya konmuştur.

**Anahtar sözcükler:** Obezite, obstrüktif uyku apne sendromu.

**Correspondence:** Ayşe Seçil Kayalı Dinç, MD. Department of Otorhinolaryngology, Ankara Numune Training and Research Hospital, 06100, Ankara, Turkey.  
e-mail: secilkayali81@yahoo.com

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Obesity is one of the most common health problems throughout the world according to the Turkish Diabetes Epidemiology II (TURDEP II) study and it has a prevalence rate of 36% in Turkey. In addition, the worldwide obstructive sleep apnea syndrome (OSAS) rate is estimated to be between 1-5%, with a slightly lower rate of 0.9-1.4% in our country.<sup>[1]</sup> Although risk factors for OSAS are known, the triggering mechanisms are not yet fully understood. Furthermore, many diseases such as obesity, metabolic syndrome and cardiovascular diseases have been associated with OSAS and Calle et al. discovered that the symptoms of OSAS decrease when patients lose weight and even sometimes the patients fully recover.<sup>[2-4]</sup>

Although the relationship between obesity and OSAS has been the focus of many studies, a few of them have compared OSAS in obese and non-obese population groups. In the present study, we aimed to evaluate the effect of obesity on OSAS by means of objective and subjective data.

## Materials and Methods

### Study Design

Seventy patients with a mean age of  $44.3 \pm 11.7$  (range: 24 to 72) years, who were seen at our polyclinic with complaints of sleep apnea and snoring were enrolled in our study. Age, gender and body mass index (BMI) of all patients were recorded. The patients also completed the Epworth sleepiness scale form, which assessed their routine sleep schedule. However, patients without any signs and/or symptoms which obviate the need for polysomnography (PSG), those under the age of 18, individuals whose mental-conscious and orientation level were not considered to be within normal limits and those who slept inadequately during the PSG (total sleep duration <4 hours) were excluded from the study.

These patients were then divided into obese (17 males and 21 females;  $BMI > 35 \text{ kg/m}^2$ ) and non-obese (23 males and 9 females;  $BMI < 30 \text{ kg/m}^2$ ) patient groups. The patients' otorhinolaryngology examination results were within normal limits and the modified Mallampati index scores, which were developed by Samsoon and Young, were determined.<sup>[5]</sup> The severity of obstruction were determined by performing flexible endoscopic examinations and using Muller's maneuver, which determined the severity of stenosis as 1+ (0-25%), 2+ (25-50%), 3+ (50-75%) and 4+ (75-100%). Later, the PSG was applied after the patients slept for an entire night and the results were simultaneously recorded.

## Statistical Analysis

The analysis of data was performed utilizing the SPSS for Windows 11.5 software program (SPSS Inc., Chicago, IL, USA). Student's t-test was used to establish the statistically significant differences regarding to the averages between the two groups and the Mann-Whitney U test was used to calculate the median values. Categorical variables were evaluated via Pearson's chi-square test or Fisher's exact test.

## Results

Mean BMI was calculated as  $38.9 \pm 4.6$  (range: 34.8 to 42.1)  $\text{kg/m}^2$  in the obese and  $22.7 \pm 2.2$  (range: 19.5 to 25.4)  $\text{kg/m}^2$  in the non-obese groups, while mean neck circumference was  $40.1 \pm 2.5$  (range: 35.0 to 45.0) cm in the obese and  $38.8 \pm 1.4$  (range: 35 to 41) cm in the non-obese groups. This higher circumference in the obese patients was statistically significant ( $p=0.006$ ). In addition, apnea-hypopnea index (AHI) and neck circumference were evaluated and a statistically significant correlation was found between these two variables ( $p < 0.001$ ). Average Epworth sleepiness scale score was 8 (range: 2 to 17) in the obese and 6 (range: 2 to 13) in the non-obese groups, respectively without any statistically significant difference between groups ( $p=0.106$ ). Obese patients had an average Mallampati score of Class III while the non-obese study participants had an average score of Class II, with a statistically significant intergroup difference ( $p < 0.001$ ) (Fig. 1).

