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[Vasiliki Epameinondas Georgakopoulou](#) , Anastasios Kallianos , [Paschalis Steiropoulos](#) , [Georgia Trakada](#) *

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Article

Adherence and Effectiveness of Positive Airways Pressure (PAP) Therapy in Obstructive Sleep Apnea (OSA) Patients Suffering from Mental Disorders

Vasiliki Epameinondas Georgakopoulou ¹, Anastasios Kallianos ², Paschalis Steiropoulos ³ and Georgia Trakada ^{2,*}

¹ Department of Pathophysiology, Laiko General Hospital, National and Kapodistrian University of Athens, 11527 Athens, Greece

² Division of Pulmonology, Department of Clinical Therapeutics, School of Medicine, National and Kapodistrian University of Athens, Athens, Greece

³ Department of Respiratory Medicine, Medical School, University General Hospital, Democritus University of Thrace, Alexandroupolis, Greece

* Correspondence: gtrakada@hotmail.com

Abstract

Objectives: Obstructive sleep apnea (OSA) is a common and serious disorder associated with significant health risks. Individuals with mental disorders exhibit a higher prevalence of OSA and may encounter unique challenges in adhering to positive airway pressure (PAP) therapy. However, evidence on long-term adherence and treatment outcomes in this population remain limited. This study aimed to evaluate PAP therapy adherence and effectiveness in adults with moderate to severe OSA, comparing individuals with comorbid mental disorders to those without psychiatric diagnoses over a three-year follow-up period. **Methods:** A prospective observational cohort study was conducted at a tertiary academic center, enrolling 1,672 adults newly diagnosed with moderate-to-severe OSA. Participants were grouped into those with (n=221) and without (n=1,451) comorbid mental disorders. Clinical, anthropometric, and sleep parameters, including Epworth Sleepiness Scale (ESS) scores and PAP usage, were assessed at baseline and at five follow-up visits over three years. Adherence was defined as average nightly PAP use, and effectiveness was evaluated by changes in ESS, BMI, blood pressure, and heart rate. Longitudinal trends were analyzed using linear mixed-effects models. **Results:** Patients with mental disorders demonstrated comparable or slightly higher PAP adherence throughout the follow-up, with numerically greater average nightly usage at each time point. Although between-group differences were not statistically significant, linear mixed effects modeling confirmed stable PAP adherence over time in both groups (Group A: $F(4, 12.79) = 0.184, p = 0.942$; Group B: $F(4, 150.11) = 1.102, p = 0.358$). Daytime sleepiness, measured by ESS, improved significantly over time in both groups (Group A: $F(5, 14.29) = 4.619, p = 0.010$; Group B: $F(5, 60.39) = 29.52, p < 0.001$). Notably, by the final follow-up, patients with mental disorders reported lower ESS scores than those without (3.67 vs. 6.00), indicating meaningful clinical improvement. **Conclusions:** PAP therapy is both feasible and effective in patients with stable mental disorders. The presence of psychiatric comorbidity does not impede adherence and may even enhance long-term engagement when supported by integrated, multidisciplinary care.

Keywords: Obstructive Sleep Apnea (OSA); Positive Airway Pressure (PAP) therapy; mental disorders; adherence; Epworth Sleepiness Scale (ESS)

1. Introduction

Obstructive sleep apnea (OSA) is a common and potentially serious sleep-related breathing disorder characterized by recurrent episodes of partial or complete upper airway obstruction during

sleep, resulting in intermittent hypoxia and sleep fragmentation [1]. In the general population, approximately 23.4% (95% CI 20.9-26.0) of women and 49.7% (46.6-52.8) of men are affected from moderate-to-severe OSA (≥ 15 events per h) [2]. However, its prevalence rises significantly among individuals with mental disorders, particularly those with major depressive disorder, bipolar disorder, and schizophrenia [3,4].

