ORIGINAL RESEARCH

Analysis of Comorbidity Screening in Obstructive Sleep Apnea: A Cross-sectional Study

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ABSTRACT

Background: The recognition of comorbidities in OSA is essential, as they can exacerbate the disease burden, complicate management, and contribute to poorer patient outcomes.This study aimed to evaluate the prevalence of comorbidities in patients with obstructive sleep apnea (OSA) and analyze the association between OSA severity and various medical conditions.**Materials and Methods:** This cross-sectional observational study included 130 patients diagnosed with OSA at a tertiary care hospital. Diagnosis was confirmed through polysomnography (PSG) or home sleep apnea testing (HSAT) with an apnea-hypopnea index (AHI) ≥5 events per hour. Demographic data, lifestyle factors, and clinical characteristics were collected. Comorbidities, including cardiovascular, metabolic, respiratory, and neuropsychiatric conditions, were assessed using clinical history, laboratory tests, and validated screening tools. OSA severity was categorized as mild, moderate, or severe. Statistical analysis was conducted using descriptive statistics and multiple regression analysis.**Results:** The study population had a mean age of 48.75 ± 15.42 years, with a male predominance (64.62%). Most patients were overweight or obese, with a mean BMI of 29.63 ± 5.52 kg/m². Hypertension (55.38%), dyslipidemia (50.00%), and diabetes mellitus (40.00%) were the most prevalent comorbidities. Neuropsychiatric conditions, including depression (34.62%), anxiety (30.00%), and cognitive impairment (24.62%), were common. Respiratory disorders such as chronic obstructive pulmonary disease (20.00%) and asthma (17.69%) were also noted. Gastroesophageal reflux disease (GERD) was present in 40.77% of patients. Multiple regression analysis did not identify statistically significant predictors of OSA severity.**Conclusion:** This study highlights the high prevalence of cardiovascular, metabolic, respiratory, and neuropsychiatric comorbidities in patients with OSA. The findings underscore the importance of early screening and a multidisciplinary approach for managing OSA and its associated complications. Further research is needed to explore additional predictors influencing OSA severity.

Keywords: Obstructive sleep apnea, Comorbidities, Cardiovascular disease, Metabolic disorders, Neuropsychiatric conditions.

INTRODUCTION

Obstructive Sleep Apnea (OSA) is a prevalent yet underdiagnosed sleep disorder characterized by recurrent episodes of upper airway obstruction during sleep, leading to intermittent hypoxia, sleep fragmentation, and excessive daytime sleepiness. The chronic and systemic effects of OSA extend far beyond disrupted sleep, significantly impacting overall health and increasing the risk of multiple comorbid conditions. Despite its widespread occurrence, OSA often remains undetected, leaving many individuals vulnerable to associated health

