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The effect of continuous positive airway pressure on depressive symptoms in obstructive sleep apnea

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ABSTRACT

Objective: Research on the connection between depression and Obstructive Sleep Apnea (OSA) has not been particularly focused. This study looked into possible links between continuous positive airway pressure, or CPAP, and depression in people with OSA.

Methods: Between July 2011 and August 2013, 47 inpatients with OSA who were referred from various specialty clinics underwent polysomnography testing. The patients were assessed using the Mini International Neuropsychiatric Interview (MINI plus). The Montgomery Asberg Depression Rating Scale (MADRS) was employed for follow-up evaluations among patients who had received a diagnosis of depression. In this study, the effect of CPAP on depressive symptoms in individuals with OSA was evaluated at baseline, three months, and six months following the initiation of therapy.

Findings: When comparing pre-CPAP and the conclusion of the CPAP course by 9.1, the 3-month follow-up by 14.4, and the 6-month follow-up by 18.7 (all $p < 0.01$), there were notable differences in the mean MADRS scores.

Conclusions: Following CPAP treatment, many OSA patients saw a considerable reduction in their MADRS scores. CPAP's ability to lessen depressive symptoms raises the possibility that mood disorders in individuals with OSA are not solely caused by physical symptoms. The amount of evidence demonstrating the connection between depression and OSA is increased by this study.

Keywords: Positive airway pressure; Depression; Obstructive sleep apnea

HIGHLIGHTS:

- OSA's public health impact demands attention.
- OSA and depression: Unraveling a complex connection.
- CPAP: Beyond OSA treatment, a potential depression solution.
- CPAP's enduring impact: A 6-month reduction in depressive symptoms.
- Research shift: CPAP emerges as a vital depression intervention.

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INTRODUCTION

Obstructive Sleep Apnea (OSA) is the most common type of sleep apnea. It is easily identified by its characteristic snoring and frequent episodes of partial or total obstruction of the upper airway during sleep. According to Malik et al. [1] and Prasad et al., [2] these events interfere with sleep cycles and occasionally cause hypoxia at night. Because of its high rate of morbidity and death, OSA is a serious public health concern [3-5]. General population often ignores OSA, which results in an under diagnosis and, ultimately, insufficient treatment [6,7].

A significant number of people with OSA are misdiagnosed, with 93% of females and 82% of males not having an official diagnosis, per the study [7,8]. Moreover, people with OSA frequently experience worse health-related quality of life, cardiovascular problems, reduced neurocognitive function, and additional metabolic dysfunctions [9-12]. There is now knowledge that depression and OSA can affect a patient's overall health as well as the course of their disease, according to recent studies [13-16].

Depression is a prevalent medical illness that is frequently disregarded and does not receive adequate treatment, according to Shoib et al. [17]. There is constant debate on the occurrence of depression in people with OSA, particularly when such people also have other chronic diseases. There is no clear evidence linking OSA with depression, despite some study suggesting that a significant percentage of patients with OSA who also have depression do not receive therapy (20–63%) [18-20].

Even though the majority of research indicates a link between depression and OSA, methodological limitations have been identified. These include small sample sizes and variation in the evaluation methods, such as questionnaires and ratings for depressive symptoms. To address the complex relationship between OSA and depression, longitudinal follow-up studies that track changes in depression status following OSA treatment are required.

Continuous Positive Airway Pressure (CPAP) has been shown to be the most successful non-pharmacological treatment for Open-Source respiratory disease (OSA) [21,22]. Varied health problems related to OSA, such as heart disease, stroke, diabetes, metabolic syndrome, and auto accidents, can be effectively prevented or treated using CPAP. Moreover, it lessens the psychological and physical symptoms brought on by OSA [23,24]. Moreover, research has linked CPAP therapy to enhancements in general

quality of life and cognitive function [21]. Continuous positive pressure breathing has been shown in numerous interventional investigations to reduce depression levels [20,25,26].

Research on the relationship between depression symptoms and CPAP therapy for OSA, however, has yielded inconsistent findings [23,27,28]. Therefore, a large-scale randomised controlled trial using validated scales to quantify depressive symptomatology is required to evaluate the efficacy of CPAP treatment for OSA. Depression symptoms may be significantly reduced by effective CPAP treatment for OSA, which may have significant clinical implications. To completely understand how OSA can alleviate depression, more research is required. Despite a multitude of epidemiologic and clinical investigations exploring the relationship between the two disorders, it remains unclear if depression is a distinct clinical phenomenon associated to OSA or if depression is a cause of OSA. This could occur if concurrent symptoms are misconstrued. This study not only looks at how CPAP affects depressed symptoms in OSA patients, but it also raises a hypothesis that ought to be looked into in a long-term surveillance research to clarify how depression and OSA are related.

