

# The Importance of Sleep Position in Obstructive Sleep Apnea Syndrome

## Obstrüktif Uykü Apne Sendromunda Uyküde Yatış Pozisyonunun Önemi

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### Abstract

### Özet

**OBJECTIVE:** Sleeping in the supine position has an important role in the severity and development of sleep apnea. Significant increase in the Apnea-Hypopnea Index (AHI) in cases with Positional Obstructive Sleep Apnea Syndrome (OSAS) seen in the side-lying position and in those sleeping in the supine position with moderate total AHI index scores, induce striking decreases in oxygen saturation. This condition is crucial in the emergence of OSAS-related complications secondary to hypoxemia. The objective of this study is to compare the incidence of comorbidities, and polysomnographic findings in cases diagnosed as positional OSAS, and those with different degrees of OSAS.

**MATERIAL AND METHODS:** We performed a retrospective study. Patients whose supine AHI scores increased relative to their non-supine AHI scores leading to further deterioration of their OSAS (from mild to moderate-severe, and from moderate to severe degrees of OSAS) were included in the study.

**RESULTS:** A total of 170 patients with positional OSAS, with a mean age of 49.4 years, were included. Patients were divided according to their AHI values as mild (AHI=5-15, n=37) and moderate-severe OSAS patients (AHI >15, n=133). There were no differences between the two groups as to concomitant conditions (hypertension, congestive heart failure, coronary artery disease, cerebrovascular disease), Epworth Sleepiness Score (ESS) and average oxygen saturation.

**CONCLUSION:** Lack of differences in the rates of additional disorders between the two groups may indicate OSAS related complications that developed in patients with mild degree positional OSAS. Therefore, AHI should be evaluated in cases with OSAS sleeping in every lying position. Cases with positional OSAS should be evaluated as a different clinical entity and the treatment plan should be made accordingly. Thus, development of OSAS related complications could be prevented in the earlier stages.

**KEY WORDS:** Sleep apnea, obstructive, supine position

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**AMAÇ:** Uyküde sırtüstü yatış pozisyonunun uykü apne gelişmesi ve ağırlığı üzerinde önemli rolü vardır. Pozisyonel Obstrüktif Uykü Apne Sendromlu (OSAS) olgularda yan yatış pozisyonundaki ve total Apne Hipopne İndeksi (AHI) çok yüksek olmasa da, sırtüstü pozisyonunda AHI'nde meydana gelen anlamlı artış, oksijen saturasyonunda belirgin azalmalara neden olmaktadır. Bu durum hipoksemiye bağlı gelişen OSAS'la ilişkili komplikasyonların ortaya çıkması bakımından önemlidir. Bu çalışmanın amacı, pozisyonel OSAS tanılı ve OSAS ağırlık dereceleri farklı olan olgularda, ek hastalıkların görülme oranlarını ve polisomnografi (PSG) bulgularını karşılaştırmaktır.

**GEREÇ VE YÖNTEMLER:** Çalışma retrospektif olarak yapıldı. Non-supin pozisyonundaki AHI ile karşılaştırıldığında, supin pozisyonunda AHI artarak OSAS ağırlık derecesi bir üst kategoriye çıkan olgular (hafif iken orta-ağır dereceye, orta iken ağır dereceye) çalışmaya alındı.

**BULGULAR:** Yaş ortalaması 49,4 olan 170 pozisyonel OSAS'lı olgu çalışmaya alındı. Total AHI'ne göre olgular hafif (AHI=5-15, n=37) ve orta-ağır (AHI >15, n=133) OSAS'lılar olarak iki gruba ayrıldı. Her iki grup arasında hipertansiyon, konjestif kalp yetmezliği, koroner arter hastalığı ve serebrovasküler hastalık gibi ek hastalıkların görülme oranı ve ortalama oksijen saturasyonu, Epworth Uyküluluk Skoru (ESS) ortalamaları açısından fark yoktu.

**SONUÇ:** İki grup arasında ek hastalıkların görülme oranları açısından fark olmaması, hafif dereceli olgularda, OSAS ilişkili komplikasyonların geliştiğini göstermektedir. Bu nedenden dolayı ki OSAS'lı olgularda her türlü yatış pozisyonundaki AHI dikkatlice değerlendirilmeli, pozisyonel OSAS'lı olgular ayrı bir antite olarak ele alınmalı ve tedavi planı buna göre yapılmalıdır. Böylece OSAS'a bağlı komplikasyonların gelişmesi daha erken dönemlerde önlenmiş olacaktır.