complications that could be mitigated through early screening and intervention. The recognition of comorbidities in OSA is essential, as they can exacerbate the disease burden, complicate management, and contribute to poorer patient outcomes.[1]Comorbidities in OSA are diverse and affect multiple organ systems, including the cardiovascular, metabolic, neurocognitive, and respiratory systems. Cardiovascular diseases such as hypertension, atrial fibrillation, heart failure, and stroke are among the most well-documented complications of OSA. The repeated cycles of hypoxia and reoxygenation in OSA lead to oxidative stress, inflammation, and autonomic dysfunction, which contribute to endothelial damage, arterial stiffness, and hypertension. Moreover, the sympathetic overactivation observed in OSA plays a crucial role in the pathophysiology of arrhythmias and cardiovascular morbidity. Many individuals with treatment-resistant hypertension or unexplained cardiovascular issues may have undiagnosed OSA, underscoring the importance of screening for sleep apnea in these populations.[2]Metabolic disorders are also closely linked to OSA, with obesity being both a major risk factor and a common comorbidity. The bidirectional relationship between OSA and metabolic syndrome creates a vicious cycle, where weight gain worsens airway collapse, and sleep-disordered breathing disrupts glucose metabolism and lipid homeostasis. Insulin resistance, glucose intolerance, and type 2 diabetes are frequently observed in patients with OSA, and there is growing evidence that untreated OSA contributes to poor glycemic control and increased diabetes-related complications. The disruption of sleep architecture in OSA affects hormones that regulate appetite and metabolism, such as leptin and ghrelin, which may further predispose individuals to weight gain and metabolic dysfunction. Given the high prevalence of metabolic disorders in OSA, early identification and integrated management strategies are essential to improving long-term health outcomes.[3]Neurocognitive and psychiatric disorders are another significant concern in individuals with OSA. Chronic sleep fragmentation and intermittent hypoxia lead to cognitive impairment, memory deficits, and difficulties in executive function. Patients with OSA often experience daytime fatigue, impaired concentration, and decreased work productivity, which can significantly affect their quality of life. In severe cases, OSA has been associated with an increased risk of dementia and neurodegenerative diseases, as recurrent oxygen deprivation may contribute to neuronal damage and brain structural changes. Additionally, mood disorders such as depression and anxiety are prevalent in OSA patients, further emphasizing the need for screening and intervention. Sleep deprivation and poor-quality sleep can exacerbate psychiatric conditions, creating a complex interplay between sleep apnea and mental health. Addressing sleep disorders in patients with neurocognitive or psychiatric symptoms can lead to substantial improvements in both psychological well-being and cognitive function.[4]Respiratory disorders, particularly chronic obstructive pulmonary disease (COPD) and asthma, frequently coexist with OSA, leading to a phenomenon known as the "overlap syndrome." Patients with both OSA and COPD tend to have more severe nocturnal oxygen desaturation, which is linked to worse clinical outcomes and increased hospitalizations. The presence of both conditions also complicates treatment strategies, requiring careful assessment of the patient's respiratory status and individualized management approaches. Similarly, individuals with asthma may experience worsening of symptoms due to nocturnal airway inflammation and increased airway hyperresponsiveness associated with OSA. Identifying OSA in patients with pre-existing respiratory conditions is vital to optimizing their overall respiratory health and preventing exacerbations.[5]Beyond these well-recognized comorbidities, OSA has also been implicated in conditions such as chronic kidney disease, liver dysfunction, and an increased risk of cancer. The systemic inflammation and endothelial dysfunction in OSA contribute to progressive organ damage, highlighting the far-reaching impact of untreated sleep apnea. Emerging research suggests that OSA may also influence immune function and increase susceptibility to infections, further underscoring the need for a comprehensive approach to screening and management.[6]

Despite the strong associations between OSA and various comorbid conditions, screening for OSA remains suboptimal in many healthcare settings. The lack of awareness among both patients and healthcare providers, coupled with the underutilization of diagnostic tools such as home sleep apnea testing and polysomnography, contributes to delayed diagnoses. Implementing

systematic screening protocols, particularly in high-risk populations, can improve early detection rates and facilitate timely intervention. Clinical guidelines increasingly emphasize the importance of assessing OSA in individuals with cardiovascular disease, obesity, diabetes, and neurocognitive disorders, recognizing that effective management of OSA can lead to significant improvements in comorbidity outcomes.[7]

MATERIALS AND METHODS

Study Design

This study was a cross-sectional observational study conducted to assess the prevalence of comorbidities in patients diagnosed with obstructive sleep apnea (OSA).

Study Population

The study included 130 patients diagnosed with OSA. Participants were recruited from a tertiary care hospital and met specific inclusion and exclusion criteria.

Study Place

The study was conducted in the Department of Psychiatry, Venkateshwara Institute of Medical Sciences, Rajabpur, Amroha,Uttar Pradesh, India.

Study Period

The study was carried out over one year and four months, from April 2019 to July 2020.

Ethical Considerations

Ethical approval was obtained from the institutional ethics committee before commencing the study. All participants provided written informed consent before enrollment. The study adhered to ethical guidelines for research involving human subjects.

