ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

DOI: 10.24179/kbbbbc.2024-106204

Investigation of Clinical, Physiological, and Polysomnographic Parameters in Patients with Obstructive Sleep Apnea Syndrome

Obstrüktif Uyku Apne Sendromu Olan Hastalarda Klinik, Fizyolojik ve Polisomnografik Parametrelerin İncelenmesi

Aynur ALİYEVA[a,b], Konul MAMMADOVA[a,c], Ramil HASHİMLİ[d]

[a]Melhem International Hospital, Clinic of Otorhinolaryngology, Head and Neck Surgery, Baku, Azerbaijan
[b]Yeditepe University Institute of Health Sciences, Doctoral Program of Neuroscience, İstanbul, Türkiye
[c]İstanbul University İstanbul Faculty of Medicine, Department of Chest Diseases, İstanbul, Türkiye
[d]LOR Hospital, Clinic of Otorhinolaryngology, Head and Neck Surgery, Baku, Azerbaijan

ABSTRACT Objective: This study aimed to examine clinical, physiological, and polysomnographic parameters in patients with obstructive sleep apnea syndrome (OSAS), comparing positional and non-positional cases based on variations in the Apnea-Hypopnea Index (AHI) between sleep positions. **Material and Methods:** A retrospective analysis was conducted on the records of 46 patients diagnosed with OSAS via overnight polysomnography from December 2023 to May 2024. Based on AHI differences in supine and lateral positions, patients were classified as positional or non-positional. Parameters evaluated included demographic data, symptom prevalence, OSAS severity, polysomnographic metrics, and upper airway physical examination findings. **Results:** Non-positional patients reported more severe symptoms, with significantly higher Epworth Sleepiness Scale scores (13±4.6 vs. 8.18±3.21; p=0.032) and a greater prevalence of witnessed apnea (91% vs. 43.5%; p=0.023), insomnia (73.9% vs. 21.7%; p=0.002), and morning headaches (78.3% vs. 39%; p=0.034). Nasal obstruction was more common in positional patients (65% vs. 21.7%; p=0.008), who also demonstrated higher sleep efficiency (85.69±7.25% vs. 69.79±11.23%; p=0.003). Severe OSAS was more frequent in non-positional patients (65% vs. 22%; p=0.003). AHI values were significantly higher overall in non-positional patients (65.49±20.49 vs. 29.56±15.23; p=0.000*) and supine/lateral positions. **Conclusion:** This study underscores distinct clinical and polysomnographic profiles between positional and non-positional OSAS patients, suggesting that positional therapy may benefit positional cases, while non-positional patients may require more comprehensive treatment.

Keywords: Obstructive sleep apnea syndrome; obstructive sleep apnea syndrome; Apnea-Hypopnea Index; polysomnography; sleep

ÖZET Amaç: Bu çalışma, obstrüktif uyku apne sendromu (OUAS) olan hastalarda klinik, fizyolojik ve polisomnografik parametreleri incelemeyi ve Apne-Hipopne İndeksi (AHİ) varyasyonlarına göre pozisyonel ve pozisyonel olmayan vakaları karşılaştırmayı amaçlamaktadır. **Gereç ve Yöntemler:** Aralık 2023-Mayıs 2024 tarihleri arasında gece boyunca yapılan polisomnografi ile OUAS tanısı alan 46 hastanın tıbbi kayıtları retrospektif olarak incelendi. Hastalar, sırtüstü ve yan pozisyonlardaki AHİ farklılıklarına göre pozisyonel veya pozisyonel olmayan olarak sınıflandırıldı. Değerlendirilen parametreler demografik veriler, semptom yaygınlığı, OUAS şiddeti, polisomnografik veriler ve üst solunum yolu fizik muayene bulgularını içermektedir. **Bulgular:** Pozisyonel olmayan hastalar daha ciddi semptomlar göstermiş olup, Epworth Uykululuk Ölçeği skorları (13±4,6'ya karşı 8,18±3,21; p=0,032) ve tanıklı apne (%91'e karşı %43,5; p=0,023), uykusuzluk (%73,9'a karşı %21,7; p=0,002) ve sabah baş ağrısı (%78,3'e karşı %39; p=0,034) gibi semptomlar açısından daha yüksek prevalans göstermiştir. Nazal tıkanıklık, pozisyonel hastalarda daha sık görülmüştür (%65'e karşı %21,7; p=0,008) ve bu grup daha yüksek uyku etkinliği göstermiştir (%85,69±7,25'e karşı %69,79±11,23; p=0,003). Şiddetli OUAS, pozisyonel olmayan hastalarda daha sık görülmüştür (%65'e karşı %22; p=0,003). AHİ değerleri, hem genel olarak (65,49±20,49'a karşı 29,56±15,23; p=0,000) hem de sırtüstü/yan pozisyonlarda pozisyonel olmayan hastalarda anlamlı derecede daha yüksektir. **Sonuç:** Bu çalışma, pozisyonel ve pozisyonel olmayan OUAS hastaları arasında belirgin klinik ve polisomnografik farklılıkları vurgulamaktadır; pozisyonel tedavinin pozisyonel vakalarda yarar sağlayabileceğini, pozisyonel olmayan hastaların ise daha kapsamlı bir tedaviye ihtiyaç duyabileceğini önermektedir.