Positive airway pressure (PAP) therapy remains the gold standard treatment for moderate to severe OSA, improving not only respiratory outcomes but also cardiovascular and neurocognitive functioning [5,6]. Nevertheless, adherence to PAP therapy is frequently suboptimal and may be particularly challenging for patients with comorbid mental illness due to factors such as reduced insight, executive dysfunction, or the effects of psychiatric medication [7].

Patients with serious mental disorders often experience excessive daytime sleepiness, fatigue, or insomnia—symptoms that overlap with those of OSA. As a result, OSA may be underdiagnosed in this population due to symptom misattribution and limited access to sleep evaluations [8,9]. Emerging evidence highlights the importance of identifying and treating OSA in individuals with psychiatric disorders. Studies have shown that patients with major depression or schizophrenia have a higher prevalence of moderate to severe OSA than the general population, with reported rates ranging from 14% to over 40%, depending on diagnostic criteria and psychiatric subgroup [4]. Importantly, untreated OSA in these populations has been associated with increased cardiovascular risk, cognitive impairment, and worsening of psychiatric symptoms. In contrast, PAP therapy has demonstrated benefits extending beyond improved sleep quality, including improvements in mood and cognitive function [10].

Despite these findings, data on long-term adherence to and the effectiveness of PAP therapy in patients with comorbid mental disorders remain sparse. Understanding whether psychiatric comorbidity compromises PAP adherence or diminishes treatment efficacy is essential for optimizing clinical management. Addressing these questions requires well-designed prospective studies that evaluate both objective and subjective sleep parameters, along with anthropometric and clinical outcomes, over extended follow-up periods.

The objective of this study was to evaluate PAP therapy adherence and effectiveness in patients with moderate to severe OSA, comparing those with comorbid mental disorders to those without. The primary objectives were to assess PAP usage patterns and therapeutic outcomes, including changes in body mass index (BMI), blood pressure, heart rate and Epworth Sleepiness Scale (ESS) scores, across multiple follow-up visits, and to determine whether mental comorbidity independently influences these parameters.

2. Materials and Methods

Study Design

The data presented were collected as part of a prospective cohort investigation conducted across two major University Hospitals in Greece, each hosting specialized sleep clinics, between January 2015 and May 2025. Adults (≥ 18 years) presenting with suspected OSA and no prior diagnosis or treatment for OSA were considered for inclusion. The study protocol was approved by the Research Ethics Committees of all participating hospitals, and all procedures involving human participants complied with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants.

Study Population

A total of 1,672 adults with newly diagnosed moderate to severe OSA were enrolled. OSA diagnosis was established using overnight polysomnography (PSG) or home polygraphy (PG) according to standard criteria (apnea-hypopnea index [AHI] ≥ 15 events/hour). Patients were categorized into two groups: a) Group A (Mental Disorder Group): patients with a documented

diagnosis of a stable mental disorder under appropriate treatment (n = 221) and b) Group B (Control Group): patients without any history of mental illness (n = 1,451).

Inclusion and Exclusion Criteria

Inclusion criteria comprised adults aged ≥ 18 years with newly diagnosed moderate to severe OSA (AHI ≥ 15 events/hour of sleep), who consented to initiate PAP therapy. Only individuals with stable psychiatric or other comorbid conditions, adequately managed through pharmacological or non-pharmacological treatment, were included. Exclusion criteria included unstable medical or psychiatric comorbidities, severe cognitive impairment or dementia that could interfere with treatment compliance, refusal to initiate PAP therapy, and incomplete follow-up data.

Procedures and Follow-Up

At baseline (Visit 1), all participants underwent a comprehensive clinical evaluation. Anthropometric measurements included height, weight, BMI, and waist, hip, and neck circumferences. Vital signs, systolic and diastolic blood pressure and heart rate, were also recorded. Spirometry was performed to assess pulmonary function and forced vital capacity (FVC) and forced expiratory volume in one second (FEV₁) were expressed as percentages of predicted values. Sleep parameters were derived from PSG or PG recordings including total sleep time, sleep efficiency, sleep architecture, AHI, oxygen desaturation index (ODI), and both mean and minimum oxygen saturation (SaO₂) levels. Subjective daytime sleepiness was evaluated using the Epworth Sleepiness Scale (ESS).