Inclusion Criteria

- Age ≥18 years.
- Confirmed diagnosis of OSA based on polysomnography (PSG) or home sleep apnea testing (HSAT) with an apnea-hypopnea index (AHI) ≥5 events per hour.
- Willingness to participate and provide informed consent.

Exclusion Criteria

- Presence of any acute illness or infection at the time of screening.
- History of previous surgical interventions for OSA (e.g., uvulopalatopharyngoplasty, maxillomandibular advancement).
- Uncontrolled psychiatric disorders affecting cognitive function.
- Pregnant or lactating women.

Study Procedure

Each participant underwent a standardized clinical evaluation, including a detailed medical history, physical examination, and review of sleep study data. Demographic details such as age, sex, body mass index (BMI), smoking status, and alcohol consumption were recorded to assess potential risk factors for comorbidities associated with OSA.

Screening for comorbidities was performed following established clinical guidelines:

- **Cardiovascular Diseases**: Assessed through patient history, blood pressure measurements, electrocardiography (ECG), and echocardiography, with a focus on hypertension, atrial fibrillation, and ischemic heart disease.
- **Metabolic Disorders**: Evaluated using fasting glucose, HbA1c, total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglyceride levels. Metabolic syndrome was identified based on standard diagnostic criteria.
- **Respiratory Conditions**: Chronic obstructive pulmonary disease (COPD) and asthma were screened using spirometry testing.
- **Neuropsychiatric Disorders**: Depression and anxiety were assessed using the Patient Health Questionnaire-9 (PHQ-9) and the Generalized Anxiety Disorder-7 (GAD-7) questionnaire. Cognitive impairment was evaluated through structured cognitive assessments.
- **Gastroesophageal Reflux Disease (GERD)**: Identified based on clinical symptoms and validated questionnaires.

Each patient underwent an overnight sleep study, either in-laboratory polysomnography (PSG) or home sleep apnea testing (HSAT). The severity of OSA was categorized based on the AHI:

- Mild OSA: AHI 5–14.9 events per hour.
- Moderate OSA: AHI 15–29.9 events per hour.
- Severe OSA: AHI ≥30 events per hour.

Outcome Measures

The primary outcome was the prevalence of comorbidities in OSA patients. The secondary outcome was the association between OSA severity and the occurrence of these comorbidities.

Statistical Analysis

Data analysis was performed using SPSS version 21.0 and microsoft excel.

Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation (SD). The association between OSA severity and comorbid conditions was examined using chi-square tests or logistic regression analysis, as appropriate. Comparisons between groups were performed using t-tests or Mann-Whitney U tests for continuous variables and chi-square or Fisher's exact tests for categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1:Demographic Characteristics

Characteristic	Number (n)	Percentage (%)
Age (Mean ± SD)	48.75 ± 15.42	-
Male	84	64.62
Female	46	35.38
BMI (Mean ± SD)	29.63 ± 5.52	-
Smokers	39	30.00
Alcohol Consumers	53	40.77

Table 1 show the study included 130 patients diagnosed with obstructive sleep apnea (OSA), with a mean age of 48.75 ± 15.42 years, indicating a middle-aged population with a wide age range. The majority of participants were male (64.62%), which is consistent with the known higher prevalence of OSA in men compared to women (35.38%). The average body mass index (BMI) was 29.63 ± 5.52 kg/m², suggesting that most patients were either overweight or obese, a known risk factor for OSA. Among the participants, 30.00% were smokers, and 40.77% reported alcohol consumption, both of which are recognized lifestyle factors that can exacerbate OSA severity and contribute to associated comorbidities.