Anahtar Kelimeler: Obstrüktif uyku apne sendromu; obstrüktif uyku apne sendromu; Apne-Hipopne İndeksi; polisomnografi; uyku

Correspondence: Aynur ALİYEVA
Melhem International Hospital, Clinic of Otorhinolaryngology, Head and Neck Surgery, Baku, Azerbaijan
E-mail: dr.aynuraliyeva86@gmail.com

Peer review under responsibility of Journal of Ear Nose Throat and Head Neck Surgery.

Received: 12 Oct 2024 ***Received in revised form:*** 12 Nov 2024 ***Accepted:*** 27 Nov 2024 ***Available online:*** 11 Dec 2024

Obstructive sleep apnea syndrome (OSAS) is a common sleep disorder characterized by repetitive episodes of partial (hypopnea) or complete (apnea) upper airway collapse during sleep, leading to disrupted sleep and decreased oxygen levels.[1,2] The severity of OSAS is typically assessed using the Apnea-Hypopnea Index (AHI), with the condition often worsening in the supine sleeping position. Numerous studies have shown that AHI can more than double in the supine position compared to the lateral position, while in some cases, lateral sleeping can normalize AHI (AHI<5), a condition known as positional OSAS (p-OSAS).[3,4] Positional dependency occurs in about 56% of patients with OSAS, indicating its clinical importance.[5-7]

While the underlying mechanisms of p-OSAS are not entirely clear, it is suggested that anatomical differences in upper airway structures, such as a narrower pharyngeal airway or differences in muscle tone, may play a key role.[7,8] Positional therapy has been recommended as an initial treatment option for p-OSAS, offering a non-invasive approach to mitigate symptoms.[9-11] However, understanding the physiological and anatomical variations between positional and non-p-OSAS remains crucial for tailoring effective treatment strategies.

This study investigates and compares the clinical, physiological, and polysomnographic (PSG) parameters in positional and non-p-OSAS patients, providing a comprehensive perspective on the variations and clinical implications of positional dependency in OSAS.

MATERIAL AND METHODS

This study adhered to the Declaration of Helsinki's highest ethical standards and principles. Informed consent was secured from all participants, ensuring anonymity and confidentiality. Ministry of Health of the Republic Azerbaijan, State Advanced Training Institute for the Doctors named after A. Aliyev Local Ethics Committee, approved (date: February 09, 2024, no: OSAS/Research No 1/*II*) this study.

PATIENTS

The medical records of patients diagnosed with OSAS who presented to our clinic between December 2023 and May 2024 were retrospectively reviewed. 46 Patients were included if they had undergone a full overnight PSG study, were diagnosed with OSAS (AHI>5), and had sufficient sleep time in both the supine and lateral positions for analysis.

The exclusion criteria were as follows:

1. Patients who had previously undergone upper airway surgery (e.g., tonsillectomy, uvulopalatopharyngoplasty) could alter upper airway anatomy and affect OSAS outcomes.

2. Patients with pulmonary diseases (chronic obstructive pulmonary disease, restrictive lung disease) which could impair oxygen saturation and confound the results.

3. Patients with severe cardiac failure or Cheyne-Stokes respiration, as these conditions are known to be associated with central sleep apnea.

4. Patients with central sleep apnea syndrome have a different pathophysiology and management than obstructive sleep apnea.

5. Patients with less than 30 minutes of recorded sleep in either the supine or lateral position during the PSG study, as insufficient time in these positions would compromise the accuracy of the positional analysis.

6. Patients met the inclusion criteria and were included in the study for further analysis.

DEMOGRAPHIC AND SYMPTOM DATA COLLECTION

Demographic data, including age, body mass index (BMI), neck circumference, and gender, were collected from patient medical records. Symptom data were gathered based on patient-reported experiences and clinical evaluations documented during their initial assessment. Key symptoms assessed included habitual snoring, witnessed apnea, daytime fatigue, morning headaches, insomnia, nasal obstruction, and dry mouth upon waking. Excessive daytime sleepiness was quantified using the Epworth Sleepiness Scale (ESS), where a score of 10 or higher indicated significant sleepiness.

UPPER AIRWAY PHYSICAL EXAMINATION

Upper airway anatomical features were assessed to determine potential physical contributors to obstruc-

tive sleep apnea severity and positional dependency. Physical examination findings documented included:

1. Septal Deviation: Assessed for nasal airflow obstruction, recorded as present or absent based on clinical observation.

2. Concha Hypertrophy: Evaluated in each patient to determine the extent of nasal cavity narrowing recorded if there was a significant enlargement of nasal turbinates.

3. Uvula and Soft Palate Pathologies: Inspected for abnormalities, including elongation or excessive soft tissue that may contribute to airway collapse.

4. Tonsil Size: Graded on a scale of I to IV based on the Brodsky grading system, with Grades III and IV indicating significant tonsillar hypertrophy.

5. Modified Mallampati Index (MMI): Measured as a clinical predictor of airway obstruction, with grades III and IV indicating higher airway collapsibility risk.