**ANAHTAR SÖZCÜKLER:** Uykü apne, tıkaçıcı, sırtüstü pozisyon

### INTRODUCTION

Obstructive Sleep Apnea Syndrome (OSAS) is a commonly seen disorder, and prevalence in adults aged 20 to 100 years has been reported to be 3.9% in men and 1.2% in women [1]. The disorder is characterised by periods of breathing cessation (apnea) and reduced breathing (hypopnea). Both types have a similar pathophysiology and are generally considered to have an identical unfavourable impact on patients. There are several methods of quantifying the severity of the disorder, such as measuring the number of apneas and hypopneas per hour of sleep (the apnea-hypopnea index: AHI),

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the degree of oxygen desaturation during sleep or the severity of the most commonly associated symptom, i.e. daytime sleepiness.

Many factors are known to contribute to the development of OSAS. Advanced age, male gender, obesity, drugs, genetic factors, configuration and caliber of the airway, sleeping position, upper respiratory tract muscles and upper respiratory tract reflexes and cytokines are some of the contributing factors. Whatever the reason is, the outcome is an upper respiratory tract obstruction. Since pharynx is the only collapsible segment of the respiratory tract, it is the most critical region where obstruction develops [2,3]. The sleeping position is a mechanical factor that may contribute to the development of OSAS. In both apneic and non-apneic persons, the cross-sectional area of airways decreases in the supine position which is more significant in cases with OSAS [4]. When the person lies in the supine position, posterior shift of the tongue and soft palate narrows the pharyngeal airway, a phenomenon called "gravity effect" [2,3]. Cases with OSAS whose supine AHI scores are  $\geq 2$  times higher than those sleeping in other lying positions are defined as patients with "position-dependent OSAS or positional OSAS" [5,6]. As understood from its definition in cases with positional OSAS, severity of the disease increases markedly in the supine position. In position-dependent cases, and especially in the treatment of patients with mild OSAS, current palliative approaches, such as lying on a backpack or tennis ball, are preferable. The aim of this study is to compare cases with mild, and moderate-severe positional OSAS with respect to comorbidities, and polysomnographic findings, review relevant therapeutical approaches and to emphasize the importance of sleep position in OSAS.

## MATERIAL AND METHODS

### Patients

We performed a retrospective evaluation of patients studied in our sleep disorders center (Gazi University, Faculty of Medicine, Ankara, Turkey). The patients were selected sequentially. From file archives arranged according to the order of the referrals to our sleep laboratory, polysomnography records, reports and other medical information were obtained. Totally 1855 file records were evaluated. OSAS patients had been examined using polysomnography (PSG) and classified according to their AHI values. An AHI of  $\geq 5/h$  was accepted as a cut-off value for a positive polysomnographic test result. Patients were categorized as mild (5-15), moderate-severe ( $>15$ ) according to American Academy of Sleep Medicine Task Force criteria [7]. In our study, according to their total AHI values, study subjects were classified as Group 1 with mild OSAS patients ( $n=37$ ), and Group 2 with combined moderate-severe OSAS ( $n=133$ ) patients. AHI values in non-supine and supine position were evaluated. The patients whose AHI values in the supine position were at least twofold of AHIs measured in non-supine position, and also cases in whom severity of OSAS increased during transition from non-supine to supine position (from mild to moderate-severe, and from moderate to severe degrees of OSAS) were included in the study. Hundred and seventy cases complying with these criteria were enrolled in the study. Apart from OSAS patients with upper airway resistance syndrome (UARS), patients with central sleep apnea syndrome

(CSAS) or narcolepsy and periodic limb movements (PLMs) were excluded from the study. Position sensor (Sleep Mate TM) was used to determine positional movements during sleeping. Informed consent was obtained from the patients.

