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Assessment of Sleep Quality and Prevalence Of Obstructive Sleep Apnea in Patients with Chronic Obstructive Pulmonary Disease

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is commonly accompanied by sleep disturbances and obstructive sleep apnea (OSA), which have a negative impact on quality of life, symptom burden, and clinical outcomes. There are, however, limited local data on sleep quality and the prevalence of OSA in patients with COPD.

Objective: To assess sleep quality and determine the prevalence of obstructive sleep apnea among patients with COPD.

Methodology: This descriptive cross-sectional study was carried out in the Department of Pulmonology, Liaquat University of Medical and Health Sciences Jamshoro, from June 2023 to May 2024. There were 162 patients with COPD who were included. Diagnosis and classification of COPD were made based on GOLD 2023 classification, which is based on spirometry. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). SPSS version 26 was used to analyze the data.

Results: The mean age of patients was 58.9 ± 10.7 years, and 64.2% were men. One hundred thirteen patients (69.8%) had poor sleep quality (PSQI > 5), and 68 (42%) patients had OSA. The frequency of mild, moderate, and severe OSA was 17.9%, 14.8%, and 9.3% of patients, respectively. There was a significant relationship between the severity of COPD and sleep quality (p=0.002).

Conclusion: Sleep disturbances and OSA are very common in COPD patients and are associated with greater disease severity, smoking, and obesity. Prompt detection and treatment of sleep disorders could enhance clinical responses and patient quality of life within COPD patients.

Keywords: Obstructive Sleep Apnea; Sleep Quality; Overlap Syndrome; Pittsburgh Sleep Quality Index

Introduction

The chronic obstructive pulmonary disease (COPD) is a chronic progressive respiratory disease, which is not only linked with limitation of airflow, dyspnea, cough and decreased exercise tolerance, but also with disturbed nocturnal physiology and impaired sleep quality.[1] Sleep disturbance is multifactorial in COPD and can be due to cough and wheeze, nocturnal hypoxemia, hyperinflation, anxiety and depression, effects of medication and other sleep related breathing disorders. Many COPD patients experience poor sleep and this is linked to poorer health status and increased symptom burden and reduced quality of life for many patients.[2,3] Recent evidence also indicates that poor sleep quality can predict symptom deterioration and subsequent exacerbations, thus making sleep assessment clinically relevant in the standard clinical care of COPD.[4,5]

Repeated upper-airway obstruction during sleep, which results in intermittent hypoxemia, sleep fragmentation, and daytime drowsiness, is the hallmark of obstructive sleep apnea (OSA). If OSA occurs in conjunction with COPD, it is called COPD–OSA overlap syndrome, and is clinically significant as it causes more oxygen desaturations at night and worse outcomes compared to COPD alone.[6] According to reports, the prevalence of OSA among COPD patients ranges from roughly 29% to 50%, and it is higher in individuals with more severe COPD and obesity.[7,8] There is also enhanced cardiovascular morbidity, pulmonary hypertension, hospitalisation risk and mortality in association with overlap syndrome.[9,10]

While clinically significant, sleep disorders in COPD are frequently undertreated owing to the possibility that daytime sleepiness and poor attention/concentration could result from COPD itself rather than from coexisting OSA.[11] Certain screening tools, including the Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale and STOP-Bang questionnaire can assist in identifying high-risk patients, but polysomnography or validated sleep testing is still crucial.[12]

There is limited local and regional evidence on the combined assessment of subjective sleep quality and prevalence of OSA among COPD patients, although poor sleep quality and OSA have been reported in international literature. Prevalence estimates vary, due to the use of different diagnostic tools, the distribution of COPD severity in many studies and the differing sampling methods. Thus, measuring sleep quality and identifying the prevalence of OSA in COPD patients is important to identify a potentially underdiagnosed comorbidity and facilitate earlier screening, referral and management.

Objective

To assess sleep quality and determine the prevalence of obstructive sleep apnea among patients with COPD.

