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RESEARCH ARTICLE

Effects of positive airway pressure therapy on quality of life in patients with obstructive sleep apnea syndrome

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ABSTRACT

Objective: Obstructive sleep apnea syndrome (OSAS) significantly impairs the quality of life of affected individuals. This study aimed to assess the health-related quality of life (HRQoL) among patients with mild, moderate, and severe OSAS, and to evaluate differences in HRQoL following a minimum of three months of continuous positive airway pressure (CPAP) therapy.

Method: Subjective daytime sleepiness and HRQoL were assessed using standardized questionnaires, including the Epworth Sleepiness Scale (ESS), Fatigue Severity Scale (FSS), Beck Depression Inventory (BDI), Apathy Evaluation Scale (AES), and Montgomery-Åsberg Depression Rating Scale (MADRS). Assessments were conducted at the initial visit following an OSAS diagnosis, confirmed through clinical and polysomnographic evaluation. After at least three months of CPAP therapy, the same HRQoL questionnaires were re-administered. The percentage change difference (PCD) for each questionnaire was calculated by comparing baseline scores with those obtained after at least three months of CPAP therapy.

Results: A total of 87 patients with OSAS were included in the study. Twenty-seven were female (31%) and 60 were male (69%). Comparison of scale scores before and after CPAP therapy revealed statistically significant reductions across the ESS, BDI, AES, MADRS, and FSS questionnaires ($p<0.001$). A weak positive correlation was found between the ESS PCD and body mass index, while a moderate negative correlation was observed between the AES PCD and duration of CPAP therapy ($p<0.001$).

Conclusion: Significant improvements in HRQoL were observed following CPAP therapy, regardless of disease severity, gender, presence of comorbid conditions, and smoking status. With the exception of AES scores, these improvements were also independent of the duration of CPAP therapy. Among the HRQoL scales, only AES scores showed a statistically significant reduction after more than six months of CPAP therapy.

Keywords: Health-related quality of life, obstructive sleep apnea syndrome, positive airway pressure therapy

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INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is characterized by episodes of partial or complete interruption of ventilation during sleep. Approximately 6% of individuals between the ages of 50 and 70 are affected by OSAS (1).

The collapse of the upper airway during sleep leads to desaturation and nocturnal arousals, resulting in sleep fragmentation (2). The main symptoms of OSAS include excessive daytime sleepiness, fatigue, cognitive and emotional disturbances, and reduced concentration and energy levels, all of which can impact quality of life (QoL) across social, physical, and psychological domains (2).

OSAS severity is typically measured using the apnea-hypopnea index (AHI), which classifies the condition into three categories: mild (AHI 5.0–14.9 events/h), moderate (AHI 15.0–29.9 events/h), and severe (AHI ≥30.0 events/h) (3). Studies have shown that continuous positive airway pressure (CPAP) therapy reduces the frequency of apneic-hypopneic events, mitigates the severity of sleep disturbances, and improves the health-related quality of life (HRQoL) in patients with OSAS (4–6).

This study aimed to assess the HRQoL in patients with mild to severe OSAS and to examine differences in HRQoL improvements following at least three months of CPAP therapy.

METHODS

This study included 87 patients diagnosed with OSAS based on clinical and polysomnographic findings. Patients, aged between 29 and 66 years, were followed at the Department of Neurology and Sleep Center, University of Health Sciences, Bakırköy Prof. Dr. Mazhar Osman Training and Research Hospital. Exclusion criteria included: prior diagnosis or treatment for OSAS; presence of other psychiatric and/or neurological diseases; failure to provide informed consent; incomplete diagnostic evaluation or failure to complete the required questionnaires; low CPAP compliance (≤4 hours per night); lack of at least primary education; and uncontrolled chronic conditions, such as hypertension (blood pressure >140/90 mmHg despite medical treatment), hyperlipidemia (low-density lipoprotein cholesterol ≥140 mg/dL), or diabetes mellitus (hemoglobin A1c [HbA1c] >8% despite treatment). The study was conducted in accordance with the Declaration of Helsinki and approved by the Bakirkoy Dr. Sadi Konuk Training and Research Hospital (decision date: November 6, 2023; number: 21/09). Written informed consent was obtained from all participants. Demographic and physical data, including age, weight, and body mass index BMI), smoking status, comorbidities, and OSAS-related symptoms were recorded. All patients underwent polysomnography. Respiratory and related events were scored in accordance with the standard criteria established by the American Academy of Sleep Medicine (AASM) Task Force (7). The AHI was defined as the number of apneas and hypopneas per hour of estimated total sleep time. Treatment was recommended for patients with an AHI ≥15 events/hour regardless of symptoms, and for those with an AHI ≥5 events/hour when accompanied by relevant symptoms or comorbidities.