MATERIALS AND METHODS

Setting

The investigation was carried out in India's Modern Hospital Srinagar, a private medical facility called Rajbagh. The professional staff at this hospital is paid on a salary basis and provides a wide range of general care and specialty services. Patients are referred to Modern Hospital from all over the state of Jammu and Kashmir since it is the only facility in the area that provides routine polysomnographic testing with a certified laboratory. In terms of race, the study participants from Modern Hospital are thought to be representative of the population.

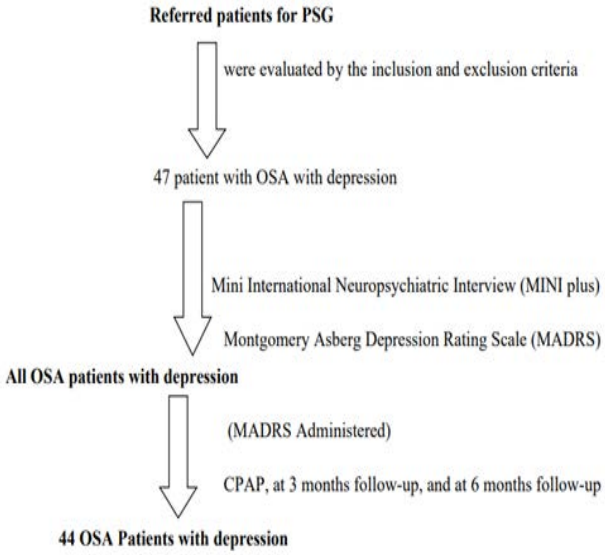
Study design

Forty-seven OSA patients participated in our non-controlled prospective interventional experiment. Based on inclusion and exclusion criteria, patients diagnosed with depression and prescribed CPAP were assessed. The Mini International Neuropsychiatric Interview (MINI plus) scale was used for the initial assessment of each patient [29]. Those who scored positively for depression on the MINI plus scale were subsequently evaluated using the Montgomery Asberg Depression Rating Scale (MADRS) at three and six months' follow-ups, as well as before and after the most recent CPAP cycle [30].

Patient selection

Between July 2011 and August 2013, Polysomnography (PSG) testing was performed on every patient referred from different specialist clinics. The participant selection process is depicted in Figure 1.

Fig.1. Participants enrollment flowchart.



Prior to the PSG experiment commencing, participants provided informed consent. An overnight PSG was performed using a computer-based technique to evaluate sleep-disordered breathing. On the first visit for presenting problems, sociodemographic information, general medical history, and clinical data, including polysomnography results, were recorded. The diagnosis and severity of OSA were then ascertained using an overnight laboratory PSG. Every patient had PSG recordings for a minimum of seven hours, starting and stopping in time with their normal home sleep cycles.

Recordings of polysomnography

Polysomnography examinations yielded a wealth of physiological data. A few of these were the ECG, six EEG channels, bilateral electrooculograms, chin and tibialis electromyograms, piezo electrodes to track movements of the wall of the belly and chest, oronasal thermocouples, and a nasal pressure transducer to assess airflow. The data was visually evaluated by an experienced researcher who was blind to the study's findings. The recordings were visually evaluated at 30-second intervals during REM sleep and non-REM sleep stages S1 through S4, using predetermined scoring criteria. Hobson J [31]. Furthermore, microarousals and respiratory episodes were rated using a set of criteria. Bonnet M and Lemons W [32].

Hobson JA quotes the definition of sleep provided by Rechtschaffen and Kales. According to Stammling, a ten-second or longer breathing stop could be a sign of apnea. A 50% reduction in thoracic-abdominal motions and a 4% drop in oxygen saturation were considered indicators of hypopnea. The number of apneas and hypopneas per hour of total sleep time was used to compute the apnea/hypopnea index, or AHI. To be diagnosed with obstructive sleep apnea, a person must have an AHI of five or more apneas or hypopneas per hour. Daytime weariness was measured using the Epworth sleepiness scale [33]. A score of nine or above on the Epworth scale was considered excessive daytime sleepiness. OSAS is the term used to describe the condition where the sum of the ESS Score and AHI is greater than 9. The total number of desaturations of at least 3% for each hour of sleep was used to determine the oxygen desaturation index, or ODI. Based on commonly accepted clinical cutoffs, the severity of OSA was categorised into four groups: No OSA (AHI<5), mild OSA (AHI ≥ 5 but <15), moderate OSA (AHI ≥ 15 but <30), and severe OSA (AHI ≥ 30).