Following the diagnosis of OSA, all patients initiated PAP therapy, either with CPAP or auto-adjusting PAP (APAP). Adherence was objectively monitored via device-generated data, recording average nightly usage in hours.

Subsequent follow-up assessments were conducted at regular intervals: at three months after PAP initiation (Visit 2), and annually thereafter for up to three years (Visits 3-5). At each visit, adherence data were downloaded from PAP devices and anthropometric and vital parameters (BMI, blood pressure, heart rate, and neck, waist, and hip circumferences) were reassessed. The ESS was re-administered at each visit to evaluate changes in subjective sleepiness over time.

Outcome Measures

The primary outcomes of the present study included adherence to PAP therapy and treatment effectiveness. Adherence was quantified as the average daily usage in hours. Effectiveness was evaluated by changes from baseline in key clinical parameters, including the ESS score, BMI, blood pressure, heart rate, and temporal trends in PAP usage.

Statistical Analysis

Descriptive statistics were used to summarize baseline characteristics. Continuous variables were expressed as means $\pm$ standard deviation (SD) and categorical variables as frequencies (percentages). Between-group comparisons were performed using the independent samples t-test for continuous variables and χ^2 test for categorical variables. A p-value <0.05 was considered statistically significant. Linear mixed models were used to analyze repeated measures data for both daily device use (hours/day) and daytime sleepiness (ESS) across study visits. Each outcome was modeled separately using Visit as a fixed effect and patient ID as a random factor to account for within-subject correlations. A diagonal covariance structure was specified, and parameter estimation was performed using restricted maximum likelihood (REML). Degrees of freedom were adjusted using the Satterthwaite approximation. All analyses were conducted using SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

3. Results

The study sample consisted of 1,672 individuals, divided into two groups: patients with a diagnosed mental disorder (Group A, n=221) and those without a mental disorder (Group B, n=1,451).

At baseline, patients in Group A were slightly younger than those in Group B (55.08 vs. 57.59 years; p = 0.006) and more likely to be female (52% vs. 36.7%; p <0.001). BMI and blood pressure were similar between groups; however, resting heart rate was significantly higher in Group A (81.13 vs. 75.1 bpm; p = 0.013), possibly reflecting autonomic dysregulation or medication-related effects. ESS scores and pulmonary function measures did not differ significantly between groups.

Regarding sleep characteristics, patients in Group A had longer total sleep time (277.35 vs. 247.71 min; p <0.001) but exhibited altered sleep architecture, characterized by less Stage 1 (p = 0.017) and Stage 3 (p = 0.04), and more Stage 2 (p = 0.001) sleep. Oxygen saturation was slightly higher in Group A (lowest SaO₂ 81.82% vs. 80.04%; p = 0.007), while time spent below 90% SaO₂, AHI and ODI were comparable between groups.

Baseline anthropometric characteristics and sleep parameters are presented in Tables 1 and 2 respectively.

Table 1. Baseline anthropometric characteristics.

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P-value
Gender (Female)	115 (52.0%)	533 (36.7%)	0.000
Age (years)	55.08 ± 12.32	57.59 ± 13.42	0.006
BMI (kg/m ²)	32.85 ± 6.44	32.03 ± 6.60	0.087
Waist (cm)	102.82 ± 35.94	100.57 ± 38.26	0.420
Hip (cm)	101.80 ± 34.62	100.56 ± 37.42	0.648
Neck (cm)	36.76 ± 12.43	35.60 ± 13.35	0.232
Systolic BP	102.43 ± 47.77	102.93 ± 49.15	0.886
Diastolic BP	65.58 ± 30.55	64.37 ± 30.98	0.588
Heart Rate (bpm)	81.13 ± 20.40	75.10 ± 16.13	0.013
ESS	8.14 ± 4.99	8.57 ± 5.08	0.269
FVC Predicted (%)	91.41 ± 17.57	91.48 ± 18.86	0.955
FEV ₁ Predicted (%)	90.94 ± 18.70	90.29 ± 20.12	0.645

SD, standard deviation; BMI, body mass index; BP, blood pressure; bpm, beats per minute; ESS, Epworth Sleepiness Scale; FVC, forced vital capacity; FEV₁, forced expiratory volume in one second.