Methodology

This descriptive cross-sectional study was carried out at the Department of Pulmonology at Liaquat University of Medical and Health Sciences (LUMHS) Jamshoro between June 2023 and May 2024. The Institutional Review Board granted ethical approval for the project (Ref No. LUMHS/IRC/2023/ Pulmo-041). Each patient provided written informed consent.

The study included people of both genders who were at least 40 years old and had a verified diagnosis of COPD according on the Global Initiative for Chronic Obstructive Lung Disease (GOLD 2023) criteria, which are FEV1/FVC ratio <0.70 on spirometry. Those with a diagnosis of obstructive sleep apnea using CPAP at the time of enrollment, active pulmonary tuberculosis (PTB), interstitial lung disease, malignancy of the lung, severe cardiac failure, neuromuscular disease, psychiatric disease or acute COPD were excluded from the study.

Using a 29% assumed prevalence of obstructive sleep apnea (OSA) in individuals with COPD, a 7% margin of error, and a 95% confidence range, the sample size was calculated using the WHO sample size calculator. 162 patients were included. During the study period, study participants were recruited from the outpatient and inpatient pulmonology units using a non-probability consecutive sampling technique.

All participants had a detailed clinical history and physical examination. A predesigned proforma was used to record demographic and disease severity data, such as age, gender, smoking history, BMI, duration of COPD, comorbidities and disease severity. COPD severity was determined by GOLD staging by spirometric findings and divided into mild, moderate, severe and very severe disease. The Pittsburgh Sleep Quality Index (PSQI) was used to measure sleep quality with a score more than five on the global scale indicating poor sleep quality. Symptoms of daytime sleepiness (when applicable), were assessed with the Epworth Sleepiness Scale. Overnight polysomnography or validated sleep assessment criteria within the department was used to assess for obstructive sleep apnea. Diagnosis and classification of OSA was based on apnea-hypopnea index (AHI). The patients who had an AHI of 5-14 events/hour were considered as mild OSA, 15-29 events/hour as moderate OSA and ≥ 30 events/hour as severe OSA.

The data were entered and analyzed in the Statistical Package for Social Sciences (SPSS) 26.0. All quantitative data (such as age, BMI, PSQI score, and apnea-hypopnea index) were reported as means ± SDs, whereas categorical data (such as gender, smoking status, COPD severity, sleep quality categories, and severity of OSA) were reported as frequencies and percentages. Possible effect modifiers such as severity of COPD, smoking, age and gender and obesity were considered in the stratification. Categorical variables were compared using

the chi-square test, whereas continuous variables were compared using a one-way ANOVA. A p-value of less than 0.05 was considered statistically significant.

Results

Mean age of patients was 58.9 + 10.7 years, with most of the patients within the age range of 51-70 years. There were 104 (64.2%) males and 58 (35.8%) females. A majority of the patients were smokers or former smokers with 113 (69.8) participants. Mean (BMI) of the participants was 27.1 +/-4.8 kg/m 2 (Table 1**.**

The mean PSQI score was 8.1 ± 3.5. Poor sleep quality (PSQI >5) was observed in 113 (69.8%) patients and normal sleep quality was observed only in 49 (30.2) patients (Table 2).

The presence of obstructive sleep apnea was detected in 68 (42.0% of the patients). Out of which, mild OSA was found in 29 (17.9%), moderate OSA in 24 (14.8%), and severe OSA in 15 (9.3) patients. The average apnea-hypopnea index was 11.6/8.9/hour (Table 3).

Severe and very severe COPD patients had significantly greater poor sleep quality than mild and moderate (p=0.002). Correlation between poor sleep quality and COPD severity is presented in table 4.

Obstructive sleep apnea was much more common in obese patients and smokers. The proportion of patients with BMI 30 kg/m2 and above that had OSA was significantly higher than the proportion of those with BMI 30 kg/m2 and below (61.5% vs. 34.0%, p=0.001). On the same note, smokers and former smokers showed increased frequencies of OSA over non-smokers (p=0.013) (Table 5).