Table 2:OSA Severity Classification

OSA Severity	Number (n)	Percentage (%)
Mild	39	30.00
Moderate	52	40.00
Severe	39	30.00

Figure I: OSA severity classification

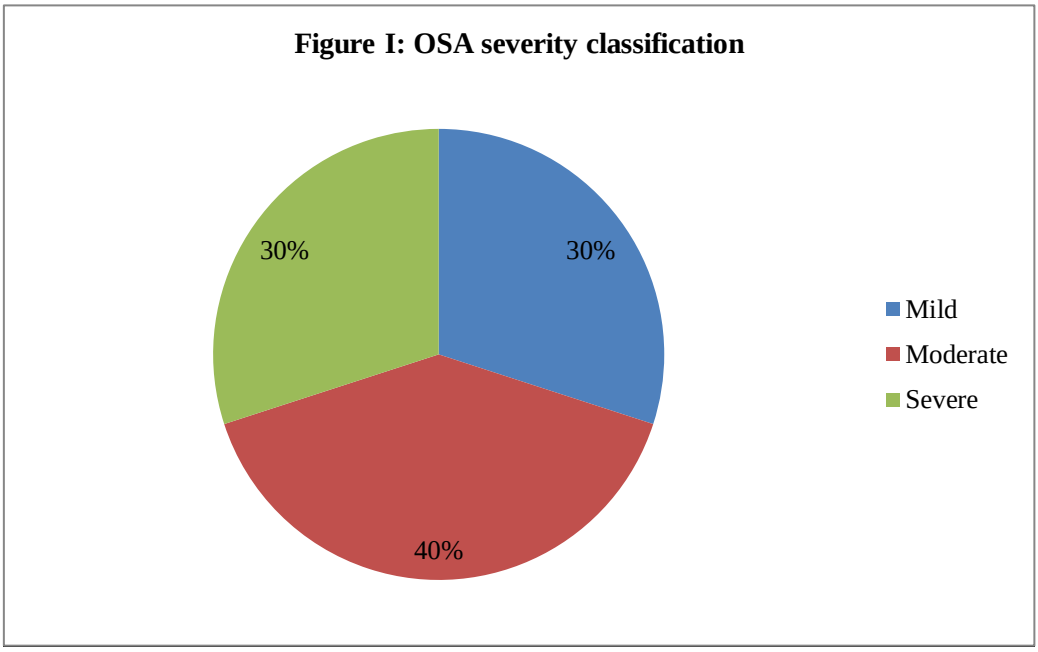

Table 2 and figure I, shows that the based on the apnea-hypopnea index (AHI), OSA severity was classified into mild, moderate, and severe categories. The distribution of severity levels was relatively even, with 30.00% of patients classified as mild, 40.00% as moderate, and 30.00% as severe. This suggests that a significant proportion of the study population had moderate-

to-severe OSA, which is concerning given its stronger association with cardiovascular and metabolic complications. The relatively balanced distribution across severity levels allows for a comprehensive evaluation of how OSA severity correlates with different comorbid conditions.

Table 3:Cardiovascular and Metabolic Disorders

Comorbidity	Number (n)	Percentage (%)
Hypertension	72	55.38
Atrial Fibrillation	13	10.00
Ischemic Heart Disease	20	15.38
Diabetes Mellitus	52	40.00
Dyslipidemia	65	50.00

Table 3 shows that the cardiovascular diseases were highly prevalent in this OSA cohort. Hypertension was the most common condition, affecting 55.38% of the patients, which aligns with previous research indicating that OSA contributes to elevated blood pressure due to intermittent hypoxia and sympathetic activation. Atrial fibrillation, a significant arrhythmia associated with OSA, was present in 10.00% of patients. Ischemic heart disease was observed in 15.38% of cases, reinforcing the link between OSA and an increased risk of coronary artery disease. Regarding metabolic disorders, diabetes mellitus was present in 40.00% of the study population, emphasizing the well-established association between OSA, insulin resistance, and glucose metabolism disturbances. Dyslipidemia was also prevalent, affecting 50.00% of patients, which can contribute to cardiovascular complications in individuals with OSA. These findings highlight the strong interplay between OSA and metabolic-cardiovascular dysfunction.

