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Revista de Cercetare si Interventie Sociala

ISSN: 1583-3410 (print), ISSN: 1584-5397 (electronic)

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Revista de cercetare și intervenție socială, 2021, vol. 72, pp. 338-352

https://doi.org/10.33788/rcis.72.21

Published by:
Expert Projects Publishing House

expert projects
publishing

On behalf of:
„Alexandru Ioan Cuza" University,
Department of Sociology and Social Work
and
HoltIS Association

REVISTA DE CERCETARE SI INTERVENTIE SOCIALA
is indexed by Clarivate Analytics (Social Sciences Citation Index),
SCOPUS and CROSSREF

Sleep Disturbances and Their Impact on Socio-Professional Capacities in Patients with Obstructive Sleep Apnea

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Abstract

As a prominent problem in the modern society and showing an increasing prevalence, sleep disorders including frequently obstructive sleep apnea (OSA) raises the issue of the multiple health and socio-professional debilitating effect. This study aimed to assess by Pittsburgh Sleep Quality Index (PSQI) questionnaire the sleep disturbances and their impact on socio-professional capacities in patients with OSA. We evaluated through the PSQI a group of 144 patients with suspected sleep disorders, whom 22 were diagnosed with OSA by polysomnography. For OSA patients, we analyzed the associated comorbidities and the characteristics of sleep disturbances and their influence on quality of socio-professional life. The main associated comorbidities to our OSA patients were the hypertension (90.90%), the type II diabetes (40.91%) and the metabolic syndrome (31.83%). We found that the most important sleep disturbances that affected the quality of life are the sleep interruptions, the waking up too early, the late falling asleep and snoring. The most significant problems induced by sleep disorders were communication problems and concentration disorders, with more than three times a week for at least 36.36% of patients. The work capacity was affected at least once a month in 77,27% of OSA patients, 40,91% reported at least one episode per week. Based on the results of PSQI and the characteristics of clinical OSA assessment, we can conclude that the patients with OSA present an impaired quality of socio-professional life.

Keywords: obstructive sleep apnea, sleep quality, polysomnography, socio-professional life, Pittsburgh Sleep Quality Self-Assessment Questionnaire, social impact.

Introduction

Sleep disorders are a prominent problem in the modern society and the sleep issues characterized as disorders, not only as symptoms, increased the awareness of the multiple health and socio-professional debilitating effect they can have alone or as comorbid factors (Tufik, Andersen, Bittencourt & de Mello, 2009). Recent studies have shown a significant increase in the prevalence of sleep disorders, such as the one published in 2020 in Journal of Clinical Sleep *Medicine* relating only for obstructive sleep apnea an increasing in prevalence of 41% over the study period from 2,429 to 3,420 per 100,000 persons (Acquavella *et al.*, 2020).

Among sleep disorders, along with insomnia, restless legs syndrome and narcolepsy, obstructive sleep apnea syndrome (OSAS) is one of the most common and most often diagnosis in sleep medicine. The prevalence of obstructive sleep apnea (OSA) defined at an apnea-hypopnea index (AHI) ≥5 varies between 9-37%,

with a mean of 22% in men and between 4-50% with a mean of 17%, in women. The prevalence of OSA with excessive daytime sleepiness riches 6% in men and 4% in women (Franklin & Lindberg, 2015). Prevalence is higher in Hispanic, African American and Asian populations, increases with age and women and men are at the same risk to develop the disorder over the 50 years of age or more. There are estimates that OSA remains undiagnosed in approximately 92% of affected women and 80% of affected men.

The impact on health of this disease must not to be neglected, being incriminated in the appearance and development of other pathologies such as systemic hypertension, metabolic syndrome, cardiovascular disease, abnormalities in glucose metabolism ranging from increased insulin resistance to diabetes type 2 (Wu et al., 2015). In addition, OSA has significant implications for mental illness, neurocognitive impairment, driving safety (being at risk of causing traffic accidents), daytime drowsiness, erectile dysfunction (Sólyom, Csiszér & Neagoș, 2014; Fischer, Neagoș, Gronau & Rettinger, 2006).