Table 2. Baseline sleep characteristics of the participants.

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P-value
Total Sleep Time (min)	277.35 ± 97.83	247.71 ± 103.43	0.000
Sleep Efficiency	76.44 ± 18.23	78.95 ± 18.03	0.092
Sleep Stage 1 (%)	10.89 ± 16.56	14.20 ± 17.77	0.017
Sleep Stage 2 (%)	63.83 ± 23.05	57.26 ± 22.99	0.001
Sleep Stage 3 (%)	17.38 ± 16.27	20.39 ± 20.24	0.040
REM (%)	8.56 ± 11.05	9.57 ± 8.93	0.272
AHI	35.01 ± 30.54	38.36 ± 27.94	0.13
Mean SaO ₂	92.02 ± 3.01	92.26 ± 3.10	0.293
Lowest SaO ₂	81.82 ± 8.84	80.04 ± 9.69	0.007
ODI	36.77 ± 32.07	31.96 ± 26.97	0.199

SD, standard deviation; REM, rapid eye movement; AHI, apnea-hypopnea index; SaO₂, arterial oxygen saturation; ODI, oxygen desaturation index.

At the first follow-up visit (Visit 1) the sample consisted of 657 participants (66 in Group A and 591 in Group B). BMI and blood pressure remained similar between groups, indicating no significant

metabolic differences. However, daytime sleepiness was more pronounced among patients with mental disorders (ESS 7.88 vs. 6.03; $p = 0.027$). PAP adherence showed a non-significant trend toward greater usage in Group A (5.71 vs. 5.14 h/day; $p = 0.054$).

At the second follow up visit (Visit 2), 385 participants were reassessed (36 in Group A and 349 in Group B). BMI and blood pressure remained similar, with no significant differences between groups. Patients in Group A continued to report higher ESS scores (7 vs. 6.01), though the difference was not statistically significant ($p = 0.497$). PAP adherence remained stable, with slightly higher usage in Group A (5.66 vs. 5.35 h/day; $p = 0.394$), supporting the trend of comparable or slightly better adherence despite psychiatric comorbidity.

At the third follow-up visit (Visit 3), the sample comprised 244 participants (27 in Group A and 217 in Group B). BMI and blood pressure remained comparable between groups. Group A showed slightly higher daytime sleepiness (ESS 7.85 vs. 5.59; $p = 0.058$), a difference that approached but did not reach significance. PAP adherence again favored Group A (5.67 vs. 5.17 h/day; $p = 0.237$), indicating sustained engagement with therapy.

At the fourth follow-up visit (Visit 4), 134 participants (15 in Group A and 119 in Group B) were evaluated. No statistically significant differences were observed between groups in BMI, blood pressure, or heart rate, suggesting similar cardiometabolic profiles. Daytime sleepiness remained slightly higher in Group A (ESS 6 vs. 5.36; $p = 0.688$). PAP adherence remained comparable, with slightly higher usage in Group A (5.62 vs. 5.37 h/day; $p = 0.66$), reinforcing the trend of sustained, long-term treatment adherence.

At the final follow-up (Visit 5) the sample consisted of 69 participants (9 in Group A and 60 in Group B). Anthropometric and hemodynamic measures remained similar between groups. Interestingly, patients in Group A reported lower daytime sleepiness (ESS 3.67 vs. 6.; $p = 0.335$) and higher mean PAP usage (6.42 vs. 5.49 h/day; $p = 0.206$), though these differences were not statistically significant.