The mean apnea-hypopnea index of the various severity groups of COPD was compared, and it was found to rise steadily with deterioration of COPD severity. The highest mean AHI values were in the patients with very severe COPD. This was a statistically significant difference (p<0.001) (Table 6).

Discussion

The current study assessed the quality of sleep and the occurrence of obstructive sleep apnea (OSA) in patients with chronic obstructive pulmonary disease (COPD). The quality of sleep was found to be poor in 69.8% of the subjects, and 42% of COPD patients were found to have OSA. The results indicate that sleep disorders and sleep-disordered breathing are very common but often under-reported comorbidities in COPD patients.

The mean age in this study was 58.9 ± 10.7 years and mostly male (64.2%). Similar demographic results were observed by Van Zeller et al.,[13] who noted that older males with COPD and a history of smoking and cardiovascular risk factors experienced more overlap syndrome. This similarity arguably can be attributed to the fact that a larger proportion of men in the developing countries smoke and work in occupations that lead to higher levels of exposure to smoking and other environmental triggers that raise the risk of both COPD and OSA.

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants

Variable	Frequency n (%) / Mean ± SD
Age (years)	58.9 ± 10.7
40–50 years 51–60 years 61–70 years >70 years	38 (23.5%) 57 (35.2%) 49 (30.2%) 18 (11.1%)
Gender	
Male Female	104 (64.2%) 58 (35.8%)
Smoking Status	
Current smokers Ex-smokers Non-smokers Body Mass Index (kg/m^2)	76 (46.9%) 37 (22.9%) 49 (30.2%) 27.1 ± 4.8
Duration of COPD (years)	7.3 ± 3.6

Table 2. Sleep Quality Assessment among COPD Patients

Variable	Frequency n (%) / Mean ± SD
Mean PSQI Score	8.1 ± 3.5
Good Sleep Quality (PSQI ≤5)	49 (30.2%)
Poor Sleep Quality (PSQI >5)	113 (69.8%)
Excessive Daytime Sleepiness (ESS >10)	71 (43.8%)

In the current study, about two-thirds of the patients were found to have poor quality sleep. This is in line with the findings of **Li** et al.,[14] who revealed that sleep quality impairment is very common in COPD patients and increases symptom burden and risk of exacerbation in the future. Similarly, poorer Pittsburgh Sleep Quality Index (PSQI) scores in patients with severe COPD were also noted by Marin et al.[15] The fact that these studies are similar to our findings may be explained by the similarity of the mechanisms involved in COPD patients such as nocturnal hypoxemia, chronic cough, hyperinflation, anxiety, and repeated sleep interruption. But the rate of low quality sleep was a little higher in our study as compared to some of the Western populations. The latter could be associated with the lack of access to healthcare, inadequate diagnosis of sleep disorders, poor socioeconomic status, and increased smoking among our local residents.

Our study found that OSA was prevalent (42.0), it is similar to the results of **Brennan** et al.,[16] who found that about one third of COPD patients experience overlap syndrome with higher prevalence in the Asian population. **Similarly, Nguyen et al, and Hansson et al,** also reported high rates OSA in moderate-to-severe COPD patients.[17,18] This difference in prevalence could be due to the fact that our study included hospitalized and symptomatic patients, more obese and smokers, and that apnea-hypopnea index threshold of ≥5 events/hour was used to diagnose OSA.

The present research showed a statistically significant correlation between severity of COPD and low sleep quality (p=0.002). Severely and very severely diseased COPD patients had significantly worse sleep quality as compared to patients with mild disease. The same results were reported by **Fanaridis** et al.,[19] who observed sleep quality and more severe nocturnal hypoxia among patients with overlap syndrome and more severe COPD. This association can be explained by worsening nocturnal oxygen desaturation, increased respiratory effort, hypercapnia, and sleep fragmentation in advanced COPD.