It is important to note that endoscopic laryngeal examination for assessing laryngeal structures and epiglottis position was not performed consistently in all patients. Consequently, this component was waived in this manuscript to maintain homogenity in the data presented.

PSG STUDY

The diagnosis of OSAS was confirmed through polysomnography. All participants underwent an overnight evaluation in the laboratory using a computerized polysomnography device (Philips Respironics ALICE 5 PSG) (Murrysville, Pennsylvania,USA). The recorded physiological signals included an electroencephalogram, electrooculogram, submental and leg electromyogram, electrocardiogram, chest and abdominal respiratory movements, arterial oxygen saturation measured by pulse oximetry, snoring, and body position. A sleep technician nurse observed the participants' behavior and verified their sleep positions. The sleep technician manually scored all sleep data according to the guideline criteria from **The AASM Manual for the Scoring of Sleep and Associated Events**.[12] Respiratory monitoring was performed using an oronasal flow sensor cannula to measure airflow at the mouth and nose, thoracic and abdominal belts to measure respiratory effort, a finger probe to assess oxygen saturation, and a microphone placed on the trachea to record snoring. Additionally, two-channel electrocardiography and leg movements via an electromyography sensor placed on the anterior tibialis muscle were recorded. Sleep stages and respiratory events were manually scored according to standard criteria.[12,13]

Obstructive apnea was defined as a cessation of airflow at the mouth and nose for at least 10 seconds, with continued respiratory effort. Hypopnea was defined as a 50% reduction in airflow at the mouth and nose and a 3% decrease in oxygen saturation or arousal.[13] The AHI was calculated by dividing the total number of obstructive apneas and hypopneas by the total sleep time (TST) in hours. Patients with an AHI>5 were diagnosed with OSAS. The severity of OSAS was classified as mild (AHI 5-15), moderate (AHI 16-30), or severe (AHI>30). Patients whose AHI normalized in the lateral position or whose AHI in the supine position was at least twice that of the lateral position were classified as positional patients (PP). In contrast, those with no significant difference in AHI between positions were classified as non-positional patients (NPP).

STATISTICAL ANALYSIS

All statistical analyses were performed using SPSS software (version 13.0; SPSS Inc., Chicago, IL, USA). Continuous variables were tested for normality with the Kolmogorov-Smirnov test. Parametric data were expressed as mean±standard deviation (SD) and compared using the independent sample t-test, while non-parametric data were analyzed with the Mann-Whitney U test. Categorical variables were presented as percentages and frequencies and compared using the chi-square (χ^2) test. Pearson's correlation analysis explored the relationships between positional changes in AHI and clinical parameters such as BMI, neck circumference, and ESS scores.[14] A p-value of less than 0.05 was considered statistically significant, and 95% confidence intervals (CI) were calculated where relevant.

RESULTS

The study cohort consisted of 46 patients, 31 males, and 15 females, with a mean age of 47.21±5.6 years. Of these, 23 patients (50%) were classified as PP and 23 (50%) as NPP. The male-to-female ratio was similar between the groups (p=0.823), with the majority of patients in both groups being male (p=0.0489), reflecting the typical gender distribution seen in OSAS.

DEMOGRAPHIC DATA

The demographic characteristics of the positional (PP) and non-positional (NPP) OSAS patients showed notable distinctions across age, BMI, neck circumference, and gender distribution.

PP were significantly younger, with a mean age of 43.6±2.21 years compared to 54.23±12.23 years in the non-positional group (p=0.038). In terms of BMI, PP also demonstrated significantly lower values (29.21±3.01) than NPP (32.15±4.3) with a p-value of 0.048.

Neck circumference, an indicator of anatomical factors contributing to airway obstruction, was significantly smaller in the positional group (40.18±1.15 cm) than in the non-positional group (45.23±3.32 cm) with a p-value of 0.045. Lastly, gender distribution was relatively similar between the groups, with a male-to-female ratio of 15/8 in the positional group and 16/7 in the non-positional group, showing no statistically significant difference (p=0.823). However, in the overall sample, a majority of patients were male (31 males and 15 females), which is consistent with the higher prevalence and severity of obstructive sleep apnea in males due to gender-based anatomical differences in upper airway structure (Table 1-Demographic data).

SYMPTOMS

NPP exhibited significantly more severe symptoms compared to PP, as reflected in multiple clinical measures. The ESS scores were notably higher in the non-positional group (13±4.6) compared to the positional group (8.18±3.21), with a p-value of 0.032, indicating greater daytime sleepiness in NPP. Additional symptoms were similarly elevated in the non-positional group, including a higher frequency of witnessed apnea episodes (91% vs. 43.5%, p=0.023), insomnia (73.9% vs. 21.7%, p=0.002), morning headaches (78.3% vs. 39%, p=0.034), and fatigue (60.9% vs. 13%, p=0.040), indicating a more severe symptom burden.

In contrast, nasal obstruction was reported more frequently among PP (65% vs. 21.7%, p=0.008), suggesting this may be a characteristic feature in this group. Habitual snoring was prevalent in both groups, with no significant difference observed (82.7% in PP vs. 91% in NPP, p=0.907) (Table 1-Symptoms).