Linear mixed models were conducted to assess longitudinal changes in daily PAP usage (hours/day) and daytime sleepiness (ESS scores) across follow-up visits. In Group A, the effect of Visit on device daily use was not statistically significant, $F(4, 12.79) = 0.184$, $p = 0.942$, indicating stable PAP usage over time. In contrast, ESS scores in Group A showed a significant main effect of Visit, $F(5, 14.29) = 4.619$, $p = 0.01$, suggesting that daytime sleepiness varied significantly across visits. Similarly, in Group B, ESS scores demonstrated a robust effect of Visit, $F(5, 60.39) = 29.52$, $p < 0.001$, indicating significant temporal variation in daytime sleepiness. The effect of Visit on daily device use was not statistically significant, $F(4, 150.11) = 1.102$, $p = 0.358$, consistent with stable adherence across time points.

Figures 1 and 2 illustrate the longitudinal trends of ESS scores and daily PAP usage, respectively, across multiple follow-up visits for Groups A and B.

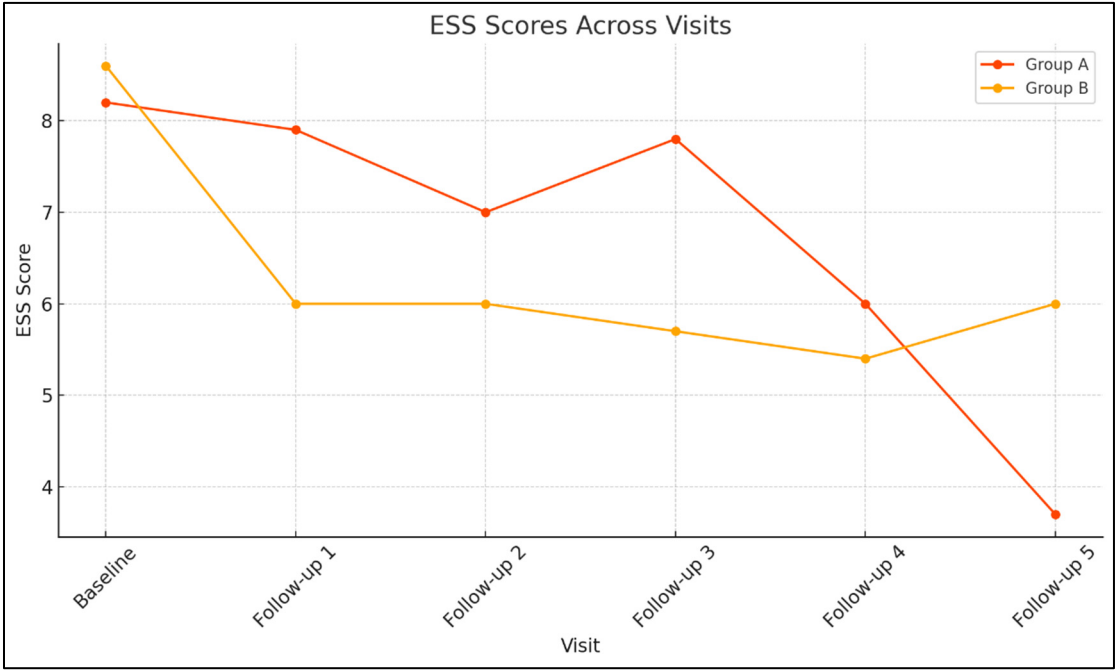


Figure 1. Changes in Epworth Sleepiness Scale (ESS) scores across visits in Group A and Group B.

