Original Research Article

Study on daytime sleepiness and quality of sleep-in patients with chronic obstructive pulmonary disease

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Abstract

Background: Literature studies revealed that Chronic Obstructive Pulmonary Disease (COPD) patients had more delay in the start of sleep, duration of sleep was shorter, there was a reduction in night-time oxygen saturation, and night awakening is more frequent. Hence, It is imperative to make a better understanding of sleep disturbances for the appropriate management of patients suffering from chronic obstructive pulmonary disease. **Settings and Design:** This is a case-control study conducted on 80 subjects divided into two groups, i.e., 40 COPD patients (Case Group) and 40 healthy non-smokers (Control Group). **Methods and Material:** All the subjects were evaluated for sleep disturbance and quality of sleep utilizing ESS (Epworth Sleepiness Scale) and PSQI (Pittsburgh Sleep Quality Index) and subjected to spirometry on the same day **Statistical analysis used:** The analysis of data was done with the use of Statistical Package for the Social Sciences (SPSS) v17.0 software. The use of Analysis of variance (ANOVA) and Chi-square test were made for the analysis of categorical variables between control and case groups. The P-value of <0.05 was deemed statistically significant. **Results:** The majority of the study subjects, i.e., 25/40 (62.5%) and 24/40 (60.00%) in the case group and control group, were in an age group > 60 years and 51-60 years of age, respectively. The patient's mean age was 63.03 years. Mean PSQI score was 12.35 (global score of >5 indicates worse sleep quality), mean FEV1 was 41.98%, mean ESS score was 9.93 (score of 10 or above taken as excessive daytime sleepiness). The majority of COPD (75%) patients had excessive daytime sleepiness compared to the control group (30%) as assessed by ESS ($\chi 2$=16.24, P=<0.0001, OR=7). About 82% of COPD patients had worse sleep quality compared to the control group, i.e., 45% as assessed by PSQI ($\chi 2$-12.17, P-value <0.0001, OR 5.76), and a considerable association was seen between the quality of sleep and daytime sleepiness with severeness of airflow obstruction in patients suffering from COPD. In inference, the findings of our research delineated that COPD is related to poor quality of sleep. There was an association between sleepiness during daytime and sleep quality in relation to the airway obstruction severity. Furthermore, as the severeness in airflow obstruction increases, the quality of sleep worsens. **Conclusions:** the patients' assessment for symptoms of daytime sleepiness, sleep apnea as well as other disorders of sleep must be considered during routine follow-up visits of COPD patients. Moreover, assessing these parameters using ESS and PSQI scoring will prompt the necessity of COPD patients for future work up to OSA evaluation using polysomnography.

Key-words: COPD, Day time sleepiness, Quality of sleep, ESS, PSQI, FEV1.

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Received Date: 23/07/2021 Revised Date: 13/07/2021 Accepted Date: 18/08/2021
DOI: https://doi.org/10.26611/10212016

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 17 October 2021

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a lung illness in which airflow is constricted.[1] It ranks fifth in the world with regards to morbidity and third with respect to mortality among non-communicable ailments.[2,3] Chronic obstructive pulmonary disease is now deemed to be a systemic ailment. According to a study conducted in Maharashtra, India, half a million individuals perish because of the chronic obstructive pulmonary disease

How to cite this article: Nanda kishore K S, Yuvarajan S, GangiReddy T K, Hariprakash S. Study on daytime sleepiness and quality of sleep-in patients with chronic obstructive pulmonary disease. *MedPulse International Journal of Medicine.* October 2021; 21(1): 27-33. https://www.medpulse.in/Medicine/