PSG DATA

PSG parameters demonstrated significant differences between the positional and non-positional groups. The TST was comparable between groups, with PP recording an average of 340.12±50.23 minutes and NPP averaging 333.25±49.2 minutes (p=0.768). Supine sleep duration was also similar between the groups, with PP averaging 163.23±70.56 minutes and NPP 161.8±73.82 minutes (p=0.893). Similarly, lateral sleep duration showed no significant difference (168.35±80.27 minutes for PP and 165.09±78.96 minutes for NPP, p=0.852).

Significant differences were observed in sleep efficiency and oxygen saturation metrics. PP demonstrated higher sleep efficiency (85.69±7.25%) than NPP (69.79±11.23%, p=0.003). Mean oxygen saturation (SaO_2) during sleep was also higher in PP (92.52±5.01%) than in NPP (80.06±4.21%, p=0.041), with PP spending a greater percentage of time with SaO2 levels above 90% (72.09±25.32% vs. 38.54±25.36%, p=0.007).

AHI values highlighted differences in OSAS severity between the groups. The overall AHI was significantly lower in PP (29.56±15.23) than in NPP (65.49±20.49, p=0.000). Supine AHI was also lower in PP (62.27±19.15) than in NPP (80.21±16.89, p=0.003). Lateral AHI further distinguished the groups, with PP having a mean lateral AHI of 20.21±10.59 compared to 60.23±25.82 in NPP (p=0.000) (Table 1-Polysomnographic Data).

OSAS SEVERITY

The severity of OSAS was markedly different between the two groups. Severe OSAS (AHI>30) was

TABLE 1: Comparison of clinical and polysomnographic findings of OSAS patients.

Parameters	PP (n=23) $\bar{X}$±SD; %	NPP (n=23) $\bar{X}$±SD; %	p value	Total (n=46) $\bar{X}$±SD; %
Demographic data				
Age	43.6±2.21	54.23±12.23	0.038*	47.21±5.6
BMI	29.21±3.01	32.15±4.3	0.048*	30.68±3.71
Neck circumference	40.18±1.15	45.23±3.32	0.045*	42.71±2.48
Gender (M/F)	15/8	16/7	0.823	31/15* (p=0.0489)
Symptoms				
Habitual snoring	19/23 (82.7%)	21/23 (91%)	0.907	40/46 (86.7%)
Witnessed apnea	10/23 (43.5%)	21/23 (91%)	0.023*	31/46 (67.4%)
Fatigue	3/23 (13%)	14/23 (60.9%)	0.040*	17/46 (37%)
Morning headache	9/23 (39%)	18/23 (78.3%)	0.034*	27/46 (58.7%)
Insomnia	5/23 (21.7%)	17/23 (73.9%)	0.002*	22/46 (47.8%)
Nasal obstruction	15/23 (65%)	5/23 (21.7%)	0.008*	20/46 (43.5%)
Dry mouth	12/23 (52%)	11/23 (47.8%)	0.056	23/46 (50%)
ESS	8.18±3.21	13±4.6	0.032*	11.6±2.1
OSAS severity				
Mild OSAS	10/23 (43%)	1/23 (4%)	0.004*	11/46 (23.9%)
Moderate OSAS	8/23 (35%)	7/23 (30%)	0.765	15/46 (32.6%)
Severe OSAS	5/23 (22%)	15/23 (65%)	0.003*	20/46 (43.5%)
Polysomnographic data				
TST (min)	340.12±50.23	333.25±49.2	0.768	336.69±49.72
Supine sleep (min)	163.23±70.56	161.8±73.82	0.893	162.52±72.21
Lateral sleep (min)	168.35±80.27	165.09±78.96	0.852	166.72±79.62
Sleep efficiency (%)	85.69±7.25	69.79±11.23	0.003*	77.74±9.45
Mean SaO_2 (%)	92.52±5.01	80.06±4.21	0.041*	86.29±4.63
Time with SaO_2 >90% (%)	72.09±25.32	38.54±25.36	0.007*	55.32±25.34
AHI	29.56±15.23	65.49±20.49	0.000*	47.53±18.05
Supine AHI	62.27±19.15	80.21±16.89	0.003*	71.24±18.06
Lateral AHI	20.21±10.59	60.23±25.82	0.000*	40.22±19.73
Upper airway physical examination findings				
Septal deviation	15/23 (65%)	2/23 (8.7%)	0.003*	17/46 (37%)
Concha hypertrophy	18/23 (78%)	5/23 (21.7 %)	0.004*	23/46 (50%)
Uvula and soft palate pathologies	6/23 (26%)	18/23 (78%)	0.015*	24/46 (52%)
Tonsil size (III-IV)	3/23 (13%)	12/23 (52%)	0.032*	15/46 (32.6%)
MMI (III-IV)	2/23 (8.7%)	15/23 (65%)	0.016*	17/46 (37%)

*p<0.05; OSAS: Obstructive sleep apnea syndrome; PP: Positional patients; NPP: Non positional patients; TST: Total sleep time; BMI: Body mass index; ESS: Epworth Sleepiness Scale; AHI: Average Apnea-Hypopnea Index; MMI: Modified Mallampati Index; SD: Standard deviation.

found in 65% of NPP, compared to only 22% of PP (p=0.003). Additionally, in 43% of PP, AHI dropped below 5 when sleeping in the lateral position, whereas only one patient in the non-positional group experienced such a reduction (p=0.004). These findings underscore the efficacy of positional therapy in PP, who tend to have milder forms of OSAS (Table 1-OSAS Severity).

