BMC Psychology

RESEARCH

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Psychological resilience as a mediator between sleep quality and mental well-being in patients with obstructive sleep apnea syndrome

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Abstract

Background Obstructive sleep apnea syndrome (OSAS) is a prevalent sleep disorder associated with impaired sleep quality and adverse psychological outcomes. The potential mediating role of psychological resilience in the relationship between sleep quality and mental well-being in OSAS remains unclear.

Objective This study investigated whether psychological resilience mediates the relationship between sleep quality and mental well-being in patients with newly diagnosed OSAS.

Methods A total of 301 patients with newly diagnosed OSAS and 104 age-matched healthy controls were assessed using the Pittsburgh Sleep Quality Index (PSQI), the Brief Resilience Scale (BRS), and the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS). Group differences were analyzed using t-tests and ANOVA. Mediation analysis was conducted to evaluate the indirect effect of sleep quality on mental well-being through psychological resilience. Statistical analyses were performed with SPSS version 21.0 software.

Results Poor sleep quality was significantly more common among females, individuals with lower socioeconomic status, single participants, and those with higher education levels. Sleep quality was negatively correlated with psychological resilience ($r = -0.58$) and mental well-being ($r = -0.43$). Mediation analysis revealed that psychological resilience significantly mediated the relationship between sleep quality and mental well-being ($\beta = -0.26$, 95% CI: -0.33 to -0.19, $p < 0.001$).

Conclusion These findings suggest that psychological resilience plays an important role in the link between poor sleep quality and diminished mental well-being in individuals with OSAS. Interventions aimed at enhancing resilience may offer psychological benefits in managing this population.

Keywords Obstructive sleep apnea syndrome, Sleep quality, Psychological resilience, Mental Well-Being

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Introduction

Sleep is increasingly recognized not only as a biological necessity for brain and stress regulation but also as a modifiable factor influencing psychiatric outcomes, as supported by both neurobiological models and randomized controlled trials [1, 2]. This functional integrity is sustained by healthy sleep architecture; however, sleep disorders such as Obstructive Sleep Apnea Syndrome (OSAS) can profoundly disrupt this system [3, 4]. By impairing the duration, depth, and continuity of sleep, OSAS may lead to significant disturbances in both neurocognitive functioning and psychological stability [5].

OSAS is a common sleep disorder characterized by recurrent upper airway obstruction during sleep. Manifesting with symptoms such as snoring, apnea, hypopnea, and frequent arousals, OSAS substantially disrupts both the duration and quality of sleep, resulting in excessive daytime sleepiness, impaired attention, and reduced quality of life [6]. Its consequences, however, are not limited to physiological domains. Emerging evidence indicates that OSAS increases the risk of depression by approximately 2.5 times and is associated with impairments in emotional regulation systems [7].

Psychological resilience refers to an individual's capacity to maintain mental stability in the face of stress and adversity. In contrast, mental well-being encompasses multidimensional elements such as deriving meaning from life, realizing personal potential, and sustaining social functioning. These constructs are closely linked to emotional stability, life satisfaction, and a sense of purpose. Despite their clinical relevance, their relationship with sleep disorders such as OSAS remains underexplored [6]. Sleep quality, a multidimensional construct encompassing subjective restfulness and structural features like sleep duration, regularity, and daytime functionality, is an essential determinant of mental and physical health [8]. Prolonged sleep disturbances contribute not only to the emergence of psychiatric symptoms but also to systemic metabolic dysregulation and heightened inflammatory activity [9]. In OSAS, these disturbances are often more pronounced, manifesting as persistent daytime sleepiness, attentional deficits, and significantly impaired quality of life [10, 11]. Prior research has shown that poor sleep quality progressively undermines psychological resilience and elevates perceived stress over time [12].

The impact of OSAS on sleep quality is not confined to subjective experience; it also involves measurable disruptions in sleep architecture. In particular, decreased time spent in REM and deep sleep stages may adversely affect processes critical to emotional regulation and cognitive restoration [6, 13]. However, the effects of these physiological changes on mental well-being are still not fully understood. To uncover the underlying mechanisms of this relationship, it is important to determine whether protective factors, such as psychological resilience, play a mediating role. While primary clinical interventions in the treatment of OSAS, such as Continuous Positive Airway Pressure (CPAP) therapy and weight loss, are essential for addressing physiological dysfunctions, they may not always sufficiently alleviate the psychological burden associated with the disorder. Therefore, understanding the role of psychological resilience as a complementary factor is crucial in providing a more holistic approach to patient care. In this regard, identifying psychological resilience as a mediating variable, given its nature as a modifiable trait, could highlight applicable and targetable areas for future psychosocial interventions [14]. Although the multifaceted effects of OSAS on sleep and psychological functioning have been increasingly recognized, the role of psychological resilience in these dynamics remains unclear. OSAS patients have been shown to report higher psychological stress, strongly associated with anxiety and depression [15]. Moreover, multilevel surgery has been linked to reduced fatigue and stress levels, along with increased resilience scores, approaching those of control groups within six months [16]. These findings highlight that OSAS affects not only physiological health but also psychological resilience, and that such effects may be reversible with appropriate interventions. Timkova et al. found that OSAS patients showed elevated hostility and reduced coping self-efficacy, both closely linked to psychological distress. Notably, self-efficacy in managing negative emotions emerged as the strongest moderator. These findings underscore the importance of psychosocial interventions, particularly those enhancing coping skills, in supporting psychological resilience in OSAS (17). While the variables of psychological resilience and mental well-being may be seen as abstract compared to the more objective physiological parameters typically investigated in OSAS research, these constructs are increasingly recognised as critical psychological outcomes in sleep medicine. Both are measurable using well-validated, psychometrically robust instruments and are supported by a growing body of literature linking OSAS to impaired emotion regulation, reduced coping capacity, and elevated risk of affective disorders [7, 12]. By incorporating these constructs, the current study seeks to complement physiological findings with a broader understanding of psychological vulnerability in OSAS.