Obstructive sleep apnea is characterized by the existence of repetitive and transient episodes of upper airway obstruction with an associated decrease in oxygen saturation and awakening from sleep. This disturbance is due to complete or partial collapse of the airway, when pharyngeal muscle tone is decreased (Lee, Lee, Chung & Kim, 2015).

Periodic narrowing during sleep of the upper airways leads to episodes of decreased blood oxygen concentration, increased activity of the sympathetic nervous system and variation in intrathoracic pressure, which together cause fragmentation of night sleep and the appearance of daytime sleepiness (Fischer et al., 2006; Fischer, Neagoș & Pirsig, 2005).

The most common cause of obstructive sleep apnea is tonsils and/or adenoids hypertrophy in pediatric population while in adults it is most commonly associated with male sex, the onset of menopause, obesity and advancing age. The typical patient is overweight or obese middle-aged male or postmenopausal female with nightly snoring and excessive daytime sleepiness. Some structural factors have been associated with OSA such as micrognathia/ retrognathia, facial elongation/ mandibular hypoplasia, adenoid and tonsillar hypertrophy, Down syndrome. Along with the already mentioned factors (obesity, advanced age, male gender) nonanatomic risk factors include central fat distribution (increased neck circumference of > 43.1 cm in men and > 40.6 cm in women), alcohol and drug use, smoking, use of sedatives, supine sleeping position, habitual snoring. Medical conditions associated with OSA may include stroke, hypothyroidism, metabolic syndrome, neurological disorders (e.g. myasthenia gravis), acromegaly, Parkinson's disease. Some previous studies suggested a possible genetic influence, based on the familial aggregation of OSA observed in some cases.

The objective diagnostic assessment for OSA must be performed on patients who have clinical selection criteria like excessive daytime sleepiness (EDS) and

the presence of at least two of the following clinical features of OSA: habitual loud snoring, witnessed apnea or gasping or choking during sleep, and diagnosed systemic hypertension (Kapur *et al.*, 2017).

The most common and widely applied evaluation tools used as a first assessment step in sleep pathology and to select the patients at risk for OSA who need a diagnostic testing include the Epworth Sleepiness Scale (ESS), Berlin Questionnaire (BQ), STOP-Bang questionnaire and Pittsburgh Sleep Quality Index (PSQI) questionnaire. Physicians often use them during preoperative evaluation to assess the risk of undiagnosed OSA but none of these diagnostic tools should be used to replace a sleep apnea testing (Al-Mardini, Aloul, Sagahyroon & Al-Husseini, 2014; Hang *et al*., 2015).

An important step in patients with sleep pathology diagnosis is the evaluation of the narrowing degree, respectively collapse of the upper airway. Various methods are used to achieve these objectives. A non-invasive and relatively new method of three-dimensional evaluation of the upper airway is the acoustic reflection technique (ART) which bases on the analysis of sound waves reflected from the airways. The ART can reproduce airways anatomy with a quality comparable to a CT or MRI (Fischer, Neagoș, & Pirsig, 2005).

In-laboratory polysomnography (PSG), full night or split-night, is considered the gold-standard diagnostic test for OSA (Garvey, Pengo, Drakatos & Kent, 2015). During nocturnal laboratory-PSG, patients are monitored with electroencephalography (EEG), electrooculography (EOG), surface electromyography (EMG), nasal and oral airflow, electrocardiography, pulse oximetry, respiratory effort (thoracic and abdominal), end tidal or transcutaneous CO2, sound recordings to measure snoring, surface EMG monitoring of limb muscles (to detect limb movements, periodic or other), continuous video monitoring respiratory impedance plethysmography.