Psychiatric diagnoses were first made using the Mini International Neuropsychiatric Interview (MINI plus) scale [29]. Patients with a diagnosis of depression were evaluated using the Montgomery Asberg Depression Rating Scale (MADRS) [30]. A consultant psychiatrist verified the presence of mental health conditions. Every patient gave their informed consent, which was collected verbally and in writing. The MADRS was used to assess patients the day following their last visit, three months later, and six months later. Preliminary interviews and information sheets made it clear that providing or withholding consent would not affect the course of treatment. Every piece of patient data, including demographic data and generic descriptors, was entered into a semi-structured case sheet.

Prior to data processing, patient names were substituted with distinct identification numbers in order to protect participant identity.

Montgomery Asberg depression rating scale

The severity of different depression symptoms is measured using the 10-point MADRS scoring system. There are six possible scores. Suicidal thoughts, anxiety, agitation, tension, appetite, energy, mood, sleep, and depression are a few of the symptoms. According to Montgomery and Asberg [30], with seven to nineteen standing for minor depression, twenty to thirty-four for moderate depression, and thirty-four or more for severe depression.

None of the trial participants with a diagnosis of depression were receiving therapy for their illness at the time of CPAP. Below is a list of the study's inclusion and exclusion criteria

Inclusion criteria

- Individuals who have been diagnosed with obstructive sleep apnea.
- Individuals experiencing depression.
- Participants who have provided written consent to engage in the research and individuals of both genders.

Exclusion criteria

- Patients who have previously undergone upper airway surgery.
- Patients undergoing oral appliances or positive airway pressure therapy.
- Patients whose diagnosis is unknown.
- Patients who are already on nocturnal oxygen supplementation.
- Subjects who did not provide informed agreement to participate in the trial.

Ethical compliance

The study was authorised by the ethics council of Sher-i-Kashmir Institute of Medical Sciences (SKIMS Srinagar), located in Srinagar, India.

Statistical analysis

The Levene test was used to evaluate variance following the completion of descriptive statistical analyses pertaining to the general characteristics of the research participants. The Kolmogorov-Smirnov test was then used to look at the variable distribution. When at least one cell had an anticipated count of less than five, the qualitative variables were evaluated using the χ^2 test or the Fisher exact test. When comparing the mean values of quantitative variables with normal distributions, student t tests were employed; for variables with non-normal distributions, Mann Whitney U tests were utilised. Student t-tests were utilised for continuous data in paired samples, and McNemar tests were performed for categorical data run. The Pearson correlation coefficient was utilised to investigate the relationship between the quantitative variables. At P values <0.05, statistical significance was acknowledged. The Pearson correlation coefficient was utilised to investigate the relationship between the quantitative variables. Utilising SPSS 11.0, the analyses were carried out.

RESULTS

The study participants were 58.6 ± 14.7 years old on average. There were 27 women (57.4%) and 20 males (42.6%) in the group. The PSG findings are summarised in Table 1.

Tab. 1. Basic characteristics and polysomnography findings of the study population.

Mean ± SD	
Age (years)	58.6 ± 14.7
AHI	26.0 ± 10.5
ESS	5.7 ± 3.2

Sleep efficiency (percent)		68.5 ± 9.4
Sleep latency (minutes)		24.3 ± 10.1
REM sleep latency (minutes)		78.8 ±14.5
ODI (percent)		24.8 ± 14.5
Awake SpO_2 (percent)		92.5 ± 4.0
Nocturnal SpO_2 (percent)		84.6 ± 6.4
Gender (number (%))	Male	20 (42.6%)
	Female	27 (57.4%)

Note: SD: Standard Deviation; AHI: Apnea/Hypopnea Index; ESS: Epworth Sleepiness Scale; REM: Rapid Eye Movement; ODI: Oxygen Desaturation Index

Table 2 displays the mean MADRS scores of patients who suffer from depression. At the six-month check-in, the MADRS scores after CPAP were 37.2 ± 9.8 for MADRS1, 28.1 ± 10.7 for MADRS2, 22.8 ± 10.2 for MADRS3, and 18.5 ± 10.9 for MADRS4. The mean trends from the baseline to the 6-month follow-up are shown in Figure 2.