### Polysomnography

Overnight PSG was performed in all patients using a computerized system (Somnostar alpha; Somnomedics, USA) which included electrooculography (2 channels), electroencephalography (4 channels), electromyography of submental muscles (2 channels), and of anterior tibialis muscle of both legs (2 channels), an electrocardiography and an airflowmeter (with an oro-nasal transducer). Chest and abdominal efforts (2 channels) during respiration were recorded using inductive plethysmography, and also arterial oxyhemoglobin saturation ( $\text{SaO}_2$ ; 1 channel) was measured by pulse oximetry with a finger probe. Sleep stages were scored according to the standard criteria of Rechtschaffen and Kales [8]. Arousals were scored according to accepted criteria of American Sleep Disorders Association (ASDA) [9]. In our study; we assessed nasal airflow with a pressure transducer. Based on the guidelines of American Academy of Sleep Medicine (AASM) published in 2007, apnea was defined as  $\geq 90\%$  decrease in air flow persisting for at least 10 seconds relative to the basal amplitude. AASM provided 2 definitions for hypopnea. The recommended one is a  $\geq 30\%$  decrease in the air flow amplitude relative to the baseline values with associated  $\geq 4\%$  oxygen desaturation, all sustaining for at least 10 seconds. Alternative definition is formulated as  $\geq 50\%$  decrease in the air flow amplitude relative to the baseline values with associated  $\geq 3\%$  oxygen desaturation or arousal, all sustaining for at least 10 seconds. In our study hypopnea was determined according to the alternative definition [10]. Obstructive apneas, and hypopneas are typically distinguished from central apneas and hypopneas by comparative evaluation of respiratory efforts during the episode. AHI was defined as the number of obstructive apneic and hypopneic episodes per hour of sleep. Patients with an AHI of  $\geq 5$  were considered as OSAS.

### Statistical Analysis

The significance of differences between groups was determined using independent samples *t* test was used. Whenever data weren't normally distributed Mann-Whitney U test was applied. Comparing for categorical data Chi-Square ( $\chi^2$ ) test and Fisher Exact Chi-Square test was applied. Arithmetic means and standard deviation ( $\bar{x} \pm \text{SD}$ ) were calculated for all values obtained.

All statistical analyses were carried out using statistical software (SPSS, version 19.0 for Windows; SPSS, IBM, USA). Differences were considered significant at ( $p < 0.05$ ).

## RESULTS

A total of 170 patients with positional OSAS, 145 men and 25 women, with a mean age of  $49.37 \pm 10$  years, were included in the study. According to their total AHI values, the patients were divided into two groups, as Group 1: AHI=5-15, mild OSAS patients ( $n=37$ ), and Group 2: AHI  $>15$  moderate-severe OSAS patients ( $n=133$ ). The demographic and clinical data of the study groups are presented in Table 1. When Group 1 and Group 2 were compared as for concomitant conditions (hypertension, congestive heart failure,

**Table 1.** Demographic and clinical data of the study groups

	Mild OSAS AHI=5-15 (n=37)	Moderate-severe OSAS AHI≥15 (n=133)	p
Men age (year) (n±SD)	46.23±7.89*	50.30±10.4	0.026
BMI (kg/m <sup>2</sup> )	29.18±5	29.4±4.23	0.720
ESS (n±SD)	11.41±5.2	11.04±5.2	0.728
Av O <sub>2</sub> sat (%)	92±1.6	89.71±7.5	0.062
Min O <sub>2</sub> sat (%)	82.71±4.9	78.08±7.5	0.0001
SE (%)	80.58±8.6	75.45±11.3	0.01
ARI (n±SD)	15.94±8.7	24.14±11.1	0.0001
Hypertension (%)	22.6	25.9	0.707
CHF (%)	0	0.9	1.000
CAD (%)	3.2	7.2	0.684
CVD (%)	0	0.9	1.000
Supine Position (min)	211.41±25.88	210.28±24.21	0.805
Nonsupine Position (min)	215.32±22.18	210.01±24.48	0.235

BMI: body mass index; ESS: Epworth sleepiness score; Av O<sub>2</sub> sat: average oxygen saturation; Min O<sub>2</sub> sat: minimum oxygen saturation; SE: sleep efficiency; ARI: arousal index; CHF: congestive heart failure; CAD: coronary artery disease; CVD: cerebrovascular disease; min: Minute; \*Mean±Standard deviation

coronary artery disease, cerebrovascular disease), the incidences in both groups were similar for all disease states (p=0.818 for hypertension, p=1.00 for congestive heart failure, p=0.684 for coronary artery disease, p=1.00 for cerebrovascular disease). Mean Epworth Sleepiness Scores (ESS) for Group 1 and Group 2 were 11.41±5.2 and 11.04±5.2, respectively (p=0.937). In 17 of the 31 patients with mild OSAS, ESS scores were higher than 10. There were also no differences as for average oxygen saturation between mild and moderate-severe OSAS patients (92.00±1.6 and 89.71±7.5, respectively, p=0.062). Minimum oxygen saturation was lower in Group 2 when compared with Group 1 (78.08±7.5 vs 82.71±4.9, p=0). During diagnostic PSG, the time passed in each sleep position for Group 1 and 2 was similar. In other words, the patients in both groups had spent acceptably similar sleeping times in the supine or lateral lying positions.