every year.[4] In Brazil, it is the main neuropathy.[3] Chronic obstructive pulmonary disease affects almost ten per cent of individuals aged Forty and above,[5] with smoking being the most considerable factor of risk.[6] The ailment is staged as follows: mild chronic obstructive pulmonary disease when the forced expiratory volume in 1 s (FEV_1) ≥80 per cent of normal, moderate chronic obstructive pulmonary disease when 50 per cent ≤ FEV_1 < 80 per cent of normal, severe chronic obstructive pulmonary disease when 30 per cent ≤ FEV1 < 50 per cent of normal, and very severe chronic obstructive pulmonary disease when FEV_1 < 30 per cent of normal.[7] Low FEV1 is linked to a higher risk of cardiovascular disorder. Chronic obstructive pulmonary disease is associated with a decrease in exercise endurance, muscle mass, and respiratory muscle strength and leads to constraints in muscle capacity, metabolism, and ventilation.[8] Fatigue, dyspnea and reduced quality of sleep are the most common COPD patients' complaints during consultations.[9,10] Symptoms of the subject might impact the sleep quality in COPD patients, according to studies.[11,12] Research conducted by Nunes *et al.* on COPD patients have shown that seventy per cent of subjects have had poor sleep quality with Pittsburgh Sleep Quality Index (PSQ) PSQI>5.[13] In another research, Lofdahl *et al.* reported that COPD patients had more delay in the start of sleep, duration of sleep was shorter, there was a reduction in night-time oxygen saturation, and night awakening is more frequent.[14] Approximately seventy per cent of patients with COPD have shown to have a lower quality of sleep as determined with the use of the PSQI assessment.[13] With this viewpoint, it is imperative to make a better understanding of sleep disturbances for the appropriate management of patients suffering from chronic obstructive pulmonary disease. Thus, in this research, we endeavoured to estimate the prevalence of daytime sleepiness, evaluate the change in the quality of sleep, and correlate the severity of airway obstruction based on spirometry with the sleep quality and sleepiness during daytime among patients suffering from chronic obstructive pulmonary disease.

SUBJECTS AND METHODS

A case-control study was conducted at the Department of Pulmonary Medicine, Sri Manukula Vinayanagar, Medical College and Hospital, Puducherry, from September 2015 to June 2017. The research was performed after getting approval from the institutional ethical committee and with fully notified written consent taken from the patients. Overall, 80 subjects were included and separated into groups of 2, *i.e.,* 40 COPD patients (Case Group) and 40 healthy non-smokers (Control Group). Subjects suffering from active pulmonary TB, subjects having bronchiectasis with a history of recent myocardial infarction and patients who were on long term anxiolytics and sedatives were excluded from the study. According to 2017 GOLD spirometric criteria for COPD severity the COPD disease is staged as follows:[15]

In patients with forced expiratory volume or forced vital capacity (FEV_1/FVC) < 0.70:

GOLD 1: Mild FEV_1≥ 80% predicted

GOLD 2: Moderate 50% ≤ FEV_1< 80% predicted

GOLD 3: Severe 30% ≤ FEV_1< 50% predicted

GOLD 4: Very Severe FEV_1< 30% predicted

Based on Post-Bronchodilator FEV_1

A fully informed written consent was taken from the patient in his native language. A thorough clinical history, thorough clinical examination, respiratory system examination was done. A chest X-ray posteroanterior (PA) view was done to support further the evidence of COPD (like hyperinflated lung fields, flattened hemidiaphragm, widened intercostal spaces). As per American Thoracic Society (ATS) guidelines, reversibility tests, including spirometry, were conducted on JK WINSPIRO pneumotach. To lessen diurnal variation, all study subjects were subjected to spirometry (10.00 to 14.00 hrs) in a fixed hour of the day. All the study subjects were instructed prior to doing spirometry [Miller *et al.* 2005] to abstain from smoking at least one hour prior to the test, abstain from alcohol at least four hours before the test, the vigorous exercise of any sort must be avoided at least thirty minutes before the test, wearing clothing that can considerably restrict full chest, as well as expansion of abdomen, should be avoided and avoid a heavy meal at least two hours before the test. The standardization methods of performing spirometry as per the ATS guidelines by the ATS/ERS task force for standardization on lung function testing was followed in the present study.