Tab. 2. Mean MADRS scores of patients with depression.

	Total number of patients	**Mean ± SD**
Pre-CPAP (MADRSI)	47	37.2 ± 9.8
End of CPAP Course (MADRS2)	42	28.1 ± 10.7
3-month follow up (MADRS3)	42	22.8 ± 10.2
6-month follow up (MADRS4)	42	18.5 ± 10.9

Note: CPAP: Continuous Positive Airway Pressure; MADRS: Montgomery Asberg Depression Rating Scale; MADRS1: pre-CPAP MADRS score; MADRS2: MADRS score at the end of the CPAP course; MADRS3: MADRS score at the 3-month follow-up; MADRS4: MADRS score at the 6-month follow-up.

Fig. 2. Graph showing mean MADRS score of patients with depression.

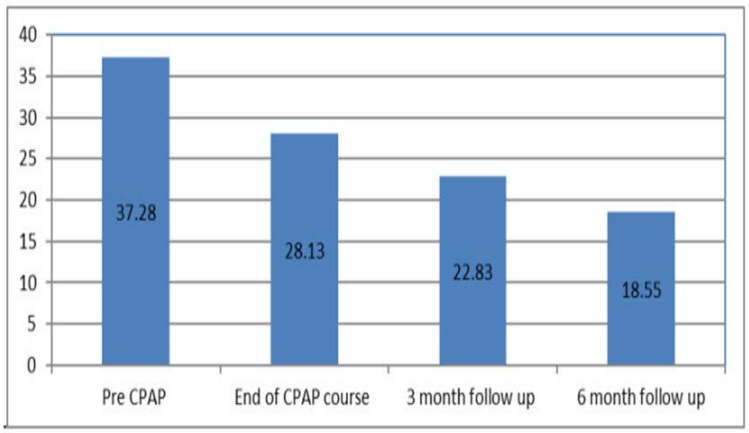


Table 3 compares the mean MADRS scores of patients with depression throughout time. The MADRS scores revealed variations of 9.1, 14.4, and 18.7 (MDRS1 *vs.* MDRS2) between pre-CPAP and the conclusion of the CPAP treatment and the 3-month follow-up. Table 4 shows statistical proof of a significant decrease in MADRS ratings with CPAP therapy over time; all comparisons had p-values of 0.000 (Figure 3).

Tab. 3. Comparison of mean MADRS scores of patients with depression.

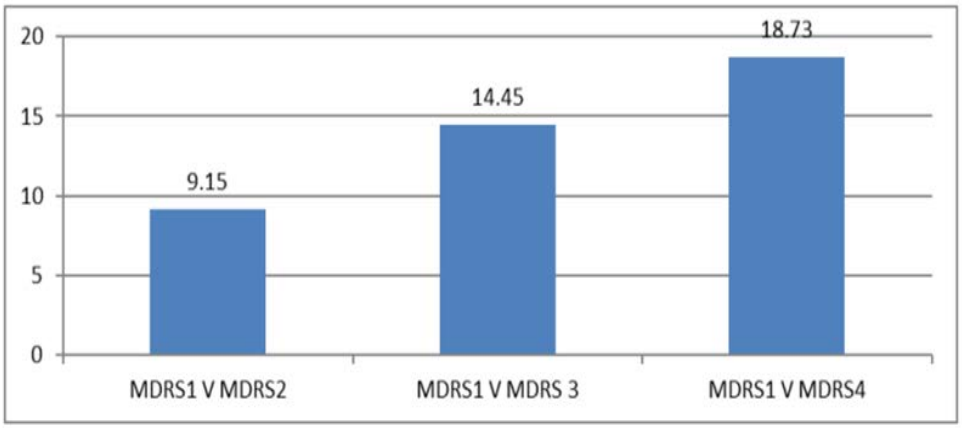
Comparison	**Mean difference**	**p-value**
MADRS1 *vs.* MADRS2	9.15	<0.01
MADRS1 *vs.* MADRS 3	14.45	
MADRS1 *vs.* MADRS4	18.73	

Note: MADRS: Montgomery Asberg Depression Rating Scale; MADRS1: pre-CPAP MADRS score; MADRS2: MADRS score at the end of the CPAP course; MADRS3: MADRS score at the 3-month follow-up; MADRS4: MADRS score at the 6-month follow-up.