## DISCUSSION

The most important outcome of this study is that the incidence of comorbidities as congestive heart failure, coronary artery disease, cerebrovascular disease in cases with mild position-dependent OSAS is as high as those with moderate-severe cases with OSAS. This phenomenon indicates that in cases with mild OSAS, OSAS-related complications develop at an early stage of the disease. Another important finding is that all night long, average oxygen saturation is similar in both groups. In other words, oxygenization of mild cases is also impaired as is the case in patients with moderate-severe OSAS. Our study has one limitation. Retrospective nature of the study brings limitations for the interpretation of findings.

Obstructive sleep apnea syndrome is a syndrome characterized with repetitive episodes of upper respiratory tract obstruction during sleep. During sleeping in supine position, tongue and soft palate converge to the pharyngeal wall and lead decreasing functional pharyngeal area. Consequently, partial or complete upper respiratory tract obstruction may ensue.

Since number of apneic and hypopneic episodes in cases with positional OSAS increases during supine sleeping position, duration of supine posture and frequency of apnea-hypopnea episodes developed during supine position are crucial points to be considered [11]. In the literature; patients were stratified in a group of positional (PP) (AHI supine ≥ 2 x AHI other position) and non-positional OSAS patients (NPP) [5,6,12-14]. Using this criteria, 57.7% of sleep apnea were classified as positional [13]. This is a higher percentage that cannot be ignored. Thus, AHI scores of body position should always be taken into consideration. Studies have shown that, position dependency is more common in mild to moderate OSAS than severe OSAS [12-14]. The frequency of apneas, and hypopneas in the supine lying position is higher in cases with positional OSAS. After especially apneic and many hypopneic episodes, decreases occurring in partial blood oxygen pressures result in intermittent oxygen desaturations in cases with OSAS who used to sleep mostly in the supine position at night. Repetitive nocturnal desaturation episodes affect autonomic nervous system. Bradycardic and tachycardic episodes occurring immediately after apneic attacks lead to cardiovascular disorders such as cardiac dysrhythmias and fluctuations in blood pressure. These outcomes manifest themselves as complications i.e. arrhythmias and hypertension [15]. As a result, respiratory events occurring during supine position induce oxygen desaturation and effects of hypoxemia face us as complications of OSAS. Lack of differences between patients with mild degree OSAS and moderate-severe degree OSAS as for concomitant conditions (hypertension, congestive heart failure, coronary artery disease, cerebrovascular disease) may be considered beginning complications associated with OSAS in cases with mild OSAS in our study. Therefore even if total AHI is within normal limits in patients who had higher AHI values and significant oxygen desaturation in the supine position, effective CPAP therapy should be considered rather than palliative therapy measures such as back ball, and back-pack. Similarly, apneas will be more frequently seen in cases with positional OSAS sleeping in the supine position, and these respiratory events will ensue in

arousals, interferences in sleep, daytime fatigue and sleepiness [16]. There was no difference between the two groups with regard to mean ESS in our study. Indeed, 17 of 31 cases with mild OSAS had ESS of >10. There were also no differences as for average oxygen saturation during night between mild and moderate-severe OSAS patients. So there were significant oxygen desaturation in patients with mild OSAS because of increasing respiratory events in the supine position.

Consequently, evaluation of OSAS cases based on only total AHI values without taken AHI in sleeping position into account would result in failure to recognize the cases with positional OSAS. Patients with positional OSAS should be evaluated carefully in terms of AHI and oxygen desaturation in the supin position. Effective PAP treatment should be thought rather than palliative treatment the management of patients with increasing the severity of OSAS and reduced oxygen levels in the supin position. Since required pressures in different postures in positional OSAS cases are different automatic CPAP devices should be an option for effective treatment and for increasing the patient's compliance.

In conclusion, cases with positional OSAS should be evaluated as a different clinical entity and treatment plan should be made accordingly. Using this approach, development of OSAS related complications could be prevented in earlier stages.

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**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

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