UPPER AIRWAY PHYSICAL EXAMINATION FINDINGS

Physical examination revealed distinct anatomical differences between the groups. Septal deviation (65% vs. 8.7%, p=0.003) and concha hypertrophy (78% vs. 21.7%, p=0.004) were significantly more common in PP, possibly contributing to their reliance on lateral sleep positions to alleviate nasal obstruction. In contrast, NPP were more likely to present

with uvula and soft palate pathologies (78% vs. 26%, p=0.015), higher MMI grades III-IV (65% vs. 8.7%, p=0.016), and larger tonsils (52% vs. 13%, p=0.032), indicating more severe oropharyngeal obstruction that likely contributes to the positional independence of their OSAS (Table 1-Upper Airway Physical Examination Findings).

DISCUSSION

OSAS is a widespread disorder with significant effects on various body systems, particularly the cardiovascular, endocrine, and circadian systems. It has been linked to hypertension, cardiovascular disease, and metabolic disorders such as insulin resistance and diabetes.[15-17] OSAS increases inflammation, oxidative stress, and hormonal imbalances, leading to complications across the body.[18] OSAS can result in severe health issues, decreased quality of life, and increased mortality.[19]

Many studies have examined the clinical, physiological, and PSG parameters of OSAS separately. However, few have focused on the relationship between sleep position, symptoms, and PSG findings.[20,21]

Our study examines the correlation between sleep position, clinical symptoms, PSG outcomes, and anterior rhinoscopy findings, offering an integrated perspective on OSAS. We emphasize the clinical relevance of p-OSAS and the role of sleep position and nasal obstruction in influencing disease severity. By addressing these factors, we aim to inform future research toward more individualized, non-invasive treatment options, especially for p-OSAS. This study highlights the importance of ongoing investigation into these correlations to enhance management strategies and improve patient outcomes.

The demographic findings underscore that younger age [(43.6±2.21) years vs. (54.23±12.23) years, p=(0.038)], lower BMI [(29.21±3.01) vs. (32.15±4.3), p=(0.048)], and smaller neck circumference [(40.18±1.15) cm vs. (45.23±3.32) cm, p=(0.045)] are associated with positional dependency in OSAS, supporting the potential for more effective use of positional therapy in this patient subgroup, it is related with the literature.[21] In our study, males were predominant in both groups, both in total and separately, yet no significant difference in the male-to-female ratio was observed between the positional (PP) and non-positional (NPP) groups (p=0.823). Mohsenin reported a higher prevalence of males in the NPP group. His research shows that OSA is more common and severe in men.[22] Men have larger but more collapsible airways, particularly during mandibular movement, making OSA more positional. Women with more stable upper airways tend to show less positional dependency. This anatomical variability may explain why men experience more severe OSA in certain positions, which could influence treatment strategies like positional therapy.[10,23-25]

Our findings demonstrated substantial clinical, physical examination, and PSG differences across several parameters between positional and non-p-OSAS patients. Upon evaluating the presenting complaints, nasal obstruction (and other symptoms) was significantly more frequent in the PP group than in the NPP group. In Zonato et al.'s study, nasal obstruction was substantially more frequent in patients with OSAS, similar to our findings.[26] They reported that 64% of OSAS patients experienced persistent nasal obstruction associated with septal deviation and concha hypertrophy. However, their study did not differentiate between positional and non-positional OSA patients, leaving a gap in understanding how sleep position might influence nasal obstruction. Our study expands on this by exploring the correlation between positional dependency, nasal obstruction, and anterior rhinoscopy findings. By integrating these aspects, we highlight the importance of considering both anatomical abnormalities and positional factors when assessing and treating OSA.

These findings highlight distinct symptom profiles between positional and non-positional groups. NPP experienced a broader range of severe symptoms, while PP predominantly reported nasal obstruction. Teculescu et al. found a significant association between habitual snoring and nasal obstruction, along with soft palate elongation, similar to our findings.[27] They observed that nasal breathing difficulties at night lead to compensatory mouth breathing, which increases upper airway resistance

and contributes to obstructive sleep apnea. This aligns with our study, where nasal obstruction was more prevalent in positional OSA patients, highlighting the role of airway resistance in OSAS pathogenesis. While Teculescu et al. study focused on habitual snorers without distinguishing between positional factors, our study further explores how nasal obstruction affects positional versus non-positional OSA. Understanding these correlations emphasizes the need to consider anatomical and positional factors in managing OSAS patients.[27]

Nasal obstruction is a key factor in the pathogenesis of OSAS, as Suratt et al. demonstrated that intranasal obstruction leads primarily to obstructive apneas and hypopneas during sleep. This is consistent with our study, where nasal obstruction contributed to dry mouth in p-OSAS (PP) patients. However, no significant difference in nasal resistance was found between positional and non-positional (NPP) groups.[28] Tagaya et al.'s work on obese patients also highlighted the role of increased nasal resistance, showing correlations with oxygen desaturation index. This supports our findings of more severe symptoms, such as fatigue and morning headaches, in NPP patients.[29]