Procedure: The FVC manoeuvre had three separate phases; a) maximal inspiration, b) a "blast" of exhalation, and c) continued complete exhalation to the EOT (end of the test). After having demonstrated the appropriate technique, advised the patient to completely and rapidly inhale from the FRC (functional residual capacity) when instructed. The breathing tube was placed into the mouth of the patient, and it was ensured that lips were closed around the mouthpiece and that the tongue was not obstructing it. A disposable nose clip was placed securely on the patient's nose, and then the FVC manoeuvre was begun with minimal hesitation, and asked the subject to take a complete inhalation before exhaling and then prompted to ''blast,'' not just ''blow,'' the air from their lungs, and encouraged to fully exhale as much as they can. All through the procedure, the patient was enthusiastically coached with appropriate body language as well as phrases like "keep going" and observed the study subjects for

distress, and also the computer displays during the test to make sure the maximum effort was achieved.[16]

Reversibility testing: An inhaled beta-agonist dose (400 micrograms of salbutamol) was given after the initial test, and spirometry was repeated 20 minutes for reversibility testing. The absence of improvement of twelve per cent or more and 200 ml or more in post Bronchodilator FVC or FEV_1 was taken as an absence of reversibility. Post bronchodilator FEV_1 was recorded in all COPD cases to assess the severity of airway obstruction. All of the study participants completed PSQI (Pittsburgh Sleep Quality Index) scoring, which is a nineteen-item self-rating scale that measures the sleep quality during the previous month utilizing seven sleep components: sleep latency, sleep efficiency, quality of sleep, sleep disturbance and sleep duration, sleep medications' usage and daytime dysfunction. A global PSQI score of more than five implies a worse quality of sleep.[17]

ESS (Epworth Sleepiness Scale) was utilized to evaluate the subject's general daytime sleepiness level. Includes 8 self-rated questions watching TV, sitting and reading, sitting inactive in a public place like in meeting or theatre, as a passenger in a car for an hour without a break, lying down to rest in the afternoon when situations allow, sitting and talking to someone, quietly sitting after a lunch without alcohol, in a car, while stopped for a few minutes in traffic. A value ≥ 10 was deemed abnormal.[18]

Statistical analysis: he data entry and analysis of data were done with a SPSS (statistical package for the social sciences) v17.0 software. Chi-square test and analysis of variance (ANOVA) were utilized to analyze categorical variables among group and control. P-value <0.05 was deemed significant statistically.

RESULTS

The majority of the study subjects, i.e., 25/40 (62.5%) and 24/40 (60.00%) in the case group and control group, were > 60 years of age and 51-60 years of age, correspondingly. 63.03 years was the subject's mean age (Table 1).

Table 1: Age distribution of COPD cases and healthy non-smokers.

Age in years	Case Group	Control Group
40-50	2	1
51-60	13	24
>60	25	15
Total	40	40
Mean age		63.03 years

In the case group, all the 40 COPD patients had breathlessness and cough, 36 patients had wheezing, and 2 patients had decreased breath sounds and rhonchi (Figure 1).

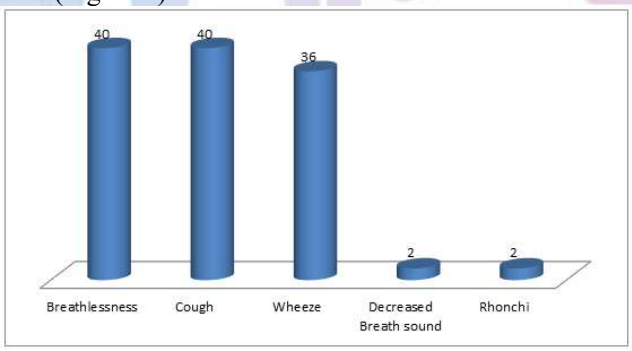

Figure 1: Distribution of symptoms in COPD patients

The results of ESS scoring were represented in Table 2. These findings depicted that 75% of COPD patients in the case group had excessive daytime sleepiness as compared to the control group (30%), and which is statistically significant based on the Chi-square test ($\chi 2$=16.24, P=<0.0001, OR=7).