Tab. 4. Effect of CPAP on the MADRS scores over time.

Pre-CPAP MADRS (baseline)	**Post CPAP**		
	After CPAP	3-month **follow-up**	**6-month follow-up**
37.28 ± 9.80	28.13 ± 10.70	22.83 ± 10.28	18.55 ± 10.93
Significance between baseline and after CPAP	P<0.01	P<0.01	P<0.01
Note: CPAP: Continuous Positive Airway Pressure; MADRS: Montgomery Asberg Depression Rating Scale			

Fig. 3. Graph showing mean comparison madrs score of patients with depression.



DISCUSSION

For Sleep Apnea (OSA), CPAP is thought to be the most effective non-pharmacological treatment because it successfully lowers symptoms. In the current study, 44 out of 47 patients received CPAP to the end. Between the pre-CPAP and the end of the CPAP course, the average MADRS score differed by 9.1, between the pre-CPAP and the 3-month follow-up, and between the pre-CPAP and the 6-month follow-up, it varied by 14.4. The fact that this improvement has been observed over time is clinically significant. Additionally, the study showed that CPAP reduces depression by demonstrating a decline in MADRS ratings in depressed individuals.

It was astounding to observe a decrease in depressive symptoms as soon as one month following the initiation of cognitive behavioural therapy (CPAP). This is supported by the findings of earlier trials [26,34] that shown improvements in mood symptoms at the beginning of treatment. Furthermore, our study showed that the benefits of Continuous Positive Pressure Breathing (CPAP) therapy for depression persisted for up to six months after the last CPAP session. These findings are in line with current studies that demonstrate that improvements in mood symptoms brought about by treatment persist for several months [35,36].

In all of the trials, there has been no discernible relationship found between CPAP therapy and reductions in depression [37,38]. Our results corroborate earlier studies that found CPAP lessens depression linked to OSA. These studies looked closely at the effects of CPAP on patients with OSA who had significant depression [39-41]. In one of the first studies on this topic, Habukawa et al. [39] found that CPAP treatment was associated with a decline in the Epworth Sleepiness Scale (ESS) score as well as a decline in the Beck Depression Inventory (BDI) and the Hamilton Depression Rating Scale (HAM-D). El-Sherbini et al. [41] reported that following CPAP treatment, six out of the eleven patients who had been diagnosed with Major Depressive Disorder (MDD) using the Structured Clinical Interview for DSM-IV Disorders showed improvements in their symptoms.

For OSA patients who simultaneously experienced depressive symptoms, CPAP therapy dramatically lowered MADRS ratings (Table 4). The reversal of depressed symptoms in obstructive sleep apnea suggests that the illness has a distinct emotional component because the physical signs of the disorder are sometimes mistaken for depressive symptoms. Our results, which show that depression affected a significant portion of patients (11%-8%), are consistent with other studies that have connected depression with OSA [42]. Persons with OSA are more likely to experience depression than persons without OSA, and a sizable fraction of patients (11%-8%) who experience depression also have undiagnosed OSA. Therefore, more investigation is required to ascertain how OSA affects the treatment of depression [43-45]. A comprehensive prospective study is necessary to address the unresolved topic of whether OSA is a risk factor for the eventual development of depression on its own. If future research concentrates on people with OSA who also have depression, it will be simpler to understand the complex relationship between depression and OSA. All things considered, our data suggests that CPAP is a helpful therapy for depression in individuals with OSA. To prove that CPAP is a successful long-term treatment for depression, larger prospective trials are needed, as the current ones lack a control group and have a limited sample size.

CONCLUSION

The recent study highlights that the fact that CPAP can reverse depression symptoms in OSA patients suggests that the illness

is more complicated than the physical symptoms that CPAP addresses.

ETHICS APPROVAL

The study was approved by the ethics committee of Sher-i-Kashmir Institute of Medical Sciences (SKIMS Srinagar), Srinagar, India.

CONSENT TO PARTICIPATE

A written consent was obtained from all participants.

CONSENT TO PUBLISH

A written informed consent for publication was obtained from all participants.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

FUNDING

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AUTHOR CONTRIBUTION

All authors made substantial contributions to conception and design; helped in the acquisition of data; analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; All authors gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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