Questionnaires

Subjective daytime sleepiness and HRQoL were assessed before and after at least three months of CPAP therapy. The Epworth Sleepiness Scale (ESS) is a self-administered questionnaire used to evaluate sleepiness. Its validity and reliability in Turkish populations have been previously established (8). Patients were instructed to assess their likelihood of falling asleep during eight routine activities experienced over the past month, using a scale from 0 to 3. The Epworth Sleepiness Scale score was calculated as the sum of the eight individual item scores, yielding a total score range of 0 to 24. Higher scores indicate greater levels of daytime sleepiness (9).

The Fatigue Severity Scale (FSS) is a unidimensional, 9-item scale used to assess fatigue. Patients rated each item on a scale from 1 (strongly disagree) to 7 (strongly agree). A mean score of ≥4 was considered indicative of pathological fatigue (10). Its validity and reliability in Turkish populations were established by Armutlu et al. (10).

The Beck Depression Inventory (BDI) was developed by Beck et al. (11) to assess the somatic and affective symptoms of depression. Total scores range from 0 to 63, with scores of 0–9 indicating no depression, 10–16 indicating mild depressive symptoms, 17–29 indicating moderate depression, and scores above 29 indicating severe depression. Its validity and reliability in Turkish populations were established by Hisli (12, 13).

The Apathy Evaluation Scale (AES) involves interviewing a patient's primary relative to assess the patient's interests, plans, goals, motivation, and energy for daily activities. The scale consists of 14 questions, each scored from 0 to 3. The maximum score is 42, with high scores indicating greater apathy severity (14).

The Montgomery-Åsberg Depression Rating Scale (MADRS) is commonly used to evaluate depression severity and monitor treatment efficacy. It includes 10 items symptoms such as apparent sadness, pessimism, inner tension, reduced sleep, reported sadness, concentration difficulties, lassitude, reduced appetite, inability to feel, and suicidal thoughts. Each item is rated on a 7-point scale ranging from 0 (none) to 6 (severe), with total scores ranging from 0 to 60 (15).

All participants completed the questionnaires. Interviews were conducted by a member of the study team who was blinded to the participants' AHI status. During the follow-up period, subjective daytime sleepiness and HRQoL were reassessed. Participants were reviewed at the sleep clinic after 3, 6, or 12 months, depending on when they demonstrated high CPAP compliance (≥5 hours/night), (16) which was monitored from the patients' CPAP devices. The percentage change differences (PCDs) were calculated as the difference between questionnaire scores at baseline and those obtained after at least three months of CPAP therapy.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 25. The distribution of continuous variables was assessed using the Shapiro-Wilk test. The Wilcoxon test was used to compare scores obtained before and after CPAP therapy. Relationships between participants' clinical and demographic variables and PCD differences were evaluated using the Mann-Whitney U test. Associations between quantitative variables and PCDs were examined using Spearman's correlation coefficient. In all analyses, $p<0.05$ was considered statistically significant.

RESULTS

A total of 87 participants—27 females (31%) and 60 males (69%)—were included in the study. Sixty-seven participants had comorbidities, including controlled hypertension (n=25), diabetes mellitus (n=25), cardiac disease (n=7), thyroid disease (n=9), hyperlipidemia (n=7), and peripheral artery disease (n=6). Table 1 summarizes the descriptive characteristics, anthropometric data, and questionnaire scores before and after at least three months of CPAP therapy.

Comparison of HRQoL scale scores before and after at least three months of CPAP therapy revealed a statistically significant decrease in the scores of the ESS ($p<0.001$), BDI ($p<0.001$), AES ($p<0.001$), MADRS ($p<0.001$), and FSS ($p<0.001$) (Table 2).

Table 1: Demographic characteristics of patients with OSAS

	n (%)
Gender	
Female	27 (31)
Male	60 (69)
Comorbidity	
No	20 (23)
Yes	67 (77)
Smoking status	
No	68 (78.2)
Yes	19 (21.8)
CPAP treatment duration (months)	
<6 months	32 (36.8)
≥6 months	55 (63.2)
	Median (min–max)
Age	51 (29–66)
Height, (cm)	169 (150–187)
Weight, (kg)	91 (62–145)
BMI	31.2 (23.4–57)
AHI	32.7 (6.3–94.7)
CPAP treatment duration (months)	6 (3–12)

OSAS: Obstructive sleep apnea syndrome; AHI: Apnea-Hypopnea Index; BMI: Body Mass Index; CPAP: Continuous positive airway pressure.