PSG generate two quantitative indices to measure the sleep-related obstructive events/ hour of sleep: the apnea-hypopnea index (AHI = apneas + hypopneas/ total sleep time in hours) and the respiratory disturbance index (RDI = apneas + hypopneas + respiratory effort-related arousals/ total sleep time in hours), AHI being more used in clinical (Sateia, 2014). Mild OSA is defined as an apnea-hypopnea index (AHI) of 5–15 events/ hour, moderate OSA as an AHI of 15–30 events/ hour, and severe OSA as an AHI of >30 events/ hour. An AHI < 5 events/ hour characterize the normal sleep (Hang et al., 2015, Berry, Brooks & Gamaldo, 2020).

The correlation of polysomnographic data with the patient clinical examination and the sleep health questionnaires offering a global assessment of individuals with sleep problems allows a complete and complex diagnosis of obstructive sleep apnea syndrome, integrating the quality of life.

The Pittsburgh Sleep Quality Index (PSQI) is a questionnaire used to self-assess sleep quality and sleep disorders over a one-month period (Garvey *et al.*, 2015). Nineteen individual items generate seven "component" scores: subjective sleep

quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction (Shigemoto *et al.*, 2015). The global score results by summing the scores for the seven components yields. The PSQI questionnaire can be a very useful tool evaluating both the quality of sleep and the quality of life in patients with sleep disorders, assessing the social impact of all categories of sleep disorders and obstructive sleep respiratory pathology in particular.

Methodology

Objectives

The aim of our study is to evaluate through the Pittsburgh Sleep Quality Index (PSQI) questionnaire the profile of sleep disorders in a group of patients diagnosed with OSA and the influence of sleep disturbances on quality of life by affecting the regeneration process during the night sleep, but especially by impairment of daily socio-professional activities and work capacity.

Study group

The study was conducted over a period of 6 months, being performed with the approval of the Ethics Committee of the institution. During this period, the study included a number of 144 patients sent to the ENT service by the internal medicine and cardiology specialties colleagues for suspected OSA. Inclusion in the study group was based on the presence of three or more of the following criteria (symptoms and/ or comorbidities): subjective perceived sleep quality impairment, overweight and obesity, smoking, hypertension, concentration disorders, diabetes mellitus, erectile dysfunction, hypercholesterolemia, myocardial infarction, stroke, regular alcohol consumption.

Material and methods

The 144 patients enrolled in the study completed the Pittsburgh Sleep Quality Self-Assessment Questionnaire to assess sleep quality over the past month, including questions about: the time elapsed until falling asleep, the duration of sleep and sleep efficiency, sleep disturbance or fragmentation, snoring, the need of medication to help the sleep, daytime dysfunctions due to sleepiness, difficulties to engage in social activity. The original English version of the Pittsburgh Sleep Quality Self-Assessment Questionnaire was translated to the Romanian language for a better and easier understanding by our patients.

The PSQI consists of 24 questions or items to be rated at 0–3 for 20 items while 4 items are open-ended, 19 of which are self-reported and 5 of which require

secondary feedback from a room or bed partner. For quantitative evaluation of sleep as perceived by the patient are used only the self-reported items: 15 rated as 0 - 3 while 4 open-ended. The open-ended items are also finally scored as structured categorical values, rated at 0–3 as per the range of values reported for them by the patient. The 19 self-reported items generate the categorical scores representing the PSQI's seven components each assessing a specific feature of sleep. The total score is calculated by summing the scores for each component and it range 0 to 21 (Buysse *et al.*, 1989).

Using the Pittsburgh sleep quality assessment questionnaire, the reported sleep events were observed over one month, taking in account the frequency of their appearance: less than once per week, 1or 2 times per week, more than 3 times per week, or the absence of symptoms. The entire questionnaire required about 10 minutes for the subject to complete and 5-7 minutes to score. A global PSQI score > 5 provided a sensitive and specific measure of poor sleep quality.