Although airway management remains the primary focus in OSAS treatment, emerging evidence highlights the importance of psychological resilience in influencing treatment adherence, symptom perception, and quality of life. Resilience buffers the mental health impact of sleep fragmentation and hypoxia, even in biologically driven conditions. Low resilience is associated with fatigue, emotional dysregulation, and poor coping, while

resilience-enhancing interventions improve psychological outcomes independently of physiological changes [15, 16, 17]. Thus, addressing resilience aligns with a biopsychosocial approach to OSAS care.

This study aims to examine the relationships between sleep quality, mental well-being, and psychological resilience in newly diagnosed OSAS patients and to evaluate the potential mediating effect of psychological resilience.

Materials and methods

Study design and setting

This study was conducted between March 2024 and April 2025 at the Sleep Laboratory and outpatient clinics of the Faculty of Medicine at Atatürk University. The study protocol was approved by the Atatürk University Social and Human Sciences Ethics Committee (Meeting No: 6, Decision No: 69; Date: March 8, 2024). Written informed consent was obtained from all participants, and the principles of the Declaration of Helsinki were used to conduct the study.

Sample size calculation

The study sample size was calculated using G*Power analysis. The "a priori analysis" of *G*Power 3.1* software was used for this. It was seen that the sample size calculated by selecting two predictor variables, 0.05 Alpha level, 0.85 power ratio (1-β), and medium effect size ($f^2 = 0.15$) for regression analysis should be 62 people [18]. Given the above information, the study's conduct with 301 participants proves the sample size is sufficient.

Inclusion and exclusion criteria

Participants were selected from among 514 individuals who presented to the Chest Diseases Outpatient Clinic at Atatürk University Faculty of Medicine with symptoms suggestive of Obstructive Sleep Apnea Syndrome (OSAS), such as snoring, witnessed apneas, or excessive daytime sleepiness. All individuals underwent overnight polysomnography (PSG) to confirm the diagnosis.

The inclusion criteria for the OSAS group were being 18 years or older, presenting with OSAS-related symptoms, and having an Apnea–Hypopnea Index (AHI) of ≥ 5 based on PSG results.

To minimize potential confounding variables that could influence psychological and physiological outcomes, individuals with chronic diseases (e.g., diabetes, hypertension, coronary artery disease, chronic obstructive pulmonary disease, renal or hepatic failure, autoimmune or endocrine disorders) were excluded. Additionally, individuals with a psychiatric diagnosis, those using psychiatric medication, or those who had previously received OSAS treatment (e.g., CPAP therapy or surgical intervention) were not included in the study.

After applying these criteria, 301 newly diagnosed OSAS patients were included in the study group.

The control group consisted of age- and sex-matched healthy volunteers who underwent PSG, had no diagnosis of any sleep disorder, and demonstrated an AHI of less than 5. These participants also had no history of psychiatric or physical illness. All participants were fully informed about the study procedures and provided written informed consent.

Data collection process

After obtaining the necessary approvals, standardized data collection forms were prepared, which included the informed consent form, a personal information form, and validated psychological instruments (the short form of the Warwick–Edinburgh Mental Well-Being Scale, the Brief Resilience Scale, and the Pittsburgh Sleep Quality Index). The height and weight of the participants were measured by trained health personnel, and body mass index (BMI; kg/m^2) was calculated. When examining BMI values, individuals with a BMI between 18.5 and 24.9 are considered to have normal weight, those between 25 and 29.9 are classified as overweight (pre-obese), and those with a BMI above 30 are considered obese [19]. When the participants' BMI (kg/m^2) levels were examined, it was observed that the values ranged from a minimum of 23.0 to a maximum of 45.0 (Mean/SD = 32.02 ± 5.88).

These questionnaires were administered face-to-face during participants' visits to the sleep clinic and were completed in approximately 15 min. During the same period, the same data collection procedure was applied to the healthy volunteers included in the control group. Data collection occurred between March 2024 and April 2025.

Variables and measurement

Objective measures

Polysomnographic assessment All participants underwent overnight attended polysomnography using the Compumedics E-series Sleep System (Melbourne, Australia). Standard channels included electroencephalography (EEG), electrooculography (EOG), electromyography (EMG), electrocardiography (ECG), nasal or oronasal airflow, thoracic and abdominal respiratory effort, pulse oximetry, and body position. Apnea was defined as a complete cessation of airflow for ≥ 10 s, while hypopnoea was defined as a ≥ 30% reduction in airflow for ≥ 10 s accompanied by either a ≥ 3% oxygen desaturation or an arousal. Respiratory events were classified as obstructive, central, or mixed in accordance with the criteria of the American Academy of Sleep Medicine (AASM) [20]. Apnoeas were classified as obstructive, central, or mixed according to the standards set by the AASM. OSAS severity was clas-

sified according to AHI values obtained from PSG data. According to AASM criteria: Mild OSAS: AHI 5–14, Moderate OSAS: AHI 15–29, Severe OSAS: AHI ≥ 30 [20].

Subjective measures

Data collection tools

Personal information form The researchers created a demographic information form to gather data on participants' age, sex, marital status, educational level, and socioeconomic status.

Warwick-Edinburgh mental Well-Being scale short form

The short form of the Warwick–Edinburgh Mental Well-Being Scale, developed to assess individuals' mental well-being, consists of seven items rated on a 5-point Likert scale [21]. It primarily evaluates functional aspects of well-being. The scores obtained from this measurement tool range from a minimum of 7 to a maximum of 35. The scale demonstrates a unidimensional factor structure with strong construct validity [22], has been adapted into Turkish with confirmed reliability and validity [23]. In the present study, Cronbach's alpha was calculated as 0.92.

