ORIGINAL ARTICLE

Poor sleep quality in chronic obstructive pulmonary disease

Mauvaise qualité du sommeil dans la bronchopneumopathie chronique obstructive

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) patients frequently complain of poor sleep quality, but the factors responsible for disturbed sleep are not well identified.

Aim: To determine the frequency of poor sleep quality and to investigate the demographic, clinical, and spirometric factors impacting sleep quality in COPD patients.

Methods: A descriptive, cross-sectional, single-center study was conducted in department 1 of Abderrahmane Mami Hospital of Ariana from January to June 2022 including COPD patients followed up at the external consultation. After their oral consent, all patients answered the questionnaire assessing sleep quality: Pittsburgh Sleep Quality Index (PSQI). Poor sleep quality was defined by a PSQI score≥5.

Results: The mean age was 66 years, with a sex ratio of 24. Our study included 100 patients. We counted 68 patients with comorbidities at admission. The most frequently reported comorbidity was arterial hypertension. A mean PSQI score was 6.59. Poor sleep quality was noted in 63% of the patients. The patients with arterial hypertension had significantly more impaired sleep quality (p=0.031). Chronic sputum was significantly associated with poor sleep quality (p<0.001). A CAT score≥ 10 was associated with poor sleep quality (p<0.001). The percentage of patients with significantly impaired sleep quality who belonged to group D was 65% (p<0.001).

Poor sleep quality was significantly associated with GOLD stage 4 (p=0.039) and lower spirometry data (p=0.001 for FEV1).

Conclusion: Poor sleep quality is frequent in COPD patients. It is associated with more severe disease. This calls for early diagnosis of sleep disorders and early initiation of adequate treatment.

Key words: COPD, Sleep, Questionnaire

Résumé

Introduction: Les patients atteints de bronchopneumopathie chronique obstructive (BPCO) se plaignent fréquemment d'une mauvaise qualité du sommeil mais les facteurs responsables d'un sommeil perturbé ne sont pas clairement identifiés.

Objectif: Déterminer la fréquence des troubles du sommeil et d'étudier les facteurs démographiques, cliniques et spirométriques impactant la qualité du sommeil chez ces patients.

Méthodes: Il s'agit d'une étude descriptive, transversale, mono centrique menée au pavillon 1 de l'hôpital Abderrahmane Mami de l'Ariana de janvier 2022 à juin 2022 incluant les patients atteints de BPCO suivis à la consultation externe. Tous les patients ont répondu au questionnaire: l'Index de Qualité du Sommeil de Pittsburgh (PSQI), après leur consentement oral. Une mauvaise qualité du sommeil était définie par un score PSQI≥5.

Résultats: L'âge moyen était de 66 ans avec un sexe ratio à 24. La comorbidité la plus fréquente était l'hypertension artérielle. Le score PSQI moyen était de 6,59. Une mauvaise qualité du sommeil était notée chez 37% de la population. Les patients hypertendus avaient une qualité du sommeil plus altérée de façon significative (p=0,031).Les expectorations chroniques étaient associées à une mauvaise qualité du sommeil de façon significative (p<0,001).Un score CAT≥ 10 était associé à une mauvaise qualité du sommeil (p<0,001).Les patients du groupe D présentaient 65% des patients qui ont montré une qualité du sommeil altérée de façon significative (p<0,001).

Conclusion: Les troubles du sommeil sont fréquents chez les patients atteints de BPCO.Un diagnostic précoce des troubles du sommeil et un traitement adéquat sont nécessaires.