Table 2: ESS scores between COPD and healthy non-smokers

ESS score	ESS SCORING				p-Value
	>10		>10		
	Case	Control	Case	Control	
Number	30	12	10	28	
Percentage	75%	30%	25%	70%	<0.0001

The results of the PSQI score was represented in Table 3. These findings revealed that 82% of patients with chronic obstructive pulmonary disease had worse quality of sleep as compared to the control group (45%) and which is statistically significant based on the Chi-square test ($\chi 2$=12.17, P=<0.0001, OR=5.7).

Table 3: PSQI score between COPD patients and healthy non-smokers

PSQI Score	PSQI SCORING				p-Value
	>5		<5		
	Case	Control	Case	Control	
Number	33	18	07	22	
Percentage	82.5%	45%	17.5%	55%	<0.0001

The majority of study subjects in the case group, i.e., 62.5%, had severe airway obstruction, followed by 22.5% subjects with moderate obstruction, and 15% of cases had very severe airway obstruction (Table 4).

Table 4: Distribution of study subjects in case group based on FEV_1

FEV_1	No. of cases	Percentage (%)
<30%	6	15
30-50%	25	62.5
50-80%	9	22.5
Total	**40**	**100%**

The results of the PSQI score were assessed with airway obstruction severity in subjects with COPD (case group), and these findings delineated that a steady increase in PSQI score with increasing severeness in airway obstruction was observed in subjects with chronic obstructive pulmonary disease (Table 5).

Table 5: Association between PSQI score with the severity of airway obstruction in subjects with COPD (case group)

Based on FEV_1	No of Patients	PSQI Score <5 (Mean)	Standard Deviation (SD)	Standard Error (SE)
Moderate	10	5.80	5.80	3.645
Severe	24	14.13	14.13	0.448
Very severe	6	16.17	16.17	0.753
Total	**40**	**12.35**	**12.35**	**4.294**

A steady increase in ESS score with increasing severeness of airway obstruction in patients with COPD was noted (Table 6).

Table 6: Association between ESS score with the airway obstruction severity in a patient with COPD

Based on FEV_1	No of Patients	ESS Score >10 (Mean)	Standard Deviation (SD)	Standard Error (SE)
Moderate	10	8.40	0.843	0.267
Severe	24	10.33	1.049	0.214
Very severe	6	10.83	0.408	0.167
Total	40	9.93	1.289	0.204

The mean age, BMI, FEV_1, PSQ1, and ESS of study subjects in the case and control group was represented in Table 7. The ESS and PSQI score was observed to be significant statistically (p,0.000) between and within the groups based on ANOVA test (Table 8 and 9).

Table 7: Mean age, BMI, FEV_1, PSQI and ESS in COPD and healthy non-smokers

		Age	BMI (kg/m²)	FEV_1	PSQI	ESS
	Number	40.00	40.00	40.00	40.00	40.00
Case	**SD**	7.27	3.71	12.470	4.29	1.29
	Mean	63.03	20.05	41.98	12.35	9.93
	Number	40.00	40.00	40.00	40.00	40.00
Control	**SD**	6.16	2.47	4.57	1.81	3.98
	Mean	60.88	23.80	88.38	4.48	5.15

Table 8: ESS score analyzed using analysis of variance (ANOVA)

ANOVA						
		ESS				
	Group	Sum of Squares	Df	Mean Square	F	p-value
Cases	**Between Groups**	32.21	2	16.10	18.296	0.000
	Within Groups	32.57	37	0.88		
	Total	64.77	39			

Table 9: PSQI score analyzed using analysis of variance (ANOVA)