Brief resilience scale

The Brief Resilience Scale, designed to measure individuals' ability to recover from stress and adversity, includes six items rated on a 5-point Likert scale [24]. The scores obtained from this measurement tool range from a minimum of 6 to a maximum of 30. The scale has demonstrated strong construct validity and internal consistency across multiple samples, and it was later adapted to Turkish with acceptable psychometric properties [25]. In the present study, the internal consistency coefficient was calculated as Cronbach's α = 0.84.

Pittsburgh sleep quality index

The Pittsburgh Sleep Quality Index (PSQI) is a widely used instrument developed to assess individuals' sleep quality over the past month [26]. The components of sleep quality are expressed as: Subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, daytime dysfunction. It comprises seven components and yields a total score ranging from 0 to 21, with scores > 5 indicating poor sleep quality. The scale has demonstrated acceptable reliability (Cronbach's α = 0.73) and was later adapted to Turkish with improved reliability (α = 0.80) [27]. In the present study, Cronbach's alpha was calculated as 0.85.

Statistical analysis

The data obtained from the participants were first analyzed through preliminary analyses. In line with Field's suggestion, outliers were evaluated in terms of linearity and normality for preliminary analyses [28]. For outliers in the study, the variables were examined by transforming them into standardized scores, and it was determined that all transformed values were between − 3 and + 3; thus, there were no outliers in the data set [29]. The standard distribution properties of the variables were analyzed with skewness and kurtosis values, and it was determined that these values were between − 2 and + 2. The fact that the skewness and kurtosis values are within the specified limits constitutes evidence of normal distribution [30]. The differentiation of sleep quality levels in terms of gender, marital status, and socio-economic status was analyzed using a t-test for independent groups, and the differentiation in terms of educational level was analyzed using one-way ANOVA. The scores obtained in the study were compared multiple times, which increases the risk of Type I error. Bonferroni correction is a method used to reduce the risk of Type I error that may result from multiple comparisons. In our study, the adjusted alpha level was calculated as α = 0.05 / 4 = 0.013 [31].

Regression-based mediation analysis was conducted to test the hypotheses of the study. Before the mediation analysis, the Durbin-Watson coefficient was checked to examine the assumption of independence of errors, one of the various assumptions of regression analysis [32]. This value was calculated as 1.01 in our study. According to Durbin and Watson, this value should be between 1 and 3 [32]. As a result of the analysis, the Durbin-Watson coefficient was within the relevant limits. For the multicollinearity assumption, another assumption of regression analysis, the relationships between predictor variables were tested with a variance inflation factor (VIF) and tolerance values. According to this assumption, the relationships between the predictor variables should not be greater than 0.90, the VIF value should be less than 5, and the tolerance value should be greater than 0.20 [33]. The correlation analysis results obtained from the research determined that the highest relationship between the predictor variables was − 0.58, which is lower than the recommended criterion value of 0.90. Also, the VIF value was found to be 1.50 and less than 5. In addition, the tolerance value was found to be 0.67. All these results showed that the multicollinearity assumption was met. In addition, the last assumption of multiple regression, the absence of multivariate outliers, was examined with Cook's D value. Since Cook's D values greater than 1 are accepted as outliers, it was determined that none of the obtained values were greater than 1 [34]. Consequently, analyses were conducted after it was seen that the study did not have a multicollinearity problem. In the mediation analyses, we used the bootstrapping resampling method with 10,000 iterations to estimate the indirect effect and calculate bias-corrected

95% confidence intervals. It is important to note that this method draws 10,000 resamples with replacements from the original sample ($N = 301$), and mediation analyses are conducted in each resample. During the bootstrap method calculation, the significance of the indirect effect was tested using SPSS Macro Process software [35]. In the results obtained, confidence intervals that do not include zero values indicate that the indirect effect is significant. SPSS 21.00 software package was used to analyze the data obtained in the study.

Results

Of the participants, 143 (47.5%) were female and 158 (52.5%) were male. The mean age of the participants was (*Mean* = 47.21, *SD* = 10.67, min.-max. = 24–67). It was found that 100 (33.2%) of the participants were primary school graduates, 42 (14.0%) were secondary school graduates, 80 (26.6%) were high school graduates and 79 (26.2%) were undergraduate graduates. When the economic status of the study participants was analyzed, 75 (24.9%) were at a low level, and 226 (75.1%) were at a medium level. When the participants' marital status was analyzed, 252 (83.7%) were married, and 49 (16.3%) were single. An examination of the demographic and clinical characteristics of our study group revealed that the majority of participants were male in terms of gender, primary school graduates in terms of education level, middle class in terms of socioeconomic status, married in terms of marital status, classified as having severe OSAS based on their AHI, and categorized as obese based on their body mass index. Demographic characteristics of the participants are given in Table 1.

In addition to the demographic characteristics of the OSAS study group, the characteristics of the control group are also presented in Table 1. An examination of the demographic data of the control group shows that the mean age was 50.35 ± 6.27, with a minimum of 40 and a maximum of 67 years.

An independent group t-test was performed to differentiate sleep quality levels based on gender, marital status, and socio-economic status. The results obtained determined that sleep quality scores of individuals differed significantly in terms of gender ($t_{(69)} = 4.78$, $p < 0.001$). When this difference was examined, the mean sleep quality scores of women (*Mean* = 10.29, *SD* = 4.57) were significantly higher than the mean sleep quality scores of men (*Mean* = 7.92, *SD* = 4.03). In addition, it was concluded that the effect size of gender on sleep quality was moderate ($n^2 = 0.07$).