Pevernagie et al. noted that nasal diseases increase airway resistance and can worsen sleep-disordered breathing, which aligns with our observation of habitual snoring in both groups.[30] While the exact relationship between nasal obstruction and breathing disturbances remains unclear, our study and previous research highlight its significant impact on OSAS severity, particularly concerning positional factors. Future research should further explore these relationships to optimize OSAS management strategies.[28-30]

As known, the ESS is a validated tool for quantifying excessive daytime sleepiness, with a score range of 0-24. Scores of 10 or above are indicative of excessive daytime sleepiness. In our study, the mean ESS score was above 10 in the NPP group and below 10 in the PP group. Excessive daytime sleepiness was significantly more prevalent in the NPP group, likely attributable to their higher AHI and lower sleep efficiency. A study assessing excessive daytime sleepiness using the Multiple Sleep Latency Test similarly found a higher prevalence of excessive daytime sleepiness in NPP patients, consistent with our findings.[14,15,31]

Our study found that p-OSAS (PP) patients had lower mean BMI values compared to non-positional (NPP) patients, indicating that a lower BMI may be a key factor in positional sleep apnea. This suggests that obesity is less common among PP, which could impact therapeutic choices. Positional therapy may be a more suitable treatment option for patients with milder anatomical obstruction and reduced adipose tissue around the neck. This aligns with previous research, such as Mador et al., who observed that positional sleep apnea is more common in mild cases, decreasing in moderate and severe cases. While Mador et al. reported no significant BMI differences between groups, our study suggests lower BMI is more typical in PP patients, possibly due to differing populations or methods. We also observed lower oxygen saturation and less time spent with oxygen saturation above 90% in the NPP group, reflecting their more severe OSAS.[32] Overall, our study and Mador et al.'s findings emphasize that positional therapy may be particularly effective for patients with mild OSAS, where positional dependency is most pronounced. In contrast, more aggressive treatments may be necessary for patients with severe, non-p-OSAS.[32]

Lateral sleep may provide some relief for both groups; however, "positional therapy," which prevents supine sleep, may not be effective in patients whose AHI remains high even in the lateral position.[33] Therefore, positional therapy may not be effective for all p-OSAS patients. In one series, 89% of patients in the PP group had AHI values drop below 20 in the lateral position, and another study reported that 75% of patients had AHI values fall below 10, suggesting that positional therapy may be a feasible treatment option for PP.[34] In our study, no significant intergroup difference was observed in the changes in AHI in the lateral position.

In our study, septal deviation and concha hypertrophy were more frequently detected in the PP group, with concha hypertrophy being significantly more common in the PP group compared to the NPP

group. Previous studies comparing OSAS patients with non-OSAS individuals found that septal deviation and concha hypertrophy were more frequently observed in OSAS patients, though these studies did not classify OSAS patients as positional or non-positional. Two studies examining anatomical changes in the upper airway of PP found that the posterior airway region was significantly wider, and soft palate elongation was less common in the PP group. Structural nasal anomalies, including nasal diseases, increase nasal resistance and lead to more significant pressure in the upper airway during sleep, contributing to the collapsibility of the pharyngeal walls.[26,35]

The Mallampati scoring system is a commonly used method for assessing tongue height. Several studies have identified a higher Mallampati grade as a valid predictor of OSAS.[36,37] In our research, Mallampati scores of grades III-IV were more frequently observed in the NPP group, consistent with the findings of Martinho et al.[35]

STUDY LIMITATIONS AND STRENGTHS

This study successfully identifies distinct clinical, physiological, and PSG differences between positional and non-positional OSAS patients, providing valuable insights into the role of sleep position in the severity and management of OSAS.

This study has some limitations, including a relatively small sample size, which may impact the generalizability of the findings. Additionally, endoscopic laryngeal and epiglottic examinations were not consistently performed, limiting the evaluation of laryngeal structures that may contribute to OSAS severity.

Despite these limitations, this study is the first in Azerbaijan to compare clinical, physiological, and PSG parameters in positional and non-p-OSAS patients. The findings provide a foundation for future OSAS research and can inform region-specific treatment approaches, marking an important step in understanding OSAS within the Azerbaijani population.