In our group patients, the scores were calculated according to the indications of the questionnaire, and the patients in whom the PSQI score was identified with values above 5 benefited from evaluation by polysomnography for OSA suspicion. According to the gold standard for the OSA diagnosis, it was confirmed in patients with AHI value > 5 per hour. For all patients confirmed with OSA, the results of the PSQI questionnaire were analyzed with the purpose of assessing the impact of OSA on quality of life by affected sleep quality and impaired socio-professional activities.

Results

Of the 144 patients included in the first stage of our study with suspected sleep disturbances, after completing the PSQI questionnaire, 22 patients were identified, aged 39 to 87 years, with suggestive scores for the presence of sleep pathology. OSA was confirmed in all 22 patients after evaluation by polysomnography and classification of AHI at values above 5, the lowest value determined in our study group being AHI=10 events per hour.

For the study group consisting of the 22 patients confirmed with OSA, the data completed in the Pittsburgh Sleep Quality Index questionnaire were analyzed, including both the demographic characteristics of the study group and the OSA associated comorbidities. In addition, the answers regarding the elements that influence the quality of sleep and the impact of sleep problems on the life quality by affecting concentration, communication and work capacity were extracted and analyzed.

Demographic statistics showed that the study group of patients diagnosed with sleep apnea included 40.91% women and 59.09% men, which may suggest a higher prevalence of OSA in men.

The analysis of comorbidities associated with OSA in our subjects showed that hypertension is a pathology present in 90.90% of patients, type II diabetes is associated in 40.91%, metabolic syndrome in 31.83%, and stroke and myocardial infarction being identified in 4.55% of patients.

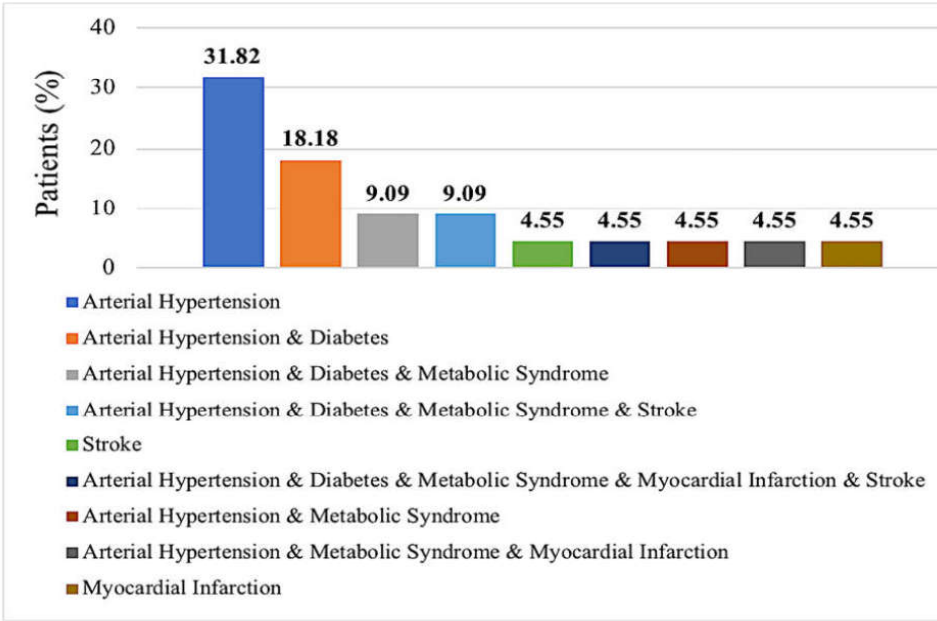

Figure 1. Cardiovascular and metabolic diseases associated with OSA in the study group

Most of the patients associated only arterial hypertension with OSA (31.82%), but associated comorbidities were present in a large number of patients, 59.09% having at least two associated pathologies, the most common being diabetes and metabolic syndrome. In two patients (4.55%), arterial hypertension and metabolic syndrome are associated with other heart conditions, such as myocardial infarction (*Figure 1*).