When the difference between marital status and sleep quality was analyzed, a significant difference was observed between sleep quality scores ($t_{(69)} = 14.32$, $p < 0.001$). When this difference was analyzed, the mean sleep quality scores of single individuals (*Mean* = 15.47, *SD* = 2.42) were significantly higher than the mean sleep quality scores of married individuals (*Mean* = 7.80, *SD* = 3.59). The effect size of marital status on sleep quality was high ($n^2 = 0.41$). Another finding was that sleep quality scores differed significantly regarding socio-economic status ($t_{(69)} = 5.16$, $p < 0.001$). When this difference is examined, the mean sleep quality scores of those with low socio-economic status (*Mean* = 11.25, *SD* = 5.31) are significantly higher than the mean sleep quality scores of those with medium socio-economic status (*Mean* = 8.32,

Table 1 Demographic characteristics of participants in study

Variable		Study Group				*p*	*N*	Control Group	
		N	%	SQSA	*t/F*			%	SQSA
Gender	Female	143	47.5	10.29	4.78***	< 0.001	36	34.6	4.33
	Male	158	52.5	7.92			68	65.4	4.76
Education Level	Primary school	100	33.2	7.04			48	46.2	4.50
	Secondary School	42	14.0	7.48	20.58***	< 0.001	24	23.1	4.83
	High School	80	26.6	10.10			24	23.1	4.80
	Bachelor degree	79	26.2	11.37			8	7.7	4.00
SEL	Low	75	24.9	11.25	5.16***	< 0.001	20	19.2	4.20
	Middle	226	75.1	8.32			84	80.8	4.71
Marital Status	Single	49	16.3	15.47	14.32***	< 0.001	32	30.8	4.69
	Married	252	83.7	7.80			72	69.2	4.58
Apnoea-Hypopnoea Index (AHI)	Mild level	30	10.0	4.73					
	Moderate level	106	35.2	7.53					
	Severe level	165	54.8	13.89					
Body mass index (BMI)	Normal weight	114	37.9	3.73					
	Pre-obese	65	21.6	5.32					
	Obese	122	40.5	12.41					

Note: SQSA = Sleep Quality Score Average, SEL = Socio Economic Level, ***$p < 0.001$

SD = 3.86). The effect size of socioeconomic status on sleep quality was moderate ($n^2 = 0.08$).

A one-way analysis of variance was performed to determine whether individuals' mean sleep quality scores differed according to their education levels. The one-way analysis of variance revealed that the mean scores of sleep quality were statistically significantly different according to the individual's educational levels ($F_{(3, 297)} = 20.58$, $p < 0.001$). Bonferroni, one of the multiple comparison tests, was used to determine which groups found the difference. One of the findings also indicated that the mean sleep quality scores of individuals with a bachelor's degree (*Mean* = 11.37, *SD* = 5.01) were significantly higher than those of both individuals with a primary school education (Mean = 7.04, SD = 3.09) and those with a middle school education (*Mean* = 7.48, *SD* = 4.29). Another result obtained showed that the mean sleep quality scores of individuals with a high school education (*Mean* = 10.10, *SD* = 3.97) were significantly higher than those of both individuals with a primary school education (*Mean* = 7.04, *SD* = 3.09) and those with a middle school education (*Mean* = 7.48, *SD* = 4.29). In addition, the effect size of education level on individuals' sleep quality scores ($n^2 = 0.17$) was found to be high. As a result, it was determined that sleep quality deteriorated as the education level of individuals increased.

An independent samples t-test was also conducted to evaluate whether the levels of sleep quality, psychological resilience, and mental well-being differed between the OSAS study group and the control group. The results showed that participants' sleep quality scores ($t_{(403)} = 10.13$, $p < 0.001$), mental well-being scores ($t_{(403)} = -3.59$, $p < 0.001$)), and psychological resilience scores ($t_{(403)} = -4.00$, $p < 0.001$) differed significantly. In other words, it was observed that the OSAS group had significantly poorer sleep quality, mental well-being, and psychological resilience levels compared to the control group. Descriptive statistics values for other variables used in the study were analyzed (Table 2).

Afterward, Pearson correlation analysis was performed to determine the relationships between the variables. In the findings, negative and statistically significant relationships were found between sleep quality and mental well-being ($r = -0.43$, $p < 0.001$) and psychological resilience ($r = -0.58$, $p < 0.001$). On the other hand, a positive and statistically significant relationship was found between mental well-being and psychological resilience ($r = 0.54$, $p < 0.001$).

As a result of mediation analyses, the total effect of sleep quality on mental well-being was negative and statistically significant ($\beta = -0.43$, $t = -8.13$, $p < 0.001$). In addition, sleep quality predicted psychological resilience negatively ($\beta = -0.58$, $t = -12.27$, $p < 0.001$), whereas psychological resilience predicted mental well-being positively ($\beta = 0.45$, $t = 7.57$, $p < 0.001$). Finally, the 95% bias-corrected confidence intervals did not include zero, and the indirect effect of sleep quality on mental well-being through psychological resilience ($ab = -0.26$, $SE = 0.04$, 95% CI [-0.33, −0.19]) was found to be significant. In other words, a one-unit increase in sleep quality may cause a −0.26-unit decrease in the mental well-being variable through psychological resilience. The findings obtained from the analyses are given in Table 3.

Consequently, psychological resilience has a mediating role in the relationship between sleep quality and mental well-being. The findings regarding the mediating role of psychological resilience in the relationship between sleep quality and mental well-being are shown in Fig. 1.

In the study, after controlling for gender, marital status, education level, and socioeconomic status, the indirect effect of psychological resilience on the relationship between sleep quality and mental well-being was also tested. The results are presented in Table 4.