Mots clés: BPCO, Sommeil, Questionnaire

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Introduction

Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable disease. In Tunisia, its prevalence is estimated at 7% among people aged over 40, according to the BOLD study (1).
COPD is a major cause of morbidity and mortality worldwide. It is now one of the three leading causes of death worldwide (2). It caused 3.23 million deaths worldwide in 2019 (3).
COPD is associated with chronic inflammation of the lung parenchyma and small airways, leading to airflow limitation. These abnormalities are progressive and irreversible and are due to exposure to harmful particulate gases, mainly tobacco and biomass (1).
Although it starts in the respiratory tract, it has a systemic impact, with the release of numerous inflammatory mediators, notably lipids, free radicals, cytokines, chemokines, and growth factors (1).
In this context, it has been noted that COPD patients frequently complain of poor sleep quality. Impaired sleep quality in COPD patients is multifactorial and poorly elucidated.
Potential long-term negative consequences of poor sleep quality are well documented and may include an increased risk of cardiovascular disease and depression (4). These two pathologies are frequent comorbidities in COPD patients, impacting the severity and prognosis of the disease.
Few studies worldwide or in Tunisia have investigated sleep quality in COPD patients.
To this end, we proposed to conduct a descriptive, cross-sectional study with the objectives
of determining the frequency of poor sleep quality in COPD patients and identifying predictive factors of poor sleep quality in COPD patients.

Methods

This was a descriptive, cross-sectional, monocentric study carried out in the Pneumology Department (Pavillon I) of the Abderrahmane Mami Hospital in Ariana over 6 months, running from January to June 2022.
The study included 100 patients who responded to the questionnaire. Oral informed consent was obtained from patients before participation. Inclusion criteria were age ≥ 18 years, patients followed for COPD diagnosed according to GOLD 2021, (2) and patients on background therapy during the 3 months before inclusion. Non-inclusion criteria were non-consenting patients, patients with an exacerbation during the month before inclusion, patients followed for obstructive sleep apnea-hypopnea syndrome and patients followed for neoplasia.
The main judgment criterion was sleep quality.
For each patient, we filled in a pre-established form and used two questionnaires: the Pittsburgh Sleep Quality Index (PSQI) and the COPD Assessment Test (CAT). Information was collected at the hospital outpatient department. The PSQI consists of 19 self-report questions and 5 questions asked of the spouse or roommate (if any). Only the self-evaluation questions are included in the score. We only asked the 19 self-evaluation questions.
The 19 self-evaluation questions combine to give 7 "components" of the overall score, each component receiving a score from 0 to 3 (0: not in the last month; 1: less than once a week; 2: once a week and 3: three or more times a week). In all cases, a score of 0 indicates no difficulties, while a score of 3 indicates severe difficulties.
The 1st component of the score assesses subjective sleep quality. The 2nd component assesses sleep latency. The 3rd component evaluates sleep duration. The 4th component assesses habitual sleep efficiency. The 5th component assesses sleep disorders. The 6th component assesses the use of sleep medication. The 7th component assesses poor form during the day. The 7 components of the score add up to an overall score ranging from 0 to 21 points, with 0 indicating no difficulties, and 21 indicating major difficulties.
An overall PSQI score <5 defines good sleepers and an overall score ≥5 defines poor sleepers (5).
The questions were asked by the same doctor each time at the end of the outpatient clinic. We translated the questionnaire into an Arabic dialect.
Initially, the questionnaire was translated by three bilinguals with different academic backgrounds, who translated the questionnaire independently of each other. The translators were native speakers of the target language (Arabic). There was no difference in translation between the three. In the second stage, the translated versions were cross-translated by three new bilinguals into the source language (French).
Data were analyzed using SPSS software. Statistical analysis was based on a comparison of means and percentages. Comparisons of 2 quantitative variables on independent series were performed using the non-parametric Mann-Whitney test. Comparisons of percentages on independent series were carried out using Pearson's chi-square test, and in the event of non-validity of this test, Fisher's exact test. In all statistical tests, the significance level $p<0.05$ was considered significant.

Results

The average age of patients was 66, with extremes ranging from 43 to 97.
There were 96 (96%) men and 4 (4%) women, with a clear male predominance and a sex ratio of 24.
Comorbidity was found in 68 (68%) patients at inclusion. Arterial hypertension was the most common, found in 29% of cases. Anxiety (21%) and depression (7%) were frequent in this study population. Smoking was noted in 98% of patients. The average number of cigarettes smoked was 50 pack-years. A CAT score was less than 10 in 32 cases and greater than or equal to 10 in 68 cases.
The main respiratory symptoms were dyspnea (100%), chronic cough (99%) and chronic sputum (89%). A stage of dyspnea on exertion greater than or equal to 2 was reported in 83 cases. The mean number of exacerbations in the previous year was 1.51, with extremes ranging from 0 to 7.

