

# The quality of sleep estimated by the Pittsburgh Sleep Quality Index in patients with mild and severe obstructive sleep apnea

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## ABSTRACT

**Background:** Obstructive sleep apnea (OSA) is a chronic sleep disorder characterized by recurrent episodes involving the partial or complete collapse of the upper respiratory tract. The main symptoms of obstructive sleep apnea are loud snoring, increased daytime sleepiness, and respiratory arrest that someone else has witnessed. Poor sleep quality is a risk factor for cardiovascular disease and can also be an indicator of the cardiovascular health index. The aim of this retrospective study was to determine the differences between mild and severe OSA patients in terms of sleep quality.

**Methods:** Demographic data, polysomnographic recordings, and the Pittsburgh Sleep Quality Index (PSQI) scores for 130 OSA patients were retrospectively extracted from the institutional information system. Mild and severe OSA patients were compared according to sleep quality measured with the PSQI.

**Main findings:** Obstructive sleep apnea was more common in men than in women (a ratio of 1.76:1). There were no sex differences in the severity of apnea or in the scores for all seven PSQI subcategories. In comparison with the mild OSA group, the severe one had statistically significantly higher PSQI scores in the subcategory of sleep disturbances ( $p=0.047$ ). There were no major variances between mild and severe OSA groups in the scores for the six other PSQI subcategories.

**Principal conclusions:** The severity of OSA and sleep quality were not influenced by sex. More severe sleep disorders were associated with more serious forms of OSA. Other examined components indicating sleep quality were not influenced by the severity of OSA.

**Key words:** obstructive sleep apnea, sleep quality, Pittsburgh Sleep Quality Index

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## INTRODUCTION

Obstructive sleep apnea is a major public health problem. Clinical manifestations of obstructive sleep apnea have been recognized, although the pathogenesis of the disease itself has not been fully elucidated (1). Obstructive sleep apnea is a chronic sleep disorder characterized by recurrent episodes involving the partial or complete collapse of the upper respiratory tract. The main symptoms of obstructive sleep apnea include loud snoring, increased daytime sleepiness, and respiratory arrest witnessed by someone else (2). The estimated prevalence of the disease in the United States ranges from 3% to 7%, and certain populations carry a higher risk of disease (2). Genetic factors related to the anatomy of the craniofacial area, soft tissue of the upper respiratory tract, distribution of adipose tissue throughout the body, neural control of the upper respiratory tract, and central respiratory regulation have an impact on disease expression (3). In addition to genetic predisposition, the development of obstructive sleep apnea is also affected by risk factors such as obesity, smoking, alcohol consumption, male gender and many other aspects (4). The gold standard in diagnosing obstructive sleep apnea is in-laboratory polysomnography. Based on the apnea-hypopnea index (AHI), the severity of obstructive sleep apnea is divided into three stages. Mild forms of the disease present with an AHI value of 5 to 15, moderate with a value of 15 to 30, and severe with an AHI value greater than 30 (5, 6). The treatment of obstructive sleep apnea includes various methods such as weight loss and continuous positive airway pressure (CPAP), as well as other lifestyle changes, oral aids, and various surgeries that dilate the upper airway (7).

Studies have shown that poor sleep quality, in the general population, has a prevalence of 8% to 18% (8). Poor sleep quality is a risk factor for cardiovascular disease and can also be an indicator of cardiovascular health (9). There are numerous works linking poor sleep quality to a number of risk factors and diseases, but the author was not able to identify any that

compared sleep quality in patients with different grades of obstructive sleep apnea. There are associations between sleep quality and nighttime sleep length, with risk factors for coronary heart disease, such as hypertension, diabetes mellitus, and obesity (10). The main motive for conducting this investigation was that a similar one on the differences in quality of sleep between patients with mild and severe obstructive sleep apnea (OSA) was not found during the literature review.