After controlling for gender, marital status, education level, and socioeconomic status, it was found that

Table 2 Total scale and subscale score averages of the study and control groups

Group	Study Group		Control Group		*t*	*p*
Scales	**Mean ± SD**	**(Min-Max)**	**Mean ± SD**	**(Min-Max)**		
Resilience	17.94 ± 3.72	7–30	19.47 ± 2.03	10–25	-4.00***	< 0.001
Mental well-being	22.09 ± 7.61	17–35	24.94 ± 5.55	10–35	-3.59***	< 0.001
Pittsburgh Sleep Quality Index	9.05 ± 4.45	3–19	4.61 ± 0.63	3–5	10.13***	< 0.001
Subjective sleep quality	1.37 ± 1.03	0–3	0.73 ± 0.81	0–3	5.73***	< 0.001
Sleep latency	1.22 ± 0.86	0–3	0.69 ± 0.61	0–2	5.78***	< 0.001
Sleep duration	1.27 ± 1.24	0–3	0.08 ± 0.27	0–1	9.74***	< 0.001
Habitual sleep efficiency	1.27 ± 1.26	0–3	0.42 ± 0.75	0–2	6.49***	< 0.001
Sleep disturbances	1.67 ± 0.69	0–3	1.15 ± 0.36	1–2	7.37***	< 0.001
Use of sleeping medication	1.30 ± 0.64	0–3	1.19 ± 0.39	1–2	1.60	0.111
Daytime dysfunction	0.94 ± 0.83	0–3	0.34 ± 0.49	0–1	6.96***	< 0.001

Note: ***$p < 0.001$, The components of sleep quality are expressed as: Subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, daytime dysfunction

Table 3 Direct and indirect effects of sleep quality on mental well-being with resilience as mediator

Dependent Variable: Mental well-being					
Independent Variable: Sleep quality	**B**	**SE**	**β**	**t**	***p***
Sleep quality to resilience	−0.48	0.04	−0.58	-12.27***	< 0.001
Resilience to mental well-being	0.91	0.12	0.45	7.57***	< 0.001
Total effect of sleep quality	−0.70	0.19	−0.40	-3.62**	0.001
Direct effect of sleep quality	−0.29	0.10	−0.17	-2.85**	0.005
			F(2, 298) = 67.94, R2 = 0.31, $p < 0.001$		
Bootstrap results for indirect effect					
Sleep quality to mental well-being via resilience	Effect	SE	Lower	Upper	
	−0.26	0.04	−0.33	−0.19	

Notes: ***$p < 0.001$, **$p < 0.01$, Statistical significance indicated in bold. CI = 95% percentile bootstrap confidence interval. Bootstrapping process was confirmed with 10,000 bootstrap samples

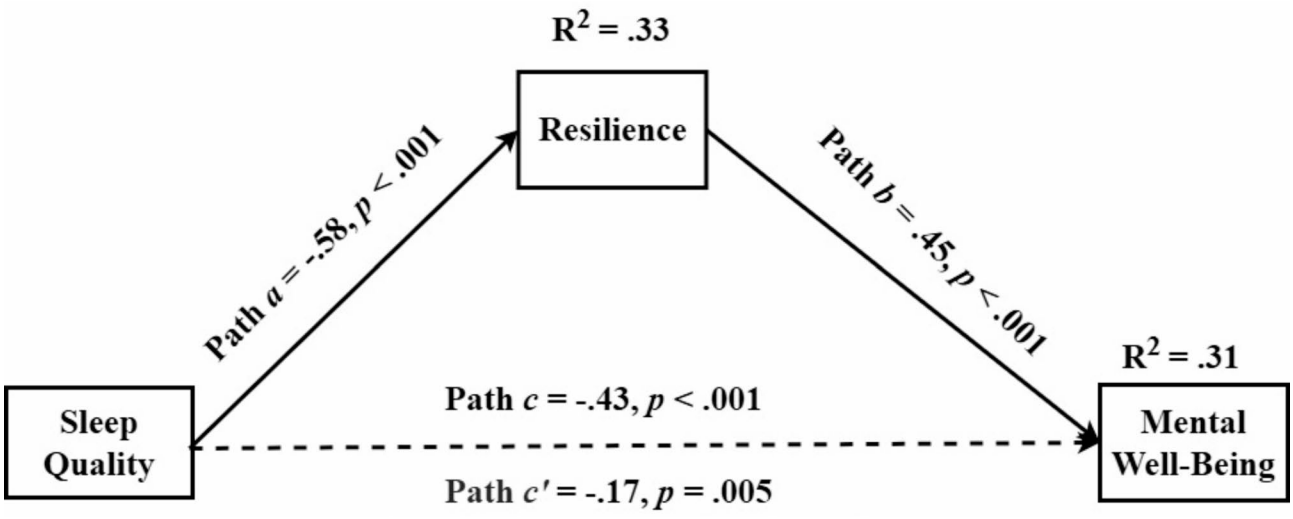


Fig. 1 The prediction of mental well-being by sleep quality through the mediation of resilience

Table 4 Direct and indirect effects of sleep quality on mental well-being through resilience, after controlling for gender, marital status, educational levels, and socio-economic status

Control Variable: Gender, marital status, socio-economic status, educational levels					
Dependent Variable: Mental well-being					
Independent Variable: Sleep quality	**B**	**SE**	***β***	***t***	***p***
Sleep quality to resilience	−0.46	0.05	−0.55	-9.31***	< 0.001
Resilience to mental well-being	0.82	0.13	0.40	6.44***	< 0.001
Total effect of sleep quality	−0.48	0.12	−0.28	-4.12***	< 0.001
Direct effect of sleep quality	−0.10	0.12	−0.06	−0.80	0.426
			$F_{(6, 294)} = 28.12$, $R^2 = 0.36$, $p < 0.001$		
Bootstrap results for indirect effect					
Sleep quality to mental well-being via resilience	Effect	SE	Lower	Upper	
	−0.22	0.04	−0.30	−0.15	

Notes. ***$p < 0.001$, Gender, marital status, socio-economic status, educational level was dummy coded; Statistical significance indicated in bold; CI = 95% percentile bootstrap confidence interval; Bootstrapping process was confirmed with 10,000 bootstrap samples

psychological resilience had a significant indirect effect on the relationship between sleep quality and mental well-being. When the models with and without control variables were compared, it was observed that the direct effect of sleep quality was not significant when gender, marital status, education level, and socioeconomic status were controlled (in other words, psychological resilience had a full mediating role), and that the indirect effect of psychological resilience decreased.