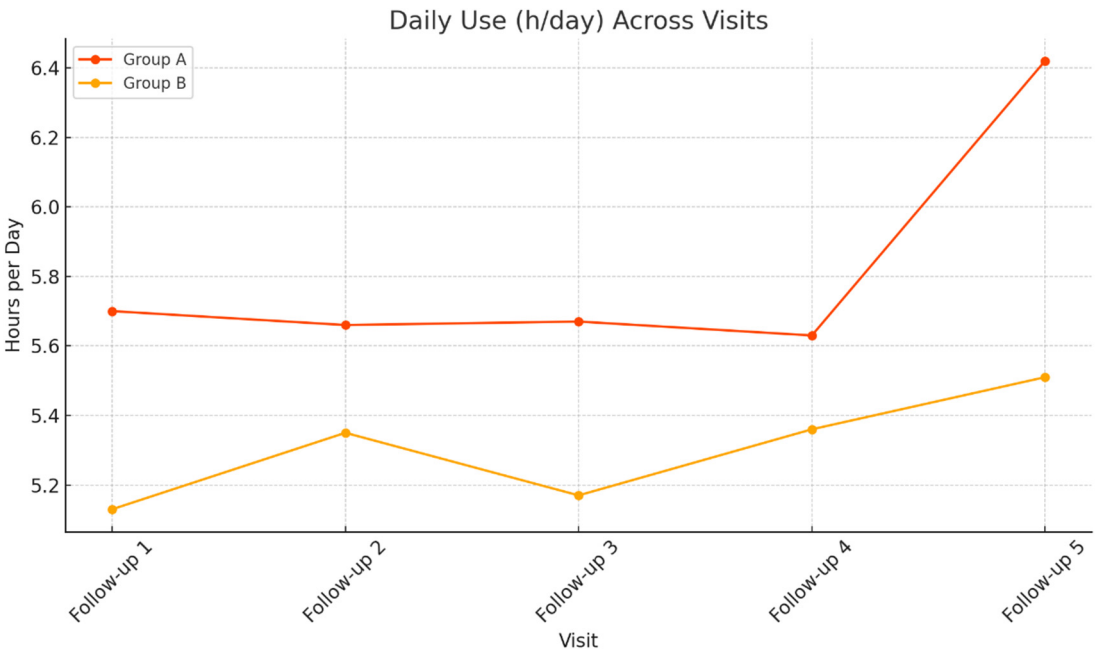


Figure 2. Changes in daily device use (hours per day) across visits in Group A and Group B.

4. Discussion

Across a cohort of 1,672 patients with sleep apnea followed for up to three years, we observed that both groups, those with and without mental disorders, benefited from PAP therapy. However, individuals with psychiatric comorbidities exhibited distinct patterns in adherence and symptom resolution. This prospective cohort study demonstrated that patients with moderate to severe OSA and comorbid mental disorders maintained consistent and comparable adherence to PAP therapy throughout the three-year follow-up period, with adherence levels occasionally surpassing those of patients without psychiatric diagnoses. Despite initially greater daytime sleepiness, individuals with mental disorders showed progressive symptom improvement, ultimately achieving lower ESS scores

at the final follow-up. These findings challenge long-held assumptions about poor treatment compliance among individuals with mental health illness and highlight the potential for effective long-term OSA management in patients with stable psychiatric conditions.

Previous studies have emphasized the high prevalence of undiagnosed OSA among individuals with psychiatric disorders, particularly depression and post-traumatic stress disorder (PTSD). A substantial proportion of these patients meet diagnostic criteria for OSA, yet often undiagnosed or untreated, despite the presence of classic symptoms such as fatigue and excessive daytime sleepiness [11–13]. Similar findings were reported by Alam et al. [14] and Gupta and Simpson [15], who found elevated OSA risk (ranging from 39% to 69%), but strikingly low rates of prior diagnosis or PAP use. In contrast, the present study focused exclusively on patients with confirmed moderate to severe OSA, including a sizeable subset with comorbid mental disorders who were initiated on PAP therapy and followed longitudinally. This design allowed us to move beyond risk estimation and examine real-world patterns of treatment adherence and clinical response in this high-risk population.