Over 2 exacerbations per year were noted with 40 (40%) of patients. Hospitalization for acute exacerbation was reported in 27 patients. A GOLD score greater than or equal to 3 was reported in 69 cases. Twelve patients belonged to Group A, 35 to Group B, 4 to Group C, and 45 to Group D.

The background treatment used was LABA+CSI (35%), LABA (28%), LABA+LAMA+CSI (22%), LABA+LAMA (14%), LAMA+CSI (1%) and CSI (1%).

Chronic respiratory insufficiency was found in 38% of patients. Long-acting oxygen therapy was indicated in 21 cases. Non-invasive ventilation was used in 7 cases.

The mean PSQI score was 6.59 (0-17). We noted that 63% of the population had poor sleep quality. The distribution of the number of patients with poor sleep quality according to the different components of the PSQI score was summarized in Table 1.

Table 1. Distribution of the number of patients with poor sleep quality according to the different components of the PSQI score

	0	1	2	3
Subjective sleep quality	4	32	15	12
Sleep latency	14	23	19	7
Sleep duration	10	26	20	7
Usual sleep efficiency	15	32	14	2
Sleep disorders	7	28	10	18
Use of sleep medication	59	1	1	2
Poor form during the day	4	12	26	21

Patients with hypertension had significantly (p=0.031) worse sleep quality. 59% of patients had a score of at least 1 for the poor daytime condition component. 56% of patients had a score of at least 1 for the sleep disorder component.

The correlation between the overall PSQI score and the various comorbidities is summarized in Table 2.

Table 2. Correlation between PSQI global score and various comorbidities

	PSQI ≥5		PSQI <5		P
Comorbidities	44	70%	24	65%	0,611
Ischemic heart disease	5	8%	4	11%	0,632
Rhythmic heart disease	0	0%	1	3%	0,193
Hypertension	23	37%	6	16%	**0,031**
Anxiety	16	25%	5	14%	0,162
Depression	5	8%	2	5%	0,636
Osteoporosis	2	3%	0	0%	0,278
Diabetes	14	22%	4	11%	0,155
Bronchial dilatation	12	19%	2	5%	0,059
Asthma	3	5%	3	8%	0,501

The mMRC stage of dyspnea was correlated with poor sleep quality. The rate of poor sleep quality according to the dyspnea stage was summarized in Table 3. Chronic expectoration was significantly associated with poor sleep quality (p<0.001). A CAT score≥ 10 was associated with poor sleep quality (p<0.001).

The greater the number of exacerbations, the more significantly sleep quality was impaired (p<0.001). Intensive care unit stay for exacerbation was significantly associated with poor sleep quality (p=0.007). Poor sleep quality was significantly associated with stage 4 of GOLD (p=0.039) and good sleep quality was significantly associated with stage 2 of GOLD (p=0.019). Poor sleep quality was significantly correlated with group D of GOLD (p<0.001). 51% of patients with poor sleep quality progressed to chronic respiratory failure. 84% of patients who did not progress to chronic respiratory failure had good sleep quality (p<0.001).

In a multivariate study, CAT≥10 was significantly associated with poor sleep quality.

Table 3. Rate of poor sleep quality according to dyspnea stage

	PSQI ≥5		PSQI <5		P
mMrc1	1	2%	16	43%	**<0,001**
mMrc2	17	27%	11	30%	0,771
mMrc3	34	54%	9	24%	**0,004**
mMrc4	11	17%	1	3%	**0,028**

Discussion

Our population had a mean age of 66 and a sex ratio of 24. The mean PSQI score was 6.59 (0-17). Sleep quality was assessed as poor in 63% of patients.