## PARTICIPANTS AND METHODS

### Participants

This retrospective cross-sectional study investigated subjects suspected of having obstructive sleep apnea who were referred to the Center for Sleep Medicine of the Department of Otorhinolaryngology at the University Hospital in Mostar from November 2018 to February 2022. During hospitalization, these subjects underwent general otorhinolaryngologic examination (including flexible nasopharyngoscopy) and overnight polysomnography. Patients diagnosed with obstructive sleep apnea by polysomnography have answered the Pittsburgh Sleep Quality Index (PSQI) questionnaire. Patients suffering from mild or severe OSA who properly completed the PSQI questionnaire were included in the investigation. The exclusion criteria included a negative polysomnogram, as well as moderate OSA and incomplete medical records, and a diagnosis of central sleep apnea.

### Methods

In-laboratory polysomnography is the study of sleep patterns and the body's response to the various stages of the sleep cycle. It is performed in a sleep laboratory in a hospital during night periods. Polysomnography is used to diagnose and evaluate different types of sleeping disorders. During polysomnography, the tone of the muscles in addition to brain wave patterns, eye movements, breathing records

and heart activities are measured. The greatest limitations of polysomnography are the differences between sleep and recording conditions at home and the sleep laboratory in the hospital. The apnea-hypopnea index (AHI) is a scale that determines the severity of OSA and divides it into three stages. An AHI value under 5 is normal, mild forms of the disease present with an AHI value of 5 to 15, moderate ones with a value of 15 to 30, and severe ones with an AHI value greater than 30. The Pittsburgh Sleep Quality Index (PSQI) is a self-rated questionnaire which assesses sleep quality and disturbances over a one-month interval. The questionnaire consists of 23 questions creating seven components that produce one global score. It takes five to 10 minutes to complete the questionnaire. Patient data were extracted retrospectively from the Hospital Information System. Patients satisfying the inclusion and exclusion criteria were identified. Patient identifiers were removed from the data set before statistical analysis. The mild and severe OSA groups were compared according to the results of the Pittsburgh Sleep Quality Index questionnaire.

### Statistical analysis

Statistical analysis of the data included a comparison of the two study groups with respect to age, gender, and Pittsburgh questionnaire results. For all parametric variables and for each group, the data distribution was tested with the Kolmogorov-Smirnov test. The Student's t-test was used in statistical processing to compare two symmetrically distributed independent variables. The chi-square test was utilized to test the nominal variables. The level of statistical significance was set at  $p < 0.05$ , and  $p$  values that could not be expressed to three decimal places were expressed as  $p < 0.001$ . The Statistical Package for the Social Sciences (SPSS) program for Windows (17.0, SPSS Inc. Chicago, Illinois, USA) was employed in the statistical analysis of the obtained data.

## RESULTS

The total number of patients in the study sample was 130. The ratio of male ( $n=83$ ) to female ( $n=47$ ) patients was 1.76: 1. Their ages ranged from eight to 82 years. The mild OSA group and the severe OSA group consisted of 56 and 74 patients, respectively.

The subjects with severe apnea (with a mean age of 57 years) were statistically significantly older than the ones with mild apnea (with a mean age of 48 years) (Student's t-test,  $t=2.971$ ;  $p=0.004$ ).

The ratio of male ( $n=35$ ) and female ( $n=26$ ) patients in the mild OSA group was 1.3:1. The ratio of male ( $n=48$ ) and female ( $n=26$ ) patients in the severe OSA group was 1.8:1. There were no statistically significant differences in the severity of apnea between the sexes (Figure 1)

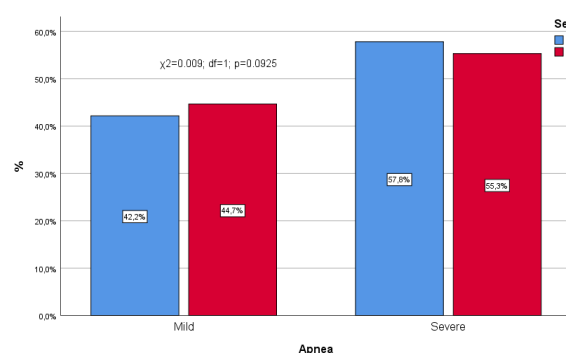


Figure 1. Comparison of male and female patients according to the severity of apnea

In comparison with the mild OSA group, the severe OSA group had statistically significantly higher PSQI scores in the subcategory of sleep disturbances. There were no significant differences between the mild and severe OSA groups in the scores for the other six PSQI subcategories (Table 1). There were no statistically significant differences between male and female patients in the scores for all seven PSQI subcategories (Table 2).