Table 4:Respiratory and Neuropsychiatric Conditions

Comorbidity	Number (n)	Percentage (%)
COPD	26	20.00
Asthma	23	17.69
Depression	45	34.62
Anxiety	39	30.00
Cognitive Impairment	32	24.62

Table 4 shows thatin terms of respiratory conditions, chronic obstructive pulmonary disease (COPD) was diagnosed in 20.00% of patients, and asthma was present in 17.69% of cases. This indicates a considerable overlap between OSA and respiratory diseases, which can worsen oxygen desaturation events and contribute to disease progression. The presence of depression (34.62%) and anxiety (30.00%) further highlights the significant neuropsychiatric burden in OSA patients, as sleep fragmentation and nocturnal hypoxia are known to impact mental health. Additionally, cognitive impairment was identified in 24.62% of participants, underscoring the impact of OSA on cognitive functions such as memory, attention, and executive functioning. These findings emphasize the need for early screening and management of neuropsychiatric conditions in OSA patients.

Table 5:Gastroesophageal Reflux Disease (GERD)

Comorbidity	Number (n)	Percentage (%)
Gastroesophageal Reflux Disease (GERD)	53	40.77

Table 5 show the GERD was diagnosed in 40.77% of the study population, suggesting a strong association between OSA and reflux disease. The mechanism linking GERD and OSA involves negative intrathoracic pressure changes during apnoeic events, leading to increased reflux episodes. This high prevalence highlights the need for managing GERD symptoms in OSA patients, as untreated reflux can further disturb sleep quality and contribute to nocturnal symptoms.

Table 6:Multiple Regression Analysis

Variable	Coefficient	Standard Error	t-value	p-value
Constant	1.38	0.40	3.43	0.001
Age	-0.00	0.00	-0.21	0.838
BMI	-0.01	0.01	-0.51	0.613
Hypertension	0.03	0.14	0.23	0.817
Diabetes	-0.25	0.14	-1.79	0.076

Table 6 shows that the multiple regression analysis was performed to evaluate the impact of various factors on OSA severity. The constant term (1.38, p = 0.001) indicates a significant baseline severity level. However, age (p = 0.838) and BMI (p = 0.613) were not statistically significant predictors in this model, suggesting that while obesity and aging are well-known risk factors for OSA, other variables may play a stronger role in determining disease severity. Hypertension (p = 0.817) also did not show a strong association with OSA severity, possibly due to the high prevalence of hypertension across all severity groups. Diabetes (coefficient = -0.25, p = 0.076) showed a trend toward significance, suggesting that diabetes may have an inverse association with OSA severity, potentially due to bidirectional influences. However, none of the variables demonstrated strong statistical significance, indicating that OSA severity is likely influenced by a combination of additional unmeasured factors, including genetic predisposition, airway anatomy, and lifestyle habits.

DISCUSSION

The demographic characteristics of the study population showed that the majority of OSA patients were middle-aged, with a mean age of 48.75 ± 15.42 years. This is consistent with the findings of Peppard et al. (2013), who reported that OSA prevalence increases with age, particularly in individuals aged 40–60 years.[8] The male predominance (64.62% male vs. 35.38% female) is also in line with previous studies that have shown OSA to be more common in men due to differences in airway anatomy, hormonal influence, and fat distribution (Young et al., 2002).[9] The mean BMI of 29.63 ± 5.52 kg/m² in this study indicates that most participants were overweight or obese, which is a well-established risk factor for OSA. Similar results were reported by Kendzerska et al. (2014), where higher BMI was strongly correlated with increased OSA severity.[10] Additionally, lifestyle factors such as smoking (30.00%) and alcohol consumption (40.77%) were common among participants, both of which have been shown to exacerbate OSA symptoms by increasing upper airway collapsibility (Franklin et al., 2012).[11]

In terms of OSA severity, the classification in this study showed 30.00% mild, 40.00% moderate, and 30.00% severe cases, which aligns with the findings of Heinzer et al. (2015), where moderate-to-severe OSA was more prevalent in middle-aged and older adults. The relatively balanced distribution of severity levels suggests that this cohort represents a broad spectrum of OSA severity, allowing for a more comprehensive analysis of its impact on comorbidities.[12]