Discussion

Considering the findings obtained in our study, it was revealed that the majority of the participants were severe OSAS patients, and their sleep quality was significantly impaired. This deterioration in sleep quality in individuals with OSAS was found to be associated with a decrease in their psychological resilience and well-being. Additionally, mediation analysis showed that psychological resilience plays a significant mediating role in the relationship between sleep quality and mental well-being. Subgroup analyses further indicated that sleep quality was particularly lower in women, individuals with low socioeconomic status, single participants, and those with higher education levels.

Obstructive sleep apnea syndrome (OSAS) is a multifactorial condition that impairs systemic physiology primarily through intermittent hypoxia and sleep fragmentation resulting from upper airway collapse during sleep [36]. This pathophysiological profile contributes to a wide spectrum of symptoms, including excessive daytime sleepiness, fatigue, impaired attention, memory deficits, and mood disturbances [37]. The cumulative effect of these symptoms reduces overall quality of life across physical, emotional, and cognitive domains and is further compounded by increased cardiovascular and cerebrovascular risk [38]. Without timely and appropriate intervention, OSAS continues to erode sleep quality and may accelerate psychological and functional decline.

OSAS-related sleep disturbances, including frequent arousals and reduced REM sleep, have been linked to declines in psychological resilience and long-term cognitive performance [39]. Disrupted sleep—whether due to OSAS or other medical conditions—has also been shown to affect cortisol regulation, potentially compromising both mental health and resilience [40]. Moreover, poor sleep quality may weaken adaptive stress responses, increasing susceptibility to anxiety and depression [41]. Our findings align with this evidence, confirming that impaired sleep quality in OSAS patients is associated with reduced psychological resilience and lower mental well-being.

Our data revealed a significant association between gender and sleep quality, with women reporting poorer sleep outcomes. While women often exhibit more favorable objective sleep parameters, they consistently report more sleep-related complaints, including insomnia and nighttime awakenings. This discrepancy is commonly attributed to hormonal fluctuations linked to puberty, the menstrual cycle, pregnancy, and menopause, all of which alter sleep regulation and architecture [42]. However, biological factors alone do not fully account for impaired sleep in women. Psychosocial stressors—including the cumulative demands of balancing occupational, familial, and social responsibilities—are known to elevate anxiety and disrupt sleep continuity. One study found that women reported significantly higher rates of insomnia, restless legs, nightmares, palpitations, hallucinations, and depression than men [43]. Another reported that women diagnosed with insomnia had stronger associations with anxiety compared to men, and that over half of women with OSAS or comorbid sleep disorders also exhibited anxiety, chronic pain, or depressive symptoms [44].

Our findings showed that individuals with OSAS who were single reported poorer sleep quality than those who were married. This may reflect broader psychosocial influences such as loneliness, lack of emotional support, irregular routines, and lifestyle instability. Prior research supports this observation. A nationwide study conducted in a subarctic climate region found that single, divorced, or widowed individuals experienced more severe sleep disturbances than those in relationships [45]. Another study reported significantly higher stress levels among single individuals with OSAS compared to their married counterparts [46]. These findings are consistent with evidence that unmarried individuals tend to exhibit greater psychological distress, reduced emotional security, and elevated cortisol levels relative to married individuals [47].

Our study found that individuals with higher education levels reported more frequent sleep disturbances. This may be attributed to increased occupational demands, cognitive workload, and psychological pressures related to academic and professional achievement. Sustained mental activity may delay cognitive deactivation, impairing sleep initiation and continuity. Moreover, the pursuit of success and the stress of unmet expectations may elevate anxiety and exacerbate sleep disturbances.

Furthermore, a strong association was observed between economic hardship and poor sleep quality. Financial instability—including job loss, debt, and income insecurity—can provoke chronic stress and elevate cortisol levels, disrupting sleep architecture. Economic strain may also contribute to symptoms of anxiety and depression, both of which are known to impair sleep regulation. A previous study reported that the pressure caused by income instability and lack of job security was associated with significant sleep disturbances [48]. These findings underscore the relevance of both psychosocial factors related to education and structural stressors linked to socioeconomic disadvantage in understanding sleep disturbances.

The pattern of associations observed in this study suggests that impaired sleep quality in OSAS may act as a modifiable stressor that compromises psychological resilience and mental well-being. Mediation analysis supports this interpretation by indicating that psychological resilience significantly accounts for the indirect

association between sleep quality and mental well-being. Rather than being an isolated clinical symptom, sleep disturbances may undermine adaptive capacity, particularly in individuals facing cognitive, emotional, or social burdens. The heightened vulnerability observed among women, single individuals, those with higher education, and individuals with low socioeconomic status indicates that demographic and contextual stress factors may exacerbate sleep-related impairment. These findings support the view that sleep should be addressed as a biological marker in OSAS and as a psychological node connected to coping resources and environmental strain.

Several limitations should be considered when interpreting these findings. The cross-sectional design restricts causal inference, and the mediation analysis reflects statistical associations rather than temporal or mechanistic pathways. While bootstrapping is a statistically robust method for testing indirect effects, the relatively small sample size ($N = 301$) may limit the stability and generalizability of the results. Furthermore, since all participants were referred for PSG based on clinical suspicion of OSAS, the findings are limited to a clinically referred population and should not be generalized to the broader asymptomatic population.

Although all participants underwent PSG, detailed parameters such as total sleep time, wake after sleep onset, percentages of REM and slow-wave sleep, respiratory effort–related arousal index, oxygen desaturation, and sleep efficiency were not analyzed in this study. This decision was primarily based on the focus of the research, which aimed to explore psychological factors related to OSAS diagnosis and severity. Additionally, technical and logistical challenges associated with extracting and standardizing these sleep architecture variables across all PSG recordings limited their inclusion. Nevertheless, the absence of such physiological data may be considered a limitation. Future studies that incorporate these variables could help to further clarify the psychological consequences of sleep disruption in OSAS. Additionally, it can be stated that the self-reported nature of the variables obtained from participants—particularly psychological resilience and psychological well-being—constitutes a limitation that should be taken into account when generalizing the findings of the study.