## DISCUSSION

Given the lack of research in this field of sleep medicine, this study attempted to get one step

closer to answering the question of whether there is a difference in sleep quality between patients with mild and severe obstructive sleep apnea. Surprisingly, in comparison with mild

OSA patients, the expected significantly poorer quality of sleep in severe OSA patients was not detected.

Table 1. The Pittsburgh Sleep Quality Index scores in the mild OSA patients and severe OSA patients

	Apnea				t	p
	Mild		Severe			
	$\bar{X}$	SD	$\bar{X}$	SD		
Component 1: Subjective sleep quality	1.55	0.69	1.50	0.85	0.387	0.700
Component 2: Sleep latency	1.07	1.01	0.86	0.78	1.317	0.190
Component 3: Sleep duration	0.88	1.10	0.88	1.08	0.018	0.986
Component 4: Habitual efficiency of sleep	0.82	1.15	0.92	1.19	0.470	0.639
Component 5: Sleep disorders	1.36	0.59	1.57	0.60	2.003	0.047
Component 6: Sleep medications	0.41	0.93	0.35	0.85	0.378	0.706
Component 7: Daily functioning	0.55	0.63	0.69	0.91	0.958	0.340
PSQI	6.64	3.48	6.77	3.75	0.198	0.843

Table 2. The Pittsburgh Sleep Quality Index scores in male and female patients

	Gender				t	p
	M		F			
	$\bar{X}$	SD	$\bar{X}$	SD		
Component 1: Subjective sleep quality	1.49	0.79	1.57	0.77	0.564	0.574
Component 2: Sleep latency	0.95	0.87	0.96	0.93	0.035	0.972
Component 3: Sleep duration	0.92	1.10	0.81	1.08	0.539	0.591
Component 4: Habitual efficiency of sleep	0.93	1.21	0.79	1.10	0.657	0.512
Component 5: Sleep disorders	1.47	0.57	1.49	0.66	0.177	0.860
Component 6: Sleep medications	0.29	0.72	0.53	1.10	1.355	0.180
Component 7: Daily functioning	0.66	0.82	0.57	0.77	0.603	0.547
PSQI	6.71	3.45	6.72	3.94	0.019	0.985

With regard to gender, the share of male respondents in the sample was significantly higher, but the difference was not statistically significant. In terms of the age difference, subjects with severe apnea were significantly older than ones with the mild form. These data confirm the results of numerous investigations that indicate that male gender and older age are the most significant risk factors. A study by Deng et al. involving over 2,700 patients with sleep apnea found that men and the elderly were the most common patients diagnosed with severe obstructive sleep apnea (11).

The sample in this paper contained a higher proportion of subjects with severe apnea. However, the observed difference was not statistically significant. This can be explained by the fact that the variation in the number of

subjects with mild and severe apnea is not large and that the total number of subjects in the study itself is not extensive. There are numerous works that indicate gender variances in people with obstructive sleep apnea. Men are more likely to be at risk, and the rate of apnea/hypopnea in men is usually higher than in women. The ratio of men to women with mild obstructive sleep apnea is 1.3: 1, and with severe obstructive sleep apnea is 1.8: 1. By searching the available literature, similar investigations comparing the gender structure according to the severity of apnea could not be found. However, research comparing the sex of patients with obstructive sleep apnea was identified. An analysis conducted in Israel by Gabbay et al. showed a higher proportion of the male population among those suffering from

obstructive sleep apnea with a male-to-female ratio of 2.9: 1 (12). According to an examination performed by Kim et al. in Korea, men were more likely to suffer from obstructive sleep apnea and the ratio of men to women was 2.5: 1, which is slightly higher than demonstrated in this article (13).