No significant differences in questionnaire scores were observed based on gender, presence of comorbidities, or smoking status ($p>0.05$). However, when questionnaire scores were compared based on CPAP therapy duration, patients who used the CPAP device for six months or more showed a significantly greater reduction in AES scores compared to those who used it for less than six months ($p=0.001$) (Table 3).

Upon examining the relationships between the PCDs in questionnaire scores, CPAP use, and participants' clinical and physical parameters, no significant correlations were found between ESS PCD and age ($p=0.619$), AHI ($p=0.632$), or duration of CPAP use ($p=0.147$). However, a weak positive correlation was observed between ESS PCD and BMI ($p=0.047$; $r=0.214$). No significant correlations were identified between the BDI, MADRS, or FSS PCD values and age, BMI, AHI, or CPAP therapy duration ($p>0.05$). Similarly, no significant correlations were found between AES PCD and age ($p=0.361$), BMI ($p=0.156$), or AHI ($p=0.117$). However, a moderate negative correlation was observed between AES PCD and CPAP therapy duration ($p<0.001$; $r=-0.420$) (Table 4).

Table 2: Questionnaire scores before and after CPAP therapy

	Before CPAP Median (min–max)	After CPAP Median (min–max)	Z	P
Epworth SSS	14 (10–24)	4 (1–12)	-8.115	<0.001*
Beck DIS	18 (2–50)	8 (0–42)	-7.667	<0.001*
Apathy ESS	16 (4–42)	9 (2–29)	-7.332	<0.001*
MADRS	16 (0–42)	8 (0–35)	-7.433	<0.001*
Fatigue SSS	6 (2–8)	3 (0–6)	-7.973	<0.001*

CPAP: Continuous positive airway pressure; Apathy ESS: Apathy Evaluation Scale Score; Beck DIS: Beck Depression Inventory Score; Epworth SSS: Epworth Sleepiness Scale Score; Fatigue SSS: Fatigue Severity Scale Score; MADRS: Montgomery-Åsberg Depression Rating Scale. *: p<0.05; Z: Wilcoxon Test.

Table 3: Patient variables and percentage change differences in questionnaire scores among patients with OSAS

Gender	**Female (n=27)**	**Male (n=60)**	**Z**	**P**
PCD_Epworth SSS	-66.67 (-93.75–-30)	-66.67 (-93.75–-10)	-0.556	0.578
PCD_Beck DIS	-60 (-90–-16)	-51.19 (-100–100)	-1.866	0.062
PCD_Apathy ESS	-47.37 (-75–0)	-47.91 (-71.43–107.69)	-0.317	0.751
PCD_MADRS	-50 (-75–12.5)	-50 (-100–116.67)	-0.08	0.936
PCD_Fatigue SSS	-57.14 (-100–0)	-57.14 (-100–50)	-0.67	0.503
Comorbidity	**No (n=20)**	**Yes (n=67)**		
PCD_Epworth SSS	-75 (-93.75–-50)	-66.67 (-93.75–-10)	-1.708	0.088
PCD_Beck DIS	-50 (-90–37.5)	-52.94 (-100–100)	-0.794	0.427
PCD Apathy ESS	-49 (-68.75–4.35)	-47.37 (-75–107.69)	-0.687	0.492
PCD_MADRS	-50 (-100–116.67)	-50 (-100–100)	-0.782	0.434
PCD_Fatigue SSS	-53.57 (-100–14.29)	-57.14 (-87.5–50)	-0.173	0.863
Smoking Status	**No (n=68)**	**Yes (n=19)**		
PCD_Epworth SSS	-66.67 (-93.75–-10)	-71.43 (-92.86–-20)	-0.376	0.707
PCD_Beck DIS	-52.38 (-90.48–100)	-57.14 (-100–62.5)	-0.577	0.564
PCD_Apathy ESS	-47.68 (-75–107.69)	-47.83 (-71.43–0)	-0.118	0.906
PCD MADRS	-50 (-100–116.67)	-51.22 (-91.43–0)	-0.142	0.887
PCD_Fatigue SSS	-57.14 (-100–50)	-57.14 (-80–0)	-0.305	0.760
CPAP Duration	**<6 months (n=32)**	**≥6 months (n=55)**		
PCD_Epworth SSS	-72.5 (-93.75–-10)	-66.67 (-91.67–-20)	-0.882	0.378
PCD_Beck DIS	-50 (-100–37.5)	-52.94 (-92.86–100)	-1.239	0.215
PCD_Apathy ESS	-39.05 (-66.67–107.69)	-50 (-75–0)	-3.247	0.001*
PCD_MADRS	-50 (-87.5–116.67)	-50 (-100–33.33)	-0.991	0.322
PCD_Fatigue SSS	-57.14 (-100–0)	-57.14 (-100–50)	-0.239	0.811

OSAS: Obstructive sleep apnea syndrome; Apathy ESS: Apathy Evaluation Scale Score; Beck DIS: Beck Depression Inventory Score; Epworth SSS: Epworth Sleepiness Scale Score; Fatigue SSS: Fatigue Severity Scale Score; MADRS: Montgomery-Åsberg Depression Rating Scale; PCD: Percentage change difference; *: p<0.05; Z: Mann-Whitney U test.