In terms of treatment effectiveness, prior research has suggested that PAP therapy may confer psychiatric benefits, particularly in mood, cognition, and functional status [13]. However, these studies often lacked long-term objective outcome measures. In our cohort, patients with mental disorders initially exhibited higher and more variable ESS scores, but showed sustained reductions over time, reaching a mean score of 3.67 at the fifth follow-up, lower than that of the non-psychiatric group (ESS = 6.00). This delayed yet significant improvement supports the hypothesis proposed by Vanek et al. [16] that PAP therapy may yield meaningful neuropsychiatric improvements, a finding previously unconfirmed due to the absence of longitudinal data.

Overall, our findings highlight the feasibility and long-term efficacy of PAP therapy in patients with comorbid mental illness, particularly when psychiatric symptoms are stable and well-managed. Clinicians should not assume reduced compliance in this population; instead, they should emphasize early and continuous patient education, regular follow-up, and integration of psychiatric care into sleep management. Delayed symptom resolution should not be interpreted as therapeutic failure, but may instead reflect gradual neurobehavioral adaptation to improved sleep architecture.

Furthermore, the slightly higher PAP adherence observed among psychiatric patients suggests that structured follow-up and coordinated care can mitigate potential barriers to adherence. Integrating mental health support into PAP adherence programs may further enhance treatment outcomes.

This study has several limitations. First, psychiatric diagnoses were not stratified by type or severity, potentially obscuring differential effects among subgroups (e.g., major depressive disorder vs. schizophrenia). Second, the exclusion of patients with unstable psychiatric or medical conditions limits the generalizability of findings to more complex populations. Third, although PAP usage was objectively monitored, symptom burden was primarily assessed using the ESS, a widely used but subjective measure influenced by mood and perception. Finally, although the follow-up period extended to five years, not all participants completed every visit, introducing potential attrition bias.

Future research should employ more granular psychiatric categorization and include additional metrics of cognitive and functional recovery beyond sleepiness. Incorporating qualitative assessments could also help elucidate motivational and perceptual barriers to adherence. Additionally, investigating the effects of psychiatric medication type and dosage on PAP efficacy and symptom resolution would be highly informative. Studies exploring integrated care models—where sleep specialists and psychiatrists collaborate in the management of patients—may yield strategies to further enhance long-term outcomes in this dual-diagnosis population.

5. Conclusions

This study demonstrates that patients with comorbid mental disorders and moderate to severe OSA can achieve comparable, and in some cases superior, adherence to PAP therapy during long-term follow-up, challenging the common assumption that psychiatric illness inherently compromises treatment compliance. Although these patients initially exhibited higher daytime sleepiness, they

experienced progressive symptomatic improvement, ultimately attaining outcomes equal or better than those without psychiatric comorbidity. These findings underscore the importance of identifying and actively managing OSA in individuals with mental disorders, particularly when their psychiatric conditions are stable and well controlled. Long-term PAP therapy appears both feasible and effective in this population, supporting the need for integrated care approaches that combine sleep medicine and mental health services to optimize patient outcomes. Further research is warranted to clarify the specific effects of different psychiatric diagnoses and pharmacological treatments on OSA management and to develop targeted interventions that enhance PAP adherence and quality of life in this high-risk group of patients.

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AHI	Apnea–Hypopnea Index
APAP	Auto-Adjusting Positive Airway Pressure
BMI	Body Mass Index
BP	Blood Pressure
CPAP	Continuous Positive Airway Pressure
ESS	Epworth Sleepiness Scale
FEV ₁	Forced Expiratory Volume in One Second
FVC	Forced Vital Capacity
ODI	Oxygen Desaturation Index
OSA	Obstructive Sleep Apnea
PAP	Positive Airway Pressure
PG	Polygraphy
PSG	Polysomnography
REM	Rapid Eye Movement
REML	Restricted Maximum Likelihood
SaO ₂	Arterial Oxygen Saturation
SD	Standard Deviation

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