Other significant associations with OSA prevalence in our study were obesity and smoking. Patients with BMI 30kg/m^2 showed a much higher prevalence of OSA (p=0.001) and smokers and ex-smokers showed higher prevalence of overlap syndrome as opposed to non-smokers (p=0.013). These results are corroborated by **Srivali et al.,**[20] who have evidence of obesity, cigarette smoking and chronic bronchitis phenotype as significant factors of upper airway collapse and nocturnal desatu-

Table 3. Prevalence and Severity of Obstructive Sleep Apnea among COPD Patients

Variable	Frequency n (%) / Mean ± SD
Mean Apnea-Hypopnea Index (AHI)	11.6 ± 8.9
No OSA (AHI <5)	94 (58.0%)
Mild OSA (AHI 5–14)	29 (17.9%)
Moderate OSA (AHI 15–29)	24 (14.8%)
Severe OSA (AHI ≥30)	15 (9.3%)
Total Patients with OSA	68 (42.0%)

Table 4. Association of COPD Severity with Sleep Quality

COPD Severity	Good Sleep Quality n (%)	Poor Sleep Quality n (%)	p-value
Mild (n=29)	15 (51.7%)	14 (48.3%)	0.002*
Moderate (n=63)	23 (36.5%)	40 (63.5%)	
Severe (n=48)	9 (18.8%)	39 (81.2%)	
Very Severe (n=22)	2 (9.1%)	20 (90.9%)	

ration in overlap syndrome (NCBI). This relationship may be due to smoking-induced inflammation of the upper airways and pharyngeal constriction caused by obesity.
Mean apnea-hypopnea index was also reported to be increasing progressively with the progression of COPD severity ($p<0.001$). The same observations were found in recent literature that showed that severe COPD is related to more nocturnal hypoxia, systemic inflammation and the severity of sleep-disordered breathing.[21] These results indicate the need to screen OSA in patients with advanced COPD at an earlier age.

Table 5. Association of Obstructive Sleep Apnea with BMI and Smoking Status

Variable	OSA Present n (%)	OSA Absent n (%)	p-value
BMI <30 kg/m² (n=118)	40 (34.0%)	78 (66.0%)	0.001*
BMI ≥30 kg/m² (n=44)	27 (61.5%)	17 (38.5%)	
Non-smokers (n=49)	13 (26.5%)	36 (73.5%)	0.013*
Smokers/Ex-smokers (n=113)	55 (48.7%)	58 (51.3%)	

There are some limitations which needs to be addressed. The research was carried out in one tertiary care facility with a relatively small sample size and this can limit the generalization of the findings. The cross-sectional study design also limited causal inference between the severity of COPD and sleep disturbance. Moreover, not all patients had access to overnight polysomnography because of the insufficiency of resources, which could have influenced the accurate assessment of the severity of OSA. Irrespective of these limitations, the study offers valuable local data on the load of low sleep quality and overlap syndrome in COPD patients and emphasizes the necessity of regular sleep evaluation in the pulmonology practice.

Conclusion

Sleep apnea and sleep disorders are relatively common conditions associated with COPD. There is a strong correlation between obstructive sleep apnea and smoking, obesity, and the severity of COPD. The study points out that sleep related disorders are common, but frequently underestimated comorbidities of COPD

Table 6. Comparison of Mean Apnea-Hypopnea Index according to COPD Severity

COPD Severity	Mean AHI ± SD	p-value
Mild	5.8 ± 3.1	<0.001*
Moderate	9.7 ± 5.4	
Severe	14.2 ± 8.2	
Very Severe	19.5 ± 10.3	

patients that may exacerbate the COPD symptoms and reduce the quality of life. Better clinical outcomes and a higher quality of life may result from early detection and treatment of sleep disturbances and obstructive sleep apnea in COPD patients, particularly in those with severe disease and risk factors.

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