ANOVA						
PSQI						
	Group	Sum of Squares	Df	Mean Square	F	p-value
Cases	Between Groups	592.04	2	296.02	86.203	0.000
	Within Groups	127.06	37	3.43		
	Total	719.10	39			

DISCUSSION

After dyspnea and tiredness, the disorder of sleep is the third predictor of life quality in COPD patients.[10] Therefore, the prevalence of sleep disorders, as well as an assessment of the quality of sleep in COPD patients, must be observed. Hence, in the current research, we aimed to estimate the prevalence of daytime sleepiness, evaluate the change in the quality of sleep, and correlate the severity of airway obstruction based on spirometry with the sleep quality and daytime sleepiness in COPD patients. In our research, 62.5% of COPD study subjects in the case group were in the age group above 60 years, and the mean age was found to be 63.03 years. These findings were comparable with many other research investigators reported in the literature. Afonso *et al.*, in their study, found that most cases were more commonly found in the age group of more than 62 years. Furthermore, Afonso *et al.* showed that more than half of the cases were aged more than 60 years.[19] This shows that there is an increased prevalence of the disease in this age group which was similar to our study. Lundback *et al.* stated that the COPD prevalence rapidly rises with increasing age, particularly among smokers.[20] Scharf *et al.*, in their research, noticed that the mean age of study subjects was 65.9 years.[12] In our study, the predominant symptom reported by the COPD patients was breathlessness and cough (40%). Elkington *et al.*, in their study, showed breathlessness was the predominant symptom with COPD patients, which impaired their mobility.[21] Miravitles *et al.* have shown that most COPD patients presented with breathlessness, and these results are consistent with our study.[22] Most of the cases in our present study demonstrated severe airway obstruction with a mean FEV_1 of 62.5%. These findings were comparable with various other researchers reported in the literature. Jones *et al.* found that most COPD patients had severe airway obstruction having a mean FEV_1 of 41.9%.[23] Fukuchi Y *et al.* found that 58% of COPD patients had mild airway obstruction, 36% of the patients had moderate obstruction; this indicates that enhanced screening efforts made them to recognize these patients early and intervening in the prevention of future complications,[24] Bednarik *et al.* found that majority of the cases exhibited (51.4%) moderate and (30.6%) mild obstruction of the airway.[25] This might be because of the fact that the awareness of the ailment is increased in the western people. Also, it is probably because of lack of awareness and symptoms of the ailment in developing nations like India, particularly among our rural population, causing subjects to present late in the course of ailment to tertiary care hospitals. In our research, there was a rise in the occurrence of daytime sleepiness in chronic obstructive pulmonary disease cases (75%) when compared to healthy non-smokers (30%) ($p<0.0001$). Our study results are in concurrence with the study revealed by Enz *et al.*, wherein authors reported that eighteen per cent experienced excessive sleepiness during daytime with an Epworth Sleepiness Scale ≥ 10/24 with a range from 0 to 19 ($P<0.01$).[26] Zohal *et al.* discovered the occurrence of excessive sleepiness during daytime (ESS ≥ 10) of thirty-two per cent in subjects with COPD.[27] Scharf *et al.* showed that twenty-five per cent of the subjects showed excessive sleepiness (ESS score >9).[12] In comparison to previous studies, in our study, the majority of COPD subjects had excessive daytime sleepiness, this could be attributable to nocturnal respiratory disturbances, shorter total sleep time, associated OSA (obstructive sleep apnea), depression and most of COPD patients had severe airway obstruction, as the airway obstruction increases excessive daytime sleepiness also increases, which can be an alarming symptom for early recognition and evaluation of sleep disorders in COPD patients. In our study, 82.5% of the cases had worse sleep quality when compared to healthy non-smokers (17.5%) and is significant statistically with a p-value <0.0001. Moreover, our study observed an increase in PSQI scores with increasing severity of airway obstruction. These results were similar to a previous research study carried out by Chang *et al.* in patients with COPD wherein two hundred (53 %) subjects suffered from poor quality of sleep (PSQI > 5), and a considerable discrepancy in the quality of sleep as evaluated by Pittsburgh Sleep Quality Index score was recorded.[28] Vukoja *et al.* found that patients suffering from COPD had longer latency to sleep and took sleep medications quite frequently, and Pittsburgh Sleep Quality Index scores were higher in COPD ($p<0.001$).[29] Sharma *et al.* found that 68.8 per cent experienced poor quality of sleep with the Pittsburgh Sleep Quality Index score of 8.1 ± 6, and sleep quality was considerably associated with life quality ($p<0.001$).[30] Zohal *et al.* reported that 67.9 per cent had poor quality of sleep in cases compared to 32.1% in the