In conclusion, our findings suggest that impaired sleep quality in individuals with OSAS is not merely a physiological disturbance but also a potential psychological risk factor that may undermine resilience and well-being. While the cross-sectional nature of this study limits causal interpretation, the identified indirect pathway through psychological resilience presents a compelling hypothesis for future research. These results reinforce the importance of early OSAS diagnosis and emphasize the necessity of an integrated clinical approach that addresses both physiological symptoms and psychological vulnerability.

Acknowledgements
Not applicable.

Author contributions
The study was conceptualized by A.A and E.A, with data collection carried out by A.A, E.A, F.K. E.A and F.K were responsible for data analysis, while the drafting of the manuscript was undertaken by A.A and Ö. A, with B.K and D.E.A also providing critical review.

Funding
The authors received no financial support for the research and/or authorship of this article.

Data availability
Data is available for submission if requested.

Declarations

Ethics approval and consent to participate
The study was approved by the Institutional Review Board of Erzurum Atatürk University, Social and Human Sciences Ethics Committee (Meeting No: 6, Decision No: 69, Date: 08.03.2024). All procedures involving human participants were conducted in accordance with the ethical standards of the institutional research committee and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Written informed consent was obtained from all participants prior to inclusion in the study.

Consent for publication
Not applicable.

Clinical trial registration
Clinical trial number: not applicable.

Competing interests
The authors declare no competing interests.

Received: 21 May 2025 / Accepted: 22 August 2025
Published online: 28 August 2025

References

1. Thondala B, Pawar H, Panjwani U. Sleep, brain, and stress. Adaptation under stress.ul environments through biological adjustments and interventions. Springer; 2024. pp. 305–26.
2. Freeman D, Sheaves B, Goodwin GM, Yu L-M, Nickless A, Harrison PJ, et al. The effects of improving sleep on mental health (OASIS): a randomised controlled trial with mediation analysis. Lancet Psychiatry. 2017;4(10):749–58.
3. Sejbuk M, Mirończuk-Chodakowska I, Witkowska AM. Sleep quality: a narrative review on nutrition, stimulants, and physical activity as important factors. Nutrients. 2022;14(9):1912.
4. Heinzer R, Vat S, Marques-Vidal P, Marti-Soler H, Andries D, Tobback N, et al. Prevalence of sleep-disordered breathing in the general population: the hypnolaus study. Lancet Respir Med. 2015;3(4):310–8. https://doi.org/10.1016/s2213-2600(15)00043-0
5. Canessa N, Castronovo V, Cappa SF, Aloia MS, Marelli S, Falini A, et al. Obstructive sleep apnea: brain structural changes and neurocognitive function before and after treatment. Am J Respir Crit Care Med. 2011;183(10):1419–26. https://doi.org/10.1164/rccm.201005-0693OC
6. Lopes C, Esteves AM, Bittencourt LR, Tufik S, Mello MT. Relationship between the quality of life and the severity of obstructive sleep apnea syndrome. Braz J Med Biol Res. 2008;41(10):908–13. https://doi.org/10.1590/s0100-879x2008005000036
7. Edwards C, Almeida OP, Ford AH. Obstructive sleep apnea and depression: A systematic review and meta-analysis. Maturitas. 2020;142:45–54. https://doi.org/10.1016/j.maturitas.2020.06.002