DISCUSSION

OSAS is a public health concern that affects individuals' physical health, psychological well-being, functional independence, and social relationships. HRQoL is increasingly recognized as a critical metric in evaluating OSAS-related morbidity.

In this study, changes in HRQoL scores were assessed before and after at least three months of CPAP therapy in patients with mild, moderate, and severe OSAS. Significant improvements in HRQoL scores were observed following CPAP treatment, regardless of disease severity, sex, presence of comorbidities, or smoking status. Among the HRQoL measures, only the

Table 4: Correlations between clinical variables and percentage change differences in questionnaire scores among patients with OSAS

	Age	BMI	AHI	CPAP duration
PCD_Epworth SSS				
r	0.054	0.214*	0.052	0.157
p	0.619	0.047	0.632	0.147
PCD_Beck DIS				
r	0.01	0.045	-0.002	-0.04
p	0.925	0.677	0.984	0.715
PCD_Apathy ESS				
r	0.099	-0.154	0.169	-0.420**
p	0.361	0.156	0.117	<0.001
PCD_MADRS				
r	-0.099	0.017	0.073	-0.178
p	0.366	0.878	0.504	0.101
PCD_Fatigue SSS				
r	0.047	-0.037	0.028	-0.126
p	0.667	0.733	0.795	0.245

OSAS: Obstructive sleep apnea syndrome; AHI: Apnea-Hypopnea Index; Apathy ESS: Apathy Evaluation Scale Score; Beck DIS: Beck Depression Inventory Score; BMI: Body Mass Index; Epworth SSS: Epworth Sleepiness Scale Score; Fatigue SSS: Fatigue Severity Scale Score; MADRS: Montgomery-Åsberg Depression Rating Scale; PCD: Percentage change difference; *: p<0.05; **: p<0.01; r: Spearman's correlation coefficient.

AES score was found to be sensitive to the duration of CPAP therapy, showing a statistically significant reduction after more than six months of consistent use.

Intermittent hypoxia and sleep fragmentation contribute to systemic inflammation, oxidative stress, endothelial dysfunction, and reperfusion injury, which may lead to alterations in brain regions responsible for regulating cognitive and emotional functions (17, 18). Neuroimaging studies have identified neocortical and cerebellar atrophy, reduced hippocampal dentate gyrus volume, and prefrontal atrophy in patients with untreated severe OSAS (19). Castronovo et al. (20) reported decreased integrity of white matter fiber tracts in this patient population. Notably, significant improvements in these affected brain regions were observed following 12 months of CPAP therapy, suggesting that some brain abnormalities may be reversible with effective treatment (20, 21). These findings underscore the critical importance of early diagnosis and intervention in patients with OSAS to mitigate the risk of cognitive decline.

Gray matter atrophy and disruptions in white matter fiber tracts, along with neurodegenerative processes, have been reported to contribute to depressive symptoms and cognitive impairment in patients with OSAS (22). One year of adherence to CPAP therapy has been shown to significantly improve global cognitive function, with notable enhancements in delayed recall and attention, as well as reductions in excessive daytime sleepiness and depressive symptoms associated with OSAS (23). Another study investigated the short-term effects of three months of CPAP therapy on cognition and depression in patients with OSAS using the Montreal Cognitive Assessment and the BDI. While improvements were noted in daytime sleepiness and depressive symptoms, no enhancement in cognitive performance was observed (24).

Previous studies have examined the relationship between obesity and cognitive impairment (25, 26). One study suggested that comorbid obesity may increase the risk of Alzheimer's disease in individuals with OSAS, as the release of pro-inflammatory cytokines from adipocytes can alter synaptic and neural plasticity and contribute to neurodegenerative processes (27). The cognitive status of patients with OSAS was evaluated, revealing deficiencies in attention, executive function, and delayed recall. After six months of CPAP therapy, these cognitive impairments showed improvement (28). In line with the current findings, several studies have reported that CPAP therapy in patients with OSAS alleviates depressive symptoms, fatigue, and sleepiness (29, 30).