CONCLUSION

This study demonstrates distinct differences between positional and non-p-OSAS patients. PP had milder symptoms, higher sleep efficiency, and better oxygen saturation levels than NPP, who exhibited more severe OSAS. These findings suggest that positional therapy may be particularly beneficial for managing p-OSAS, whereas NPP may need more intensive treatment approaches. Understanding these clinical and PSG differences can guide personalized treatment strategies for OSAS patients based on their positional dependency.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Aynur Aliyeva, Konul Mammadova, Ramil Hashimli;* ***Design:*** *Aynur Aliyeva;* ***Control/Supervision:*** *Aynur Aliyeva, Ramil Hashimli;* ***Data Collection and/or Processing:*** *Aynur Aliyeva, Konul Mammadova, Ramil Hashimli;* ***Analysis and/or Interpretation:*** *Aynur Aliyeva, Konul Mammadova, Ramil Hashimli;* ***Literature Review:*** *Aynur Aliyeva, Konul Mammadova, Ramil Hashimli;* ***Writing the Article:*** *Aynur Aliyeva;* ***Critical Review:*** *Aynur Aliyeva, Konul Mammadova, Ramil Hashimli;* ***References and Fundings:*** *Aynur Aliyeva, Konul Mammadova, Ramil Hashimli;* ***Materials:*** *Aynur Aliyeva, Konul Mammadova, Ramil Hashimli.*