The quality of sleep and implicitly the quality of life are influenced by a series of dysfunctions that affect sleep, the most important being included in the Pittsburgh Sleep Quality Self-Assessment Questionnaire: falling asleep later and waking up earlier, snoring, nocturnal respiratory dysfunctions and the need for sleep medication.

The standard fall asleep period is considered 10-15 minutes. Almost all patients stated that in the last month they had problems in sleep induction, falling asleep in more than 30 minutes (81.82%).

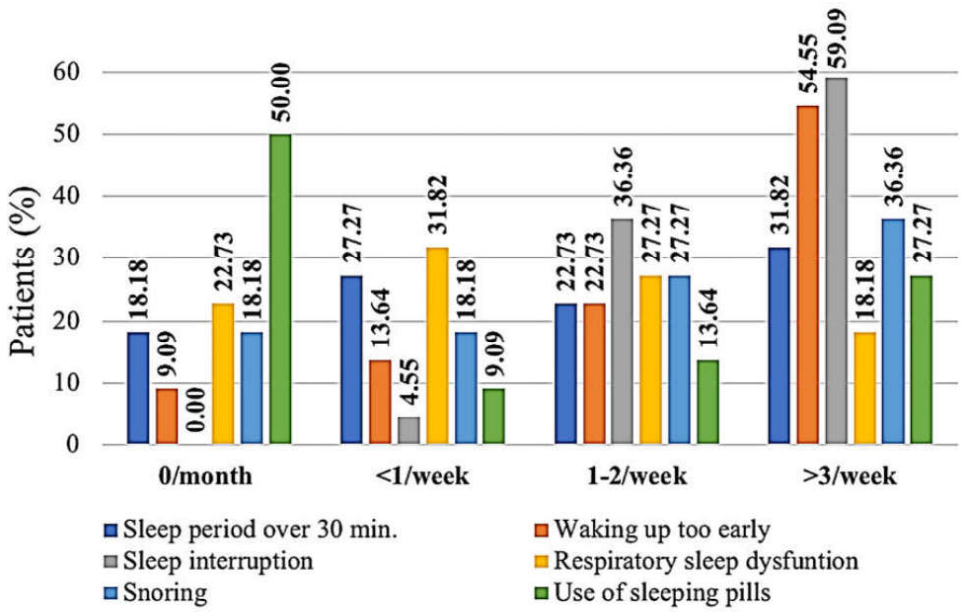

Figure 2. Frequency of major disturbances affecting sleep quality in patients with OSA (Pittsburgh Sleep Quality Self-Assessment Questionnaire results)

As can be seen in *Figure 2*, most of the patients diagnosed with OSA reported more than 3 events per week for most sleep quality dysfunctions: 31.82% fall asleep very late, 54.55% wake up too early, 59.09% have sleep interruptions and 36.36% snore. If we consider at least one event per week for each category of studied dysfunction, we can say that the majority of these patients have impaired sleep quality: 54.55% fall asleep late, 77.28% wake up too early, 95.45% accuses sleep interruptions, 45.45% report respiratory dysfunction in sleep.

The use of sleep induction medications appears to be a helpful solution for patients who report less than one sleep disturbance event per month in each category. Half of these patients (50%) use sleeping medications. Of the patients who have the most events per week (over 3), 27.27% use sleeping medication, but its effectiveness is debatable given the high frequency of sleep disorders.

In order to analyze the self-assessment of sleep quality in relation to PSQI and the severity of symptoms, it was determined the average value of the Pittsburgh Sleep Quality Index (PSQI) equal to 10.86. Thus, two subgroups were considered according to the absolute mean value of PSQI (< 10 and > 10) (*Figure 3*).