Poor sleep quality was significantly associated with the presence of hypertension (p=0.031) and symptomatic disease with: the presence of chronic sputum (p<0.001), dyspnea stage ≥2 (p<0.001), CAT score ≥ 10 (p<0.001) and a significant number of exacerbations (p<0.001).

Poor sleep quality was also associated with spirometrically advanced disease stage with lower FEV1 (p<0.001) and GOLD stage 4 (p<0.001), as well as with a worse disease course: patients in group D (p<0.001), the onset of chronic respiratory failure (p<0.001) and the need for an ICU stay (p<0.001).

Our study recruited patients presenting to tertiary and specialist care facilities. COPD treatment was therefore adapted to the severity of the pathology.

The study was made more interesting by the choice of the sleep quality assessment scale. We chose this scale firstly because it is a brief, reliable, valid, and standardized measure of sleep quality

This scale was chosen because it explores all sleep-related items in a short space of time.

Nevertheless, this study has certain limitations. The nature of the study: given that it is a cross-sectional study, the causal link between the various factors studied and sleep quality cannot be formally established. The study is monocentric, so it may not be representative of the general population. Sleep quality was assessed subjectively, using a questionnaire rather than polysomnography.

The sleep state is associated with significant changes in respiratory physiology, including ventilatory responses to hypoxia and hypercapnia, upper airway and intercostal muscle tone, tidal volume, and minute ventilation. These changes are further amplified in certain disease states, such as chronic obstructive pulmonary disease (COPD and asthma), restrictive breathing disorders, neuromuscular disorders, and heart disease (7).

Depending on the severity of the obstruction, patients may present with varying degrees of hypoxemia, hypercapnia, and hyperinflation with air trapping. There is also an increase in work of breathing. Respiratory muscles are weakened and there is significant diaphragm dysfunction (8).

Ventilatory responses to hypoxia and hypercapnia are reduced in normal individuals during sleep, further compromising the reduced ventilatory responses of COPD patients during sleep, particularly during the rapid-eye movement (REM) stage of sleep. Decreased hypercapnic ventilatory response leads to alveolar hypoventilation responsible for hypoxemia (8).

COPD patients present with various sleep disorders such as sleep maintenance or sleep initiation insomnia, frequent nocturnal awakenings, and reduced sleep efficiency (7).

Our results showed that 63% of the study population had poor sleep quality. Sleep quality was studied using the validated PSQI questionnaire, for which a mean score of 6.59 was recorded for our entire study population. However, it should be noted that the PSQI is not a COPD-specific instrument and that other causes unrelated to COPD such as diabetes, cardiovascular comorbidities, and pain related to other pathologies may also have contributed to the sleep quality reported in our study.

A study was carried out in Serbia (9) assessing sleep quality in COPD patients, also using the PSQI questionnaire. The percentage of patients who reported poor sleep quality was 38%. A second study carried out in Turkey (10) found that 37.3% of the COPD population studied had sleep disorders using the PSQI.

Other studies have investigated sleep quality in these patients, using the Jenkins Sleep Evaluation Questionnaire (JSEQ) as a measurement tool. These studies took place in China, the USA, and five European countries. JSEQ scores were generally similar between the geographic regions tested. The US cohort (11) scored slightly lower (5.4) than Europe (11) (6.1) or China (11) (6.3), indicating better sleep quality. For the population, the average JSEQ global score was six point one. Nocturnal awakenings were the most frequently reported sleep disorder, occurring at least one to three times in the last 28 days in 75.3% of patients (11).

In our series, nocturnal awakening was included in component 5 (sleep disorders) of the PSQI score, with 56% of patients having at least a score of 1 for this component, close to the rate observed in the previously cited study (66%).

Another study, carried out in Taiwan (12), also found that sleep disorders had the highest score for patients with a PSQI ≥5. This same study grouped COPD patients according to total sleep duration (component 3) and showed that a sleep duration < 5h per night was associated with a lower FEV1.

This deterioration in sleep quality suggests an impact on patients' daytime activities. Indeed, in our study, 59% of patients had at least a score of 1 for component 7, which assesses poor form during the day.