Muller's maneuver was performed by way of flexible endoscopic examination in our study. The level of the soft palate obstruction was also evaluated in the obese (2+; 25-50%) and non-obese (1+; 0-25%) groups. In Muller's

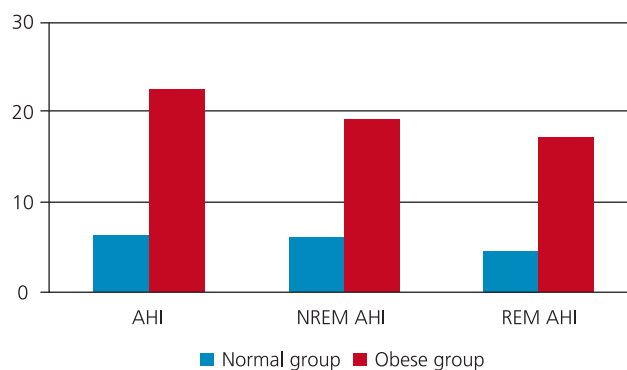


Fig. 1. Comparison of the Mallampati index scores in the obese and non-obese patient groups.

maneuver, the levels of obstruction in both the soft palate and oropharynx were higher in the obese patients with a statistically significant difference between obese and non-obese groups ( $p < 0.001$  and  $p = 0.002$ , respectively) (Fig. 2).

When PSG results were examined, there was no statistically significant difference between the average percentages of obese (84.9%) and non-obese patients (86%) regarding sleep efficiency ( $p = 0.597$ ). The average AHI score was determined to be 22.5 (range: 2.2 to 77.2) in the obese and 6.4 (range: 0.1 to 19.5) in the non-obese groups, respectively. Furthermore, average scores of rapid eye movement (REM) AHI in the non-obese and obese patients were 4.6 (range: 0.0 to 26.8) and 17.2 (range: 0.0 to 85.9) with a statistically significant difference between the groups ( $p < 0.001$ ,  $p = 0.002$  and  $p < 0.001$ , respectively). The average lowest oxygen saturation was 75.5% (range: 40 to 90%) in the obese and 88% (range: 72 to 93%) in the non-obese group, which represented a statistically significant difference between groups ( $p < 0.001$ ). The PSG findings revealed that the frequency of simple snoring ( $AHI < 5$ ) was statistically significantly higher in the non-obese group ( $p = 0.003$ ). However, severe OSAS ( $AHI > 30$ ) was seen more frequently in the obese group which was also statistically significant ( $p < 0.001$ ). Any statistical difference was not observed between the two groups in terms of the AHI scores of mild and moderate OSAS ( $p > 0.05$ ) (Fig. 3). In the obese group, the number of patients with REM-dependent OSAS was higher than those in the non-obese group which attained a level of statistical significance ( $p < 0.013$ ). Position-dependent OSAS was more frequently seen in the non-obese group compared with the obese group, with a difference which was also deemed to be statistically significant ( $p = 0.004$ ). However, any statistical significance differences were not seen between both groups with respect to the incidence of these two types of OSAS ( $p > 0.05$ ).

### Discussion

Both OSAS and obesity are common in our society and many diseases, including obesity, metabolic syndrome and cardiovascular disease have been associated with OSAS. Furthermore, obesity is noted as being one of the seven causes of sleep disorders in the International Classification of Sleep Disorders.<sup>[6]</sup> Obstructive sleep apnea syndrome is the most frequently seen sleep-related breathing disorder, with an observed prevalence of 2-4% in middle-aged adults and up to 20% in the elderly.<sup>[2,3,7]</sup>

Contrary to the popular belief, obesity does not necessarily correlate to being overweight precisely, but it in fact demonstrates that the fat composition in the body is redundant (higher than the average ranges detected in the non-obese population).<sup>[8]</sup> In a Turkish study in which 24,788 individuals were scanned, obesity was detected in 30% of females, 13% of males and 22.3% of the population in general.<sup>[9]</sup> Obesity has been found to be the major risk factor for OSAS with a 10% weight gain beyond the normal range being associated with an increased risk of developing this disorder.<sup>[10]</sup> While obesity occurs more frequently in females, males have a markedly increased risk for OSAS, which was confirmed in our study.<sup>[11]</sup> We have discovered that especially in the obese group, AHI scores increased more frequently in obese males than obese females and this finding was overwhelmingly statistically significant ( $p < 0.01$ ).