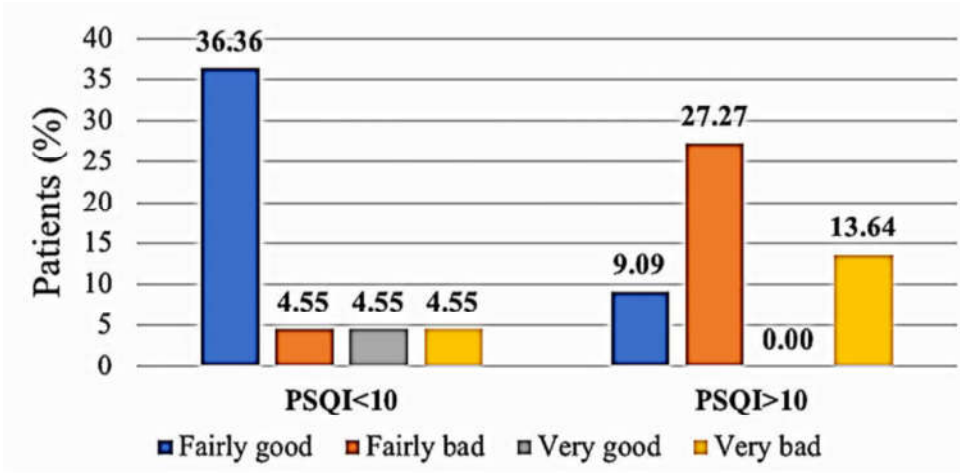

Figure 3. Subjective assessment of sleep quality in patients with OSA relative to the PSQI mean

The subjective assessment of sleep quality over the last month using the Pittsburgh Sleep Quality Self-Assessment Questionnaire found that 50% of patients with OSA have very good sleep (4.55%) or fairly good sleep (45.45%), most of them (40.91%) recording a value of PSQI below 10. Patients with OSA who assessed that they had poor or very poor sleep quality accounted 50%, of whom the majority (40.91%) had a PSQI score of over 10. It is observed that a rather small percentage (4.55%) of patients with OSA appreciate that they have a very good sleep. Among the patients with PSQI below 10, only 4,55% reported a very good quality of sleep, while among the patients with PSQI above 10, none reported a very good quality of sleep and only 9.09% appreciated sleep as good enough (*Figure 3*).

A percentage of 72.73% of patients with OSA reported at least one episode of communication problems in last month, 36.36% of patients presenting more than 3 such events / week.

Regarding concentration disorders, 71.73% of patients diagnosed with OSA reported at least one episode during last month, a percentage of 36.36% of patients having more than 3 such episodes per week. Most patients (59.09%) had more than one episode of concentration problems per week.

According to the questionnaire results, work capacity was affected in 77.27% of patients diagnosed with OSA, reporting at least one episode during last month. The obviously subjective periods of work capacity loss had in most of them a frequency of less than 1 episode per week (36.36%), in 27.27% of patients the episodes occurring 1- 2 times per week and in 13.64% at least 3 times / week. A percentage of 40.91% of patients reported at least one episode per week in which their work capacity was affected.

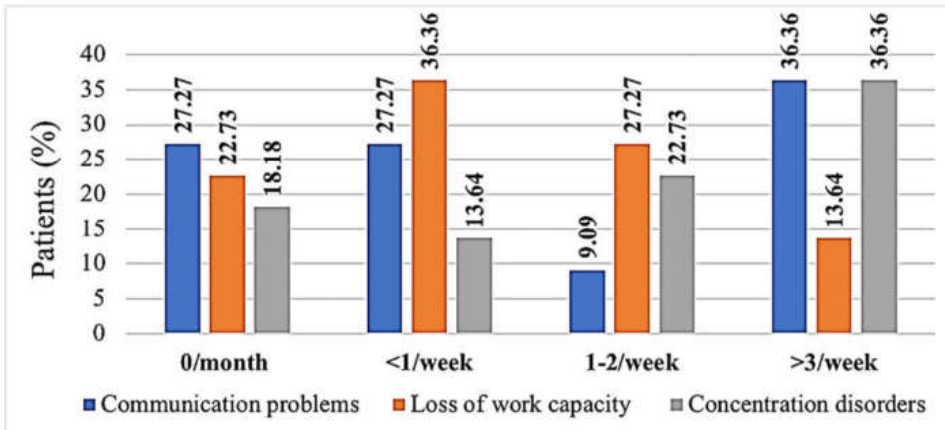

Figure 4. The frequency of periods of impaired concentration, communication and work capacity induced by sleep disturbances in patients with OSA