Several studies have also examined sex and age differences in OSAS and HRQoL scores, with some reporting that females exhibit worse HRQoL scores than males (31–33). However, in our study, neither gender nor the presence of comorbidities significantly affected HRQoL scores. This discrepancy may be due to differences in sample sizes across studies.

Some studies have also reported no association between HRQoL scores and OSAS severity (5, 34). In line with those findings, our study found no significant correlation between HRQoL and OSAS severity before CPAP therapy. Davis et al. (35) demonstrated a poor correlation between HRQoL impairment and sleep apnea severity. It was concluded that changes in HRQoL among patients with sleep-related breathing disorders depend on the interactions between sleep stages, obesity, and daytime sleepiness, with no associations found with sleep fragmentation, hypoxemia, or apnea recurrence (36).

A systematic review noted only small improvements in daytime sleepiness after CPAP therapy in patients with OSAS (37). While nasal CPAP therapy does alleviate daytime sleepiness, its effects on mood

and physical activity remain controversial. Previous studies have reported inconsistent findings regarding the impact of CPAP therapy on depressive symptoms, particularly over the long term (38). In one study, a few months of CPAP therapy reduced depressive symptoms (39), whereas another found no such effect (40). Yet another study reported a reduction in depressive symptoms following CPAP therapy, suggesting that the improvement was unlikely to be due to a placebo effect (41). Although our study did not find a significant relationship between the duration of CPAP use and depressive symptoms, a reduction in depression scores was observed.

In the current study, sleepiness and sleep quality improved following CPAP therapy, consistent with previous findings. Females are more likely to report excessive daytime sleepiness than males (42). One study found that 12 weeks of CPAP therapy reduced self-reported sleepiness in female patients (43). Aro et al. (29) confirmed that long-term CPAP therapy in OSAS patients may alleviate depressive symptoms, reduce anxiety, and improve sleepiness. In our study, we observed that patients with higher BMI values exhibited higher percentage changes in ESS scores after CPAP therapy, indicating that as BMI increases, the reduction in daytime sleepiness associated with CPAP therapy becomes more pronounced.

A study conducted in China concluded that the combined presence of OSAS and chronic smoking results in more severe cognitive impairment compared to smoking alone (44). Additionally, a meta-analysis of 37 studies revealed that smokers have an elevated risk of developing dementia, which can be significantly reduced through smoking cessation (45). In our study, smoking status did not impact HRQoL scores in patients with OSAS.

Meira et al. (46) suggested that among comorbidities associated with Parkinson's disease, OSAS may contribute to greater deterioration in the attention/memory domain, psychotic symptoms, and apathy over a four-year period, in addition to cognitive impairment. In our study, the reduction in AES scores was more significant after at least six months of CPAP therapy, suggesting that AES scores are among the first to show improvement following CPAP initiation.

Yorulmaz et al. (47) concluded that fatigue has a profound impact on patients with OSAS, particularly among those reporting weight gain, excessive daytime sleepiness, and additional chronic conditions. Patients with OSAS often experience fatigue, lack of energy, and boredom due to poor sleep quality (48). Fatigue-related dysfunction has been linked to insomnia in OSAS patients (49). However, another study reported no correlation between disease duration and fatigue in OSAS patients (50). While our study did not find a relationship between fatigue and CPAP therapy duration, a reduction in fatigue scores was observed after therapy. The conflicting results in previous studies may stem from differences in study design, exclusion criteria, and sample sizes.

CONCLUSION

In conclusion, we observed significant improvements in symptoms such as daytime sleepiness, depression, apathy, and fatigue in patients with OSAS following CPAP therapy. These improvements were independent of gender, comorbidities, smoking status, and, except for AES scores, the duration of CPAP therapy. Among the HRQoL scales, only AES scores showed a significant reduction after more than six months of CPAP therapy. This finding suggests that improvements in HRQoL may first be reflected in reductions in apathy. Other symptoms, such as depression, fatigue, and daytime sleepiness, may require longer durations (potentially over one year) of CPAP therapy to show substantial improvement, as reported in previous studies (20, 21, 23, 38). One limitation of our study is that it included patients who used CPAP therapy for a maximum of 12 months, which prevented the assessment of HRQoL changes beyond that period. However, in the next phase of our study, we plan to reevaluate these scales during the second year of CPAP use in the same patient group. OSAS is a condition that significantly impacts patients' HRQoL and carries numerous social and economic consequences. Increasing public awareness of sleep disorders and improving access to CPAP therapy for patients diagnosed with OSAS are crucial steps toward enhancing patient outcomes.

Ethical Approval: The Bakirkoy Dr. Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 06.11.2023, number: 21/09).

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