8. Kline CE. Sleep quality. Encyclopedia of behavioral medicine. Springer; 2020. pp. 2064–6.
9. Lechat B, Scott H, Naik G, Hansen K, Nguyen DP, Vakulin A, Catcheside P, Eckert DJ. New and emerging approaches to better define sleep disruption and its consequences. Front NeuroSci. 2021;15:751730. https://doi.org/10.3389/fnins.2021.751730
10. Charest J, Grandner MA. Sleep and athletic performance: impacts on physical performance, mental performance, injury risk and recovery, and mental health: an update. Sleep Med Clin. 2022;17(2):263–82.
11. Karuga FF, Kaczmarski P, Białasiewicz P, Szmyd B, Jaromirska J, Grzybowski F, et al. REM-Osa as a tool to understand both the architecture of sleep and pathogenesis of sleep apnea—literature review. J Clin Med. 2023;12(18):5907.
12. Palagini L, Moretto U, Novi M, Masci I, Caruso D, Drake CL, et al. Lack of resilience is related to stress-related sleep reactivity, hyperarousal, and emotion dysregulation in insomnia disorder. J Clin Sleep Med. 2018;14(5):759–66.
13. BaHammam AS, Pirzada AR, Pandi-Perumal SR. Neurocognitive, mood changes, and sleepiness in patients with REM-predominant obstructive sleep apnea. Sleep Breath. 2023;27(1):57–66.
14. Chmitorz A, Kunzler A, Helmreich I, Tüscher O, Kalisch R, Kubiak T, et al. Intervention studies to foster resilience–A systematic review and proposal for a resilience framework in future intervention studies. Clin Psychol Rev. 2018;59:78–100.
15. Wong JL, Martinez F, Aguila AP, Pal A, Aysola RS, Henderson LA, Macey PM. Stress in obstructive sleep apnea. Int J Environ Res Public Health. 2023;20(18):1–15. https://doi.org/10.3390/ijerph20186740
16. Jung SY, Mun YM, Lee GM, Kim SW. The effect of multilevel surgery for obstructive sleep apnea on fatigue, stress and resilience. J Clin Med. 2023;12(3):1075. https://doi.org/10.3390/jcm12031075
17. Timkova V, Nagyova I, Reijneveld SA, Tkacova R, van Dijk JP, Bültmann U. Psychological distress in patients with obstructive sleep apnoea: the role of hostility and coping self-efficacy. J Health Psychol. 2020;25(13–14):2244–59. https://doi.org/10.1177/1359105318792080
18. Balkin RS, Sheperis CJ. Evaluating and reporting statistical power in counseling research. J Couns Dev. 2011;89(3):268–72.
19. Weir CB, Jan A. BMI classification percentile and cut off points. StatPearls Publishing; 2025.
20. Ruehland WR, Rochford PD, O'Donoghue FJ, Pierce RJ, Singh P, Thornton AT. The new AASM criteria for scoring hypopneas: impact on the apnea hypopnea index. Sleep. 2009;32(2):150–7.
21. Tennant R, Hiller L, Fishwick R, Platt S, Joseph S, Weich S, et al. The Warwick-Edinburgh mental well-being scale (WEMWBS): development and UK validation. Health Qual Life Outcomes. 2007;5:1–13.
22. Haver A, Akerjordet K, Caputi P, Furunes T, Magee C. Measuring mental well-being: A validation of the short Warwick–Edinburgh mental well-being scale in Norwegian and Swedish. Scand J Public Health. 2015;43(7):721–7.
23. Demirtaş AS, Baytemir K. Warwick-edinburgh mental Iyi Oluş ölçeği Kisa formu'nun türkçe'ye uyarlanmasi: Geçerlik ve Güvenirlik Çalişmasi. Elektronik Sosyal Bilimler Dergisi. 2019;18(70):689–701.
24. Smith BW, Dalen J, Wiggins K, Tooley E, Christopher P, Bernard J. The brief resilience scale: assessing the ability to bounce back. Int J Behav Med. 2008;15:194–200.
25. Doğan T. Kısa Psikolojik Sağlamlık ölçeği'nin Türkçe uyarlaması: Geçerlik ve Güvenirlik Çalışması. J Happiness Well-Being. 2015;3(1):93–102.
26. Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193–213.
27. Ağargün MY. Validity and reliability of Turkish version of Pittsburgh sleep quality index. Türk Psikiyatri Dergisi. 1996;7:107.
28. Field A. Discovering statistics using IBM SPSS statistics. London: Sage Publications Limited; 2024.
29. Tabachnick BG. Using multivariate statistics. Alyn and Bacon. 2007.
30. George D, Mallery P. IBM SPSS statistics 26 step by step: A simple guide and reference. Routledge; 2019.
31. Haynes W. Bonferroni correction. In: Dubitzky W, Wolkenhauer O, Cho KH, Yokota H, editors. Encyclopedia of systems biology. Springer; 2013.
32. Durbin J, Watson GS. Testing for serial correlation in least squares regression. I. Breakthroughs in statistics: methodology and distribution. Springer; 1992. pp. 237–59.
33. Hair JF Jr, Gabriel LDS, Silva Dd M, Braga S. Development and validation of attitudes measurement scales: fundamental and practical aspects. RAUSP Manage J. 2019;54(4):490–507.
34. Cook RD. Detection of influential observation in linear regression. Technometrics. 2000;42(1):65–8.
35. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav Res Methods. 2008;40(3):879–91.
36. Dempsey J, Veasey S, Morgan B, O'DONNELL C, Dempsey JA, Veasey SC, Morgan BJ, O'Donnell CP. Pathophysiology of Sleep Apnea. Physiol Rev 90: 47–112, 2010. Physiological reviews. 2010;90(2):797-8.
37. Kales A, Caldwell AB, Cadieux RJ, Vela-Bueno A, Ruch LG, Mayes SD. Severe obstructive sleep apnea—II: associated psychopathology and psychosocial consequences. J Chronic Dis. 1985;38(5):427–34.
38. Gall R, Isaac L, Kryger M. Quality of life in mild obstructive sleep apnea. Sleep. 1993;16(suppl8):S59–61.
39. Lockley SW, Foster RG. Sleep: a very short introduction. USA: Oxford University Press; 2012.
40. Schwartz RN, Payne RJ, Forest VI, Hier MP, Fanous A, Vallée-Gravel C. The relationship between upper airway collapse and the severity of obstructive sleep apnea syndrome: a chart review. J Otolaryngol Head Neck Surg. 2015;44(1):32. https://doi.org/10.1186/s40463-015-0086-2
41. Knutson KL, Phelan J, Paskow MJ, Roach A, Whiton K, Langer G, et al. The National sleep foundation's sleep health index. Sleep Health. 2017;3(4):234–40.
42. Krishnan V, Collop NA. Gender differences in sleep disorders. Curr Opin Pulm Med. 2006;12(6):383–9.
43. Valipour A, Lothaller H, Rauscher H, Zwick H, Burghuber OC, Lavie P. Gender-related differences in symptoms of patients with suspected breathing disorders in sleep: a clinical population study using the sleep disorders questionnaire. Sleep. 2007;30(3):312–9. https://doi.org/10.1093/sleep/30.3.312
44. Foster SN, Hansen SL, Capener DC, Matsangas P, Mysliwiec V. Gender differences in sleep disorders in the US military. Sleep Health. 2017;3(5):336–41. https://doi.org/10.1016/j.sleh.2017.07.015
45. Unnarsdóttir AB, Hauksdóttir A, Aspelund T, Gunnarsdóttir V, Tómasson G, Jakobsdóttir J, et al. Sleep disturbances among women in a Subarctic region: a nationwide study. Sleep. 2022;45(8). https://doi.org/10.1093/sleep/zsac100
46. Merrill RM. Mental health conditions according to stress and sleep disorders. Int J Environ Res Public Health. 2022;19(13). https://doi.org/10.3390/ijerph19137957
47. Chin B, Murphy MLM, Janicki-Deverts D, Cohen S. Marital status as a predictor of diurnal salivary cortisol levels and slopes in a community sample of healthy adults. Psychoneuroendocrinology. 2017;78:68–75. https://doi.org/10.1016/j.psyneuen.2017.01.016
48. Salas-Nicás S, Sembajwe G, Navarro A, Moncada S, Llorens C, Buxton OM. Job insecurity, economic hardship, and sleep problems in a National sample of salaried workers in Spain. Sleep Health. 2020;6(3):262–9. https://doi.org/10.1016/j.sleh.2020.02.014

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