(Pittsburgh Sleep Quality Self-Assessment Questionnaire results)

The most significant problems induced by sleep disorders were communication problems and concentration disorders, recording over 3 events per week in over 36% of patients diagnosed with OSA. Only 18% to 27% of subjects have not experienced such dysfunctions in the last month.

Discussion

At present, it is unanimously accepted that undetected and untreated sleep disorders, far from being only a consequence of pathological conditions, are often primary drivers of other illnesses. It is well recognized the connection between sleep disturbance and neurocognitive impairment including depression, anxiety, stress, attention deficits, impaired cognitive performance or impulsivity increase. Cardiovascular and cerebrovascular diseases has a higher frequency due to sympathetic activity changes linked to these disturbances. The consequences in individuals' lives are wider, affecting the performance in both socially and professionally life, decreasing the overall health and hence the quality of life (Manzar *et al.*, 2018).

In previous studies, higher prevalence of OSA in men compared to women has been reported, also our study group registering a predominance (59.09%) of male subjects diagnosed with OSA (Franklin & Lindberg, 2015, Kim & Taranto-Montemurro, 2019).

The association of OSA with comorbidities at diagnosis has been recognized since the early studies, OSA patients showing a high prevalence of cardiovascular diseases (systemic hypertension, coronary artery disease, arrhythmias, ischemic stroke), respiratory diseases (chronic obstructive pulmonary diseases, asthma) and metabolic disorders (diabetes mellitus, dyslipidemia, gout) (Wu *et al.*, 2015, Bonsignore *et al.*, 2019). In our study, the arterial hypertension is the most frequent condition associated with OSA present in 90.90% of patients (as single associated medical condition in 31,82% of cases), in almost 60% of cases being associated with other comorbidities most common diabetes and metabolic syndrome, but also in multiple association with myocardial infarction, stroke.

The sleep pathologies have a bi-directionally interaction with numerous neurological, psychological, physiological and behavioral factors justifying the need for both reliable, validated subjective tools and objective polysomnographic (PSG) testing in clinical practice. The two categories of instruments have different approaches but they are complementary, subjective tools accounting for behavioral and psychological manifestations not tested by sleep polygraphy or polysomnography. Self-rating questionnaires such as the Pittsburgh Sleep Quality Index (PSQI) can be useful in both sleep disorders risk assessment and objective testing indications (to identify the patients with possible undetected sleep dysfunction and to direct further diagnostic investigation), and, especially, in quality of life assessment (patient primary interest like satisfaction, self-perceived health quality) (Mollayeva *et al.*, 2016).

The PSQI is the most widely used and possibly the most translated sleep questionnaire. It consists of 24 items/ questions to be rated, generating categorical scores for each of the PSQI's seven components each evaluating a specific feature of sleep. A global score is determined by summing the scores for each component and reflects subject's sleep experience for the last month (Mollayeva *et al.*, 2016, Manzar *et al.*, 2018). The PSQI can be a useful tool in identification of the patients with possible undetected sleep dysfunction who need further investigation especially by scoring the daytime dysfunction component (Component 7: questions 7 and 8). All the subjects in our study with a PSQI > 5 were confirmed with OSA, by nocturnal PSG, from mild to severe grade, based on the AHI measurements severity classification; the AHI values were > 10 apneas/ hypopneas events per hour for all the patients. In contrast to the PSQI, the Epworth Sleepiness Scale (ESS) is more predictable for obstructive sleep apnea, but multidimensional sleep quality assessment of the PSQI makes it much more useful in evaluation of the OSA impact in quality of life (Mondal, Gjevre, Taylor-Gjevre & Lim, 2013). Previously published studies have shown that OSA causes significant impairment of quality of life, but the severity of impairment is not directly proportional to the severity of OSA expressed by AHI values and we did not analyze, in our study, the correlation between the PQSI score and the AHI (Dutt *et al.,* 2013, Kang *et al.*, 2017).