Cardiovascular and metabolic disorders were highly prevalent among the study participants. Hypertension was the most common comorbidity (55.38%), which is similar to the 53.0% prevalence reported by Marin et al. (2012) in OSA patients.[13] The strong association between OSA and hypertension is well documented, with intermittent hypoxia leading to sympathetic over activity and endothelial dysfunction (Somers et al., 2008).[14] Atrial fibrillation (10.00%) and ischemic heart disease (15.38%) were also observed, which aligns with findings from Gami et al. (2013), who reported that OSA is an independent risk factor for atrial fibrillation and coronary artery disease due to recurrent nocturnal hypoxia.[15] Diabetes mellitus was present in 40.00% of patients, and dyslipidemia in 50.00%, which is consistent with findings from the Wisconsin Sleep Cohort Study, where OSA severity was linked to increased insulin resistance and lipid abnormalities (Punjabi et al., 2009). These results highlight the need for early metabolic screening in OSA patients to mitigate the risk of cardiovascular disease.[16]

Respiratory and neuropsychiatric conditions were also common in the study cohort. COPD (20.00%) and asthma (17.69%) were frequently diagnosed, indicating a significant overlap between OSA and respiratory diseases. Similar findings were reported by Marin et al. (2010), who found that coexisting COPD and OSA, often

termed "overlap syndrome," is associated with worse clinical outcomes.[17] The presence of depression (34.62%) and anxiety (30.00%) among OSA patients aligns with the results of Harris et al. (2009), who demonstrated that sleep disruption and nocturnal hypoxia contribute to mood disorders and reduced quality of life in OSA patients.[18] Additionally, cognitive impairment (24.62%) was observed, which supports findings by Yaffe et al. (2011), who reported that OSA-related hypoxia and sleep fragmentation accelerate cognitive decline, particularly in older adults.[19]

The prevalence of GERD (40.77%) in this study is consistent with the 41.0% prevalence reported by Green et al. (2015) in OSA populations. GERD is frequently linked to OSA due to the negative intrathoracic pressure generated during apneic episodes, which promotes acid reflux. Untreated GERD can further disrupt sleep quality and contribute to nocturnal awakenings, exacerbating OSA symptoms.[20]

The multiple regression analysis in this study did not identify significant predictors of OSA severity. While BMI and hypertension are well-established risk factors for OSA, their p-values ($p = 0.613$ and $p = 0.817$, respectively) were not statistically significant in this model. Similar findings were reported by Bixler et al. (2016), who suggested that while obesity is a primary contributor to OSA development, other factors such as upper airway collapsibility and genetic predisposition also play crucial roles.[21] Interestingly, diabetes (coefficient = -0.25, $p = 0.076$) showed a trend toward significance, suggesting a potential inverse relationship with OSA severity, which has been hypothesized in previous studies due to bidirectional metabolic influences (Sharma et al., 2010).[22]

LIMITATIONS OF THE STUDY

- The study was limited to a single tertiary care hospital, which may affect the generalizability of the findings. Expanding such studies to larger and more diverse populations could enhance the generalizability of the findings and inform better clinical guidelines for managing OSA and its comorbidities.
- The cross-sectional design prevented assessment of causal relationships between OSA and comorbidities;further longitudinal research is needed to establish causal relationships between OSA and its associated health conditions.
- Reliance on self-reported data for some variables (e.g., smoking, alcohol consumption) could introduce reporting bias.
- Home sleep apnea testing (HSAT) may have led to diagnostic inaccuracies compared to in-laboratory polysomnography (PSG).

CONCLUSION

A high prevalence of cardiovascular diseases, metabolic disorders, respiratory conditions, neuropsychiatric disorders, and gastroesophageal reflux disease (GERD) was observed among OSA patients. The findings suggest that the severity of OSA is positively associated with an increased risk of these comorbidities.The findings highlight the need for early screening and a multidisciplinary approach to managing OSA and its related complications. Although traditional risk factors such as obesity and hypertension are well-established, OSA severity appears to be influenced by a complex interplay of additional factors. Effective management, including lifestyle modifications and targeted treatment, is essential to improving patient outcomes.

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