In the Chinese, American, and European cohort studies, impaired sleep quality was associated with low levels of daytime energy, chronic fatigue, daytime sleepiness, and alterations in self-reported quality of life. Impaired sleep quality was directly linked to poor quality of life (11).

In this study, 42.7% of patients complained of a constant lack of energy and 36.5% of sleep-induced fatigue (11).

Other studies have established a link between poor sleep quality and impaired quality of life in COPD patients (13,15). This underlines the importance of an effective management strategy that directly approaches sleep disorders.

In our series, poor sleep quality was directly linked to more severe disease in symptomatic and spirometric terms. Indeed, dyspnea of stage mMRC≥2 was significantly associated with a global PSQI score ≥5. These results concur with those of several studies reported in the literature, which found a statistically significant correlation between poor sleep quality and the severity of dyspnea. These studies are summarized in Table 4.

Table 4. Relationship between sleep disturbance in COPD patients and dyspnea stage

Authors	Year	Results
Dignani et al. [30]	2015	An association between the PSQI index and the modified MRC scale
Omachi et al.[15]	2012	Sleep disorders are associated with dyspnea severity (mMRC) in COPD patients
Serin et al [26]	2020	Positive correlation between dyspnea severity and poor sleep quality (CASIS score)
Chang et al. [31]	2016	A positive correlation between scores on the modified MRC dyspnea scale and poor sleep quality (PSQI)

The multivariate study showed that a CAT score≥10 is associated with poor sleep quality. This is in line with other studies indicating that poor sleep quality in COPD patients is associated with poorer health status (11,17).

The pooled Chinese, European, and American cohort study showed that symptomatic patients (CAT≥ 10) had higher JSEQ scores indicating poor sleep quality (11).

In our series, the greater the number of exacerbations, the more significantly sleep quality was impaired. This result has been found in numerous studies. Indeed, in a study of 480 COPD patients, higher PSQI scores were associated with an increased risk of exacerbations over the 18-month follow-up period. Patients with higher PSQI scores had a shorter delay in the onset of an acute exacerbation and a higher risk of hospitalization (16).

Similarly, a study carried out in Greece (17) confirmed a significant correlation between poor sleep quality assessed by the CASIS-7 score, and deterioration in health status, measured by the CAT score.

Regarding comorbidities, in our series, the presence of hypertension was among the factors associated with poor sleep quality. A study carried out in the USA showed that the prevalence of insomnia was higher in patients with cardiovascular comorbidities, with 43.1% for arterial hypertension (18).

Most patients do not receive management specifically targeting nocturnal symptomatology. A lack of awareness of nocturnal symptoms among physicians has been

reported in the literature (19,20).
Our study provides further evidence of the need to focus management on nocturnal symptoms and associated sleep disorders, particularly in patients with severe COPD, to improve their quality of life.

Conclusion

In conclusion, our study reveals that sleep disorders are common in COPD patients. Poor sleep quality in COPD patients was associated with poorer health status, more severe disease, and reduced ability to perform activities of daily living.
Our study suggests the need to treat nocturnal symptoms and associated sleep disorders (in addition to daytime symptoms) to improve patients' quality of life. Thus, optimizing the management of the COPD patient is the main step in treatment.
Raising awareness among primary care physicians and pulmonologists of the frequency of sleep disorders and the importance of diagnosis and management is recommended.

Abbreviation list
COPD: Chronic obstructive pulmonary disease
CAT: Chronic obstructive lung disease Assessment Test
CASIS: COPD and Asthma Sleep Impact Scale
FEV1: Forced expiratory volume in the first second.
GOLD: global initiative for chronic obstructive lung disease
JSEQ: Jenkins Sleep Evaluation Questionnaire
LABA: long-acting B2 adrenergic receptor agonists
LAMA: long-acting muscarinic acetylcholine receptor antagonists
mMRC: modified Medical Research Council
PSQI: Pittsburgh Sleep Quality Index
REM: Rapid Eye Movement

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