The quality of life in suspected OSA subjects is mainly influenced by the subjective sleep quality being estimated by their subjective sleep perception rather than AHI (Kang *et al.*, 2017). The PSQI components scores and global score are stronger associated to disturbance in quality of socially and professionally patients' life being the most appropriate tool for the sleep quality influence assessment on socio-professional status of the subjects.

In our research, we analyzed sleep quality by evaluation of the factors influencing it: the time elapsed until falling asleep, the duration of sleep and sleep efficiency, sleep disturbance or fragmentation, snoring and the need of medication to help the sleep. Almost all our subjects related problems in sleep induction and falling asleep time longer than 30 minutes in last months (81.82%), most of them reporting more than 3 events per week for most sleep quality evaluated characteristics and the majority having more than one event per week for each category of studied dysfunction.

Previous investigators have reported strong association of poor quality sleep to depression and psychosocial stress, but also to cognitive decrements, diminished attention and executive functions, independent of depression and anxiety related to insufficient qualitative sleep even in healthy young adults (Selvi *et al.*, 2010, Benitez & Gunstad, 2012). As reported in literature, some more cognitive in nature functions were associated with an increased risk of work disability in patients with OSA, in contrast with more physically active in nature abilities which presents a lower risk (Omachi, Claman, Blanc & Eisner, 2009). In our study group, a percentage of more than 70% of the subjects presented at least one episode of communication problems, concentration disorders or affected work capacity during last month. The 40,91% of patients who reported at least one episode per week in which their work capacity was affected is a worrying one regarding the comfort and professional efficiency and work productivity. We can conclude that there is a decrease in professional performance and social integration capacity in the entire group of patients, with variables present, related to the frequency of these occurrences.

The results of our study confirm the validity of the Pittsburgh Sleep Quality Self-Assessment Questionnaire to assess the socio-professional impact of sleep quality disorders, in accordance with other studies in the literature (Buysse *et al.*, 1989; Osonoi *et al.*, 2015; Wu *et al.*, 2015; Javadi, Darvishpour, Mehrdad & Lakeh Javadi, 2015). The patients included in our study had a PSQI > 5, which means poor sleep quality, but the subjective evaluation of the 36.36% of the subjects with PSQI < 10 as `fairly good` and of the 27.27% of the subjects with PSQI > 10 as `fairly bad` opens the possibility of a individualised interpretation.

Conclusion

Subjective self-measurement, administered in the form of questionnaire has proved the usefulness in global approach of sleep disturbances, being a possible indicative tool for objective sleep testing in order to diagnose medical pathology (obstructive sleep apnea, central sleep apnea, sleep-related hypoventilation, sleep-related hypoxemia disorder) but especially for identification, quantification and integration of sleep-quality deterioration impact on the quality of life.

Based on the findings of our study using the Pittsburgh Sleep Quality Self-Assessment Questionnaire it can be concluded that sleep quality alteration in patients with obstructive sleep apnea and associated comorbidities produce significant impairment of the quality of social and professional life.

Recommendations

Sleep-related breathing disorders including obstructive sleep apnea must be fully assessed, both as complex medical condition and in terms of effects on social and professional life. The therapeutic approach of this complex health pathology must include both medical treatment and rehabilitation, but also psychological counseling or specific techniques in approaching the human as a whole.

Acknowlegments

All authors have equally contribution as the first author to this study.

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