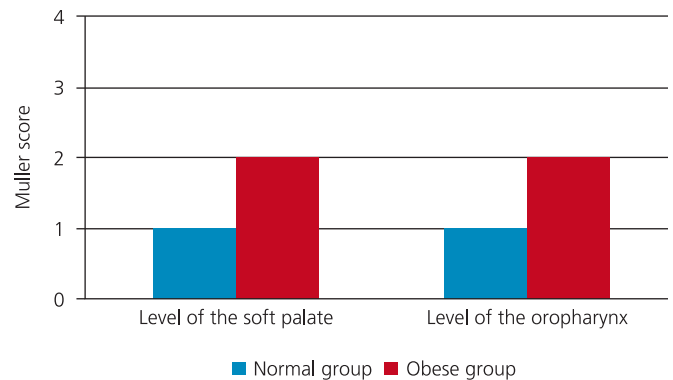


Fig. 2. Comparison of the levels of obstruction in the soft palate and oropharynx in the obese and non-obese patient groups.

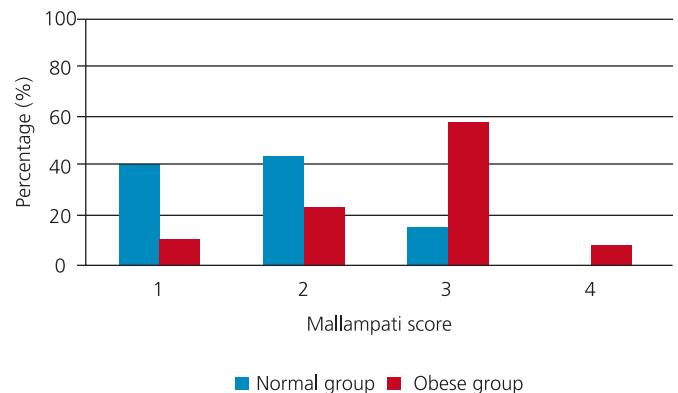


Fig. 3. Comparison of the apnea-hypopnea index (AHI) scores in the obese and non-obese patient groups.

The mechanisms linking obesity with risk of OSAS include diminished pharyngeal lumen diameter, due to fatty tissue in the lateral walls of the airway, decreased upper airway muscle strength due to fatty deposits in the muscles and reduced upper airway diameter secondary to a mass effect of the enlarged abdomen on the chest wall and tracheal traction.<sup>[6-8]</sup>

Moreover, previous studies have demonstrated that rather than a generalized increase in fat mass, central obesity, for which abdominal obesity is used as a surrogate and fat distribution in the upper part of the body, where neck circumference is used as a marker, play key roles in the development of OSAS.<sup>[12]</sup>

The most common parameter used to evaluate the degree of obesity is BMI. The National Center for Health Statistics defines BMI between 18.5 and 24.9 as normal; BMI between 25.0 and 29.0 as overweightness and BMI greater than 30.0 as obesity.<sup>[10]</sup> In a study published in 2001 by Resta et al., the authors determined that OSAS was observed in more than 50% of people with a BMI score of higher than 40.<sup>[13]</sup>

Terris et al. detected a moderate relationship between collapse rates and the level of sleep apnea.<sup>[14]</sup> In our study, we found that the levels of obstruction, detected when examining the lower levels of obstruction in both the soft palate and oropharynx via Muller's maneuver were statistically significantly correlated with the AHI scores.

A comparative study by Chiarakul et al. performed in 2007 also reported that a more significant increase in AHI scores during REM occurred in the obese patients compared to the non-obese patients.<sup>[15]</sup> Moreover, they detected that the oxygen saturation rate was statistically significantly lower in the obese group ( $p < 0.05$ ).

Oksenberg et al. demonstrated that treatment with continuous positive airway pressure is more beneficial for obese patients lying in the supine position rather than in a lateral position and Mancini et al. determined that positional-dependent OSAS was more frequent in obese patients.<sup>[16,17]</sup> In our study, we confirmed that the AHI scores increased while lying in the supine position and in the REM period, which were statistically significant findings. Furthermore, minimum oxygen saturation rate was statistically significant lower in the obese group ( $p < 0.05$ ). The total sleep duration and sleep efficiency of the patients in our two groups were similar without any statistically significant difference between groups.

## Conclusion

Our study indicated that obesity increases the severity of OSAS, in part due to significant narrowing of the airway at the level of the soft palate and oropharynx. Furthermore, it should be noted that the risk is greater for males, especially when combined with obesity. Additionally, our study has shown that the risk of supine position-dependent OSAS and especially REM-dependent OSAS were notably higher in obese patients.

**Conflict of Interest:** No conflicts declared.

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