Subjects with severe apnea tended to be significantly older than ones with the mild form. This information can be explained by the fact that the elderly report late to the doctor without paying attention to the symptoms of the disease, which leads to a more severe clinical picture. Upon searching the available scientific literature, a similar study examining age and severity of apnea could not be identified. However, numerous works involving middle-aged and obstructive sleep apnea patients were found. A paper by O'Connor et al. in Canada showed that the median age of patients with obstructive sleep apnea was 49 years for men and 51 years for women (14). One examination conducted by Vagiakis et al. in Greece revealed that the average age for men is 51, while for women it is 57 (15). It is evident that obstructive sleep apnea is the disease with the highest prevalence in middle-aged to elderly people.

The main objective of this study was to determine whether there is a difference in sleep quality, assessed by the Pittsburgh questionnaire, between patients with mild to severe obstructive sleep apnea. The questions and data obtained from the Pittsburgh questionnaire were divided into seven components. Differences in sleep quality in relation to the degree of apnea are shown in Table 1, and variations in sleep quality in relation to sex are presented in Table 2. With the level of statistical significance set at  $p < 0.05$ , there is no statistically significant difference between the two test groups, except in component 5 in Table 1 where  $p = 0.047$ . The results obtained mean that the initial hypothesis was rejected, but nevertheless a higher incidence of poor sleep quality was observed in patients with severe obstructive sleep apnea. There was also no statistically significant

difference in sleep quality between the gender groups, but it was revealed that men are more likely to have severe sleep apnea, which can lead to poorer sleep. A statistically significant difference in component 5, sleep disorder, in Table 1 stems from the fact that patients with severe sleep apnea find it harder to fall asleep and wake up more often at night due to sleep-disordered breathing. In addition, patients with severe apnea are mostly elderly and late-diagnosed patients, who therefore find treatment extremely difficult and are uncooperative. The reason other components are not statistically significant may be due to the small number of total respondents.

The reason for the small number of respondents may be due to the fact that this study includes patients from the years when the coronavirus disease (COVID-19) was widespread and due to epidemic measures and those implemented by University Clinical Hospital Mostar, the scope of the Center for Sleep Medicine was reduced. In addition, because of the pandemic itself, people were not motivated to see a doctor for fear of infection. When searching the available scientific literature, similar works examining sleep quality in patients with varying degrees of OSA severity were not found. This article therefore presents research that is unique for this part of the region as well as the world, and this topic should certainly be addressed. This paper does not provide an unambiguous answer to the question of whether the Pittsburgh questionnaire can determine the quality of sleep in patients with mild to severe obstructive sleep apnea, so it is recommended that the investigation be repeated with a larger group of respondents to be more reliable.

## CONCLUSIONS

Men have more commonly suffered from OSA than women. More severe OSA was associated with older age. The severity of OSA and sleep quality were not influenced by sex. More severe sleep disorders were linked with more severe forms of OSA. Other examined components of



the PSQI indicating sleep quality were not affected by the severity of OSA.

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#### CONFLICT OF INTEREST

The author(s) declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

#### AUTHORS' CONTRIBUTIONS

FČ: contribution to study conception and design, acquisition of data, literature review, writing the paper; ML: supervision, contribution to study conception and design, literature review, critical revision of the paper, assistance in writing the paper; JL: acquisition of data, contribution to study conception and design, literature review, assistance in writing the paper, supervision.

#### ETHICAL BACKGROUND

**Institutional review board statement:** The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee.

**Informed consent statement:** Informed consent was obtained from all subjects involved in the study.

**Data availability statement:** We deny any restrictions on the availability of data, materials and associated protocols. Derived data supporting the findings of this study are available from the corresponding author on request.

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