REFERENCES

1. Goyal M, Johnson J. Obstructive sleep apnea diagnosis and management. Mo Med. 2017;114(2):120-4. PMID: 30228558; PMCID: PMC6140019.
2. Lv R, Liu X, Zhang Y, Dong N, Wang X, He Y, et al. Pathophysiological mechanisms and therapeutic approaches in obstructive sleep apnea syndrome. Signal Transduct Target Ther. 2023;8(1):218. PMID: 37230968; PMCID: PMC10211313.
3. Sforza E, Roche F, Chapelle C, Pichot V. Internight variability of apnea-hypopnea index in obstructive sleep apnea using ambulatory polysomnography. Front Physiol. 2019;10:849. PMID: 31354515; PMCID: PMC6630080.
4. Ozeke O, Erturk O, Gungor M, Hızel SB, Aydın D, Celenk MK, et al. Influence of the right- versus left-sided sleeping position on the apnea-hypopnea index in patients with sleep apnea. Sleep Breath. 2012;16(3):617-20. PMID: 21678115.
5. Boyd SB, Upender R, Walters AS, Goodpaster RL, Stanley JJ, Wang L, et al. Effective Apnea-Hypopnea Index ("Effective AHI"): a new measure of effectiveness for positive airway pressure therapy. Sleep. 2016;39(11):1961-72. PMID: 27568799; PMCID: PMC5070750.
6. Kim WY, Hong SN, Yang SK, Nam KJ, Lim KH, Hwang SJ, et al. The effect of body position on airway patency in obstructive sleep apnea: CT imaging analysis. Sleep Breath. 2019;23(3):911-6. PMID: 31111410.
7. Richard W, Kox D, den Herder C, Laman M, van Tinteren H, de Vries N. The role of sleep position in obstructive sleep apnea syndrome. Eur Arch Otorhinolaryngol. 2006;263(10):946-50. PMID: 16802139.
8. McNicholas WT. Obstructive sleep apnoea: focus on pathophysiology. Adv Exp Med Biol. 2022;1384:31-42. PMID: 36217077.
9. Verbraecken J, Dieltjens M, Op de Beeck S, Vroegop A, Braem M, Vanderveken O, et al. Non-CPAP therapy for obstructive sleep apnoea. Breathe (Sheff). 2022;18(3):220164. PMID: 36340820; PMCID: PMC9584565.
10. Srijithesh PR, Aghoram R, Goel A, Dhanya J. Positional therapy for obstructive sleep apnoea. Cochrane Database Syst Rev. 2019;5(5):CD010990. PMID: 31041813; PMCID: PMC6491901.
11. Yingjuan M, Siang WH, Leong Alvin TK, Poh HP. Positional therapy for positional obstructive sleep apnea. Sleep Med Clin. 2020;15(2):261-75. PMID: 32386700.
12. American Academy of Sleep Medicine. The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifications. Westchester, IL: American Academy of Sleep Medicine; 2007.
13. American Academy of Sleep Medicine. The International Classification of Sleep Disorders: Diagnostic & Coding Manual. 2nd ed. Westchester, IL: American Academy of Sleep Medicine; 2005.
14. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep. 1991;14(6):540-5. PMID: 1798888.
15. Stavrou VT, Astara K, Tourlakopoulos KN, Papayianni E, Boutlas S, Vavougios GD, et al. Obstructive sleep apnea syndrome: the effect of acute and chronic responses of exercise. Front Med (Lausanne). 2021;8:806924. PMID: 35004785; PMCID: PMC8738168.
16. Aliyeva A. Obstructive sleep apnea and circadian rhythms. Journal of the Ear Nose Throat and Head Neck Surgery. 2023;31(3):179-88. doi: 10.24179/kbbbbc.2023-98095
17. Gunta SP, Jakulla RS, Ubaid A, Mohamed K, Bhat A, López-Candales A, et al. Obstructive sleep apnea and cardiovascular diseases: sad realities and untold truths regarding care of patients in 2022. Cardiovasc Ther. 2022;2022:6006127. PMID: 36017216; PMCID: PMC9388301.
18. Lavalle S, Masiello E, Iannella G, Magliulo G, Pace A, Lechien JR, et al. Unraveling the complexities of oxidative stress and inflammation biomarkers in obstructive sleep apnea syndrome: a comprehensive review. Life (Basel). 2024;14(4):425. PMID: 38672697; PMCID: PMC11050908.
19. Bjornsdottir E, Keenan BT, Eysteinsdottir B, Arnardottir ES, Janson C, Gislason T, et al. Quality of life among untreated sleep apnea patients compared with the general population and changes after treatment with positive airway pressure. J Sleep Res. 2015;24(3):328-38. PMID: 25431105; PMCID: PMC4439289.
20. Zhang Y, Xiao A, Zheng T, Xiao H, Huang R. The relationship between sleeping position and sleep quality: a flexible sensor-based study. Sensors (Basel). 2022;22(16):6220. PMID: 36015983; PMCID: PMC9416198.
21. Tantawy SA, Kamel DM, Alsayed N, Rajab E, Abdelbasset WK. Correlation between body mass index, neck circumference, and waist-hip ratio as indicators of obesity among a cohort of adolescent in Bahrain: a preliminary cross-sectional study. Medicine (Baltimore). 2020;99(17):e19950. PMID: 32332676; PMCID: PMC7440259.
22. Mohsenin V. Effects of gender on upper airway collapsibility and severity of obstructive sleep apnea. Sleep Med. 2003;4(6):523-9. PMID: 14607346.
23. Bonsignore MR, Saaresranta T, Riha RL. Sex differences in obstructive sleep apnoea. Eur Respir Rev. 2019;28(154):190030. PMID: 31694839; PMCID: PMC9488655.
24. Chang JL, Goldberg AN, Alt JA, Mohammed A, Ashbrook L, Auckley D, et al. International consensus statement on obstructive sleep apnea. Int Forum Allergy Rhinol. 2023;13(7):1061-82. PMID: 36068685; PMCID: PMC10359192.
25. Akashiba T, Inoue Y, Uchimura N, Ohi M, Kasai T, Kawana F, et al. Sleep Apnea Syndrome (SAS) clinical practice guidelines 2020. Sleep Biol Rhythms. 2022;20(1):5-37. PMID: 38469064; PMCID: PMC10900032.
26. Zonato AI, Bittencourt LR, Martinho FL, Júnior JF, Gregório LC, Tufik S. Association of systematic head and neck physical examination with severity of obstructive sleep apnea-hypopnea syndrome. Laryngoscope. 2003;113(6):973-80. PMID: 12782807.
27. Teculescu D, Hannhart B, Cornette A, Montaut-Verient B, Virion JM, Michaely JP. Prevalence of habitual snoring in a sample of French males. Role of "minor" nose-throat abnormalities. Respiration. 2001;68(4):365-70. PMID: 11464082.
28. Suratt PM, Turner BL, Wilhoit SC. Effect of intranasal obstruction on breathing during sleep. Chest. 1986;90(3):324-9. PMID: 3743143.
29. Tagaya M, Nakata S, Yasuma F, Noda A, Morinaga M, Yagi H, et al. Pathogenetic role of increased nasal resistance in obese patients with obstructive sleep apnea syndrome. Am J Rhinol Allergy. 2010;24(1):51-4. PMID: 20109326.
30. Pevernagie DA, De Meyer MM, Claeys S. Sleep, breathing and the nose. Sleep Med Rev. 2005;9(6):437-51. PMID: 16242364.
31. Scharf MT. Reliability and efficacy of the epworth sleepiness scale: is there still a place for it? Nat Sci Sleep. 2022;14:2151-6. PMID: 36536636; PMCID: PMC9759004.
32. Mador MJ, Kufel TJ, Magalang UJ, Rajesh SK, Watwe V, Grant BJ. Prevalence of positional sleep apnea in patients undergoing polysomnography. Chest. 2005;128(4):2130-7. PMID: 16236865.
33. de Vries GE, Hoekema A, Doff MH, Kerstjens HA, Meijer PM, van der Hoeven JH, et al. Usage of positional therapy in adults with obstructive sleep apnea. J Clin Sleep Med. 2015;11(2):131-7. PMID: 25406271; PMCID: PMC4298770.
34. Maurer JT, Stuck BA, Hein G, Verse T, Hörmann K. Schlafapnoetherapie mit einer neuartigen Rückenlage-Verhinderungs-Weste [Treatment of obstructive sleep apnea with a new vest preventing the supine position]. Dtsch Med Wochenschr. 2003;128(3):71-5. German. PMID: 12529835.
35. Martinho FL, Tangerina RP, Moura SM, Gregório LC, Tufik S, Bittencourt LR. Systematic head and neck physical examination as a predictor of obstructive sleep apnea in class III obese patients. Braz J Med Biol Res. 2008;41(12):1093-7. PMID: 19148371.
36. Goranović T, Milić M, Nesek Adam V, Šimunjak B. Assessment of standard anthropometric airway characteristics relevant for airway management of patients with obstructive sleep apnea syndrome during sleep breathing disorder surgery: a retrospective, single center study. Acta Clin Croat. 2023;62(Suppl1):21-8. PMID: 38746615; PMCID: PMC11090223.
37. Bins S, Koster TD, de Heij AH, de Vries AC, van Pelt AB, Aarts MC, et al. No evidence for diagnostic value of Mallampati score in patients suspected of having obstructive sleep apnea syndrome. Otolaryngol Head Neck Surg. 2011;145(2):199-203. PMID: 21572078.