control group, and the mean scores of sleep quality were 8.03 ± 3.66.[27] Scharf *et al.* found that 77% of the patients had a PSQI score >5, and the median PSQI was 12.[12] Nunes *et al.*, in their study, found that 21 (70%) cases indicated poor sleep quality with a Pittsburgh Sleep Quality Index score of > 5(P<0.02).[13] Agusti *et al.* found that sleep quality was poor in COPD cases, and the prevalence of symptomatic sleep disturbance might exceed seventy-five per cent in patients with chronic obstructive pulmonary disease.[31] Sajel de *et al.* found that all the patients had poor quality of sleep with a median global PSQI score of 11 (*P*<0.01).[32] Poor quality of sleep in COPD has a considerable negative impact on the body's physiology in terms of cognitive impairment and other comorbidities. Worse sleep quality in the majority of our COPD patients could be multifactorial such as increased night-time symptoms with cough, breathlessness, increased sleep latency, bad dreams, smoking, severe airway obstruction. Hence the percentage of patients having worse sleep quality was higher in our study. It was also noted in our study that sleepiness during daytime and sleep quality worsens as the severity of the airway obstruction increases and found that there is a relation between sleep quality, daytime sleepiness with severeness of airway obstruction, which showed statistical significance (p<0.000). This finding was similar to a previous research carried out by Enz *et al.* wherein authors stated that sleepiness during daytime among patients suffering from COPD might be partially due to nocturnal respiratory disturbances and affect mostly younger subjects having more severe symptoms of COPD. Because COPD is a chronic illness, it affects the susceptibility to sleepiness and might thus affect the Epworth sleepiness scale score independently.[26] Vukoja *et al.* revealed that there was a moderate association between Pittsburgh Sleep Quality Index and COPD assessment test (CAT) score (p<0.001), and there was no correlation between PSQI with lung function parameters.[29] De S *et al.* found that there was no significant association of COPD severity with the global Pittsburgh Sleep Quality Index score. The poor quality of sleep prevalence in chronic obstructive pulmonary disease cases was high regardless of the severeness in airflow obstruction; the depression present in COPD was a risk factor for poor sleep quality.[32] However, in contrast to literature findings in our study, there was a significant association of ESS and PSQI scores between the groups based on the ANOVA test. The discrepancy seen between global Pittsburgh Sleep Quality Index scores and self-reported quality of sleep rating was either because of patients' unawareness, or patients were accustomed to poor quality of sleep. There might be a possibility that recorded and self-reported findings are not similar. Selection bias could be the confounding factor for negative correlation in their study.

CONCLUSION

The findings of our study delineated that chronic obstructive pulmonary disease is correlated to poor sleep quality. There was an association between sleep quality and daytime sleepiness in relation to the severity of airway obstruction. Furthermore, as the severeness of airway obstruction increases, the quality of sleep worsens. Hence, assessing subjects for symptoms like daytime sleepiness, sleep apnea and other disorders of sleep ought to be considered at the time of regular follow-up visits of COPD patients. Moreover, assessing these parameters using ESS and PSQI scoring will prompt the necessity of COPD patients for future work up to OSA evaluation using polysomnography.

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Source of Support: None Declared
Conflict of Interest: None Declared