

Open Minds

Internacional Journal

ISSN 2675-5157

vol. 2, n. 3, 2026

... ARTICLE 4

Acceptance date: 23/02/2026

COGNITIVE IMPAIRMENT IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Funding agency: PROBIC-UEFS (Institutional Program for Scientific Initiation Scholarships - UEFS)

Abstract: Considering that Obstructive Sleep Apnea Syndrome (OSAS) **significantly** compromises the cognitive, emotional, and social functioning of **affected individuals**, this study is justified by the need to understand **how** this condition **interferes** with patients' daily activities. **Thus**, we seek to assess cognitive impairment in **individuals** with OSA, focusing on attention, memory, and executive functions, **in addition to investigating possible differences in impact between genders**. **To this** end, a cross-sectional, analytical, and exploratory study was conducted using the validated *Sleep Apnea Quality of Life Index* questionnaire, applied to 137 **participants** treated at a center specializing in sleep medicine. The results indicate that, although it was not possible to identify a direct statistical relationship between the severity of apnea and cognitive changes, the reports **show significant impairments** in executive functions and quality of life, especially among women. **It is therefore concluded** that OSAS should be seen as a **comprehensive** condition that affects patients' **mental** and behavioral **processes** and emotional balance, **reinforcing the need** for a multidisciplinary approach that includes neuropsychological monitoring in treatment.

Keywords: obstructive sleep apnea; cognitive impairment; quality of life.

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is a respiratory disorder that occurs during rest, defined by repetitive episodes of complete (apnea) or partial (hypopnea) obstruction of the upper airways, lasting 10 seconds or longer. This condition results in reduced oxygen saturation and sleep fragmentation. The continuous interruption of sleep, associated with breathing pauses, can lead to neurocognitive, functional, and psychosocial changes¹.

Population studies show that people with OSA have low perceptions of quality of life and that, even in cases considered mild, they have greater difficulty performing daily activities^{2,3,4}. Although it is challenging to accurately determine a direct relationship between the degree of apnea and neurocognitive changes, most studies indicate that the impairments are more evident in more severe cases⁴.

The intellectual changes identified in people with this syndrome are varied, with the main ones being impairments in cognitive performance, the ability to remember information, concentration, and executive skills. Car accidents and incidents in the workplace are important indicators of this disorder and represent significant causes of illness and mortality among these individuals⁵.

Sleep is essential for biological regulation and maintaining the body's homeostasis. It plays an essential role in the proper functioning of the body, greatly influencing the central nervous system (CNS), endocrine system, cardiac system, vascular system, and emotional balance.

Sleep occurs in two major cycles. The first, known as Non-Rapid Eye Movement

(NREM) sleep, is the longest phase and is characterized by low-frequency brain activity in the central nervous system (CNS)⁸. NREM sleep is divided into three stages (N1, N2, and N3), which occur in cycles lasting about 90 minutes and repeat between four and six times per night. In this stage, the body enters into progressive relaxation, with a decrease in heart rate, breathing, and temperature. A slowdown in brain activity can be observed, which is essential for the physical and mental restoration of the human being. In this phase, several hormones are also released.

In REM (rapid eye movement) sleep, brain activity intensifies, promoting memory consolidation and emotional balance. In an 8-hour night of sleep, about 1.5 hours correspond to REM sleep. Continuous interruptions in these cycles cause countless physical, emotional, and intellectual health problems in these individuals.

The etiology of sleep apnea involves multiple factors and is not yet fully understood. Depending on the frequency and duration of interruptions in oxygen flow, individuals with this condition may not achieve the restorative effect provided by a peaceful night's sleep.

Given the health consequences for individuals with OSAS, this study aims to assess, through a questionnaire, the cognitive impairment in patients with obstructive sleep apnea in their daily activities.

MATERIALS AND METHODS

Type and Nature of the Study

This is a cross-sectional study of an analytical and exploratory nature in which

individuals were analyzed through a questionnaire in four areas of domains: cognitive impairment, attention deficits, memory, and executive functioning.

Research setting

The study was conducted on individuals treated at a private center specializing in sleep medicine in the city of Salvador, Bahia.

Sampling

The sample size was calculated based on an estimated one year of care. Thus, this study consisted of a simple random sample of 137 questionnaires.

Inclusion criteria: individuals treated at the Sleep Institute (Salvador, Bahia) who underwent polysomnography, answered the validated questionnaire on quality of life, and signed the informed consent form.

Exclusion criteria: Questionnaires from individuals who underwent the examination with CPAP or intraoral devices and were under 18 years of age.

Data collection technique

The data were obtained and tabulated from the information collected in the questionnaire entitled "Sleep Apnea Quality Of Life Index"¹³ after being adapted into Portuguese by Sampaio, Pereira & Winck¹³.

Definition of variables

The dependent variable was the presence or absence of sleep apnea, while the independent variables were gender, age, behavioral, emotional, and psychological issues.

Data Analysis Plan

This instrument contains 19 items on a Likert scale ranging from 1 to 5, where 1 is “very high” and 5 is “none.”

To construct the latent variable (quality of life), Item Response Theory (IRT) was used for models with gradual response, defining scores through individual characteristics and employing a probabilistic relationship in each of the items used for the purpose of selecting patients with impaired cognition^{14, 15, 16}. The estimation of the parameter methods was performed using the mirt package in the R Core Team (2019) statistical computing environment version 3.6.0, which is available free of charge at www.r-project.org/^{17, 18}.

Quality control

The items were examined using Cronbach's alpha coefficient to assess the internal reliability of the instrument. Through this, it can be seen that Cronbach's alpha coefficient presented a high value (0.945), which suggests a high level of reliability of the instrument used.

Ethical issues

This research was previously approved by the Research Ethics Committee of the State University of Feira de Santana.

All data collection took place after the signing of the Free and Informed Consent Form (FICF), which was signed in two copies containing the necessary information about the research and authorization to participate in the research. Anonymity and confidentiality were ensured during the use of the information collected, excluding the

names of the participants from the database and subsequent publications.

RESULTS AND DISCUSSION

Among the 137 individuals evaluated, 74 were male and 63 were female, with ages ranging from 20 to 80 years.

With the data provided from the epidemiological characteristics of the sample analyzed, it was possible to create tables and figures that better explain the results of this research.

Table 1 evaluated the prevalence of apnea in association with age. The study showed that among young individuals (20-39 years old), there was a higher prevalence of the absence of this disease (47.2%), and when present, mild apnea (44.4%) was the most recurrent condition. In the older age groups (60-80 years), there was an increase in moderate and severe cases, with 53.3% of the elderly presenting moderate apnea and 13.3% presenting severe apnea.

Regarding gender, the data show that the association with sleep apnea was also positive. The highest percentages of moderate (39.2%) and severe (9.5%) apnea were found in men, while among women, there was a lower prevalence of severe apnea (4.8%) and a higher number of individuals without this condition (49.2%).

The analysis of daily activities, feelings of tiredness, and ability to stay alert provided in Table 2 revealed striking differences between genders. In the female sample, there was a 73% rate of positive results, with 38.1% categorized as “moderate” and 34.9% as “very high.” Despite a higher prevalence of apnea in males, they had higher rates in the “small” (37.8%) and moderate

Sleep Apnea									
Variables	Absence		Mild		Moderate		Severe		p*
	N	%	N	%	N	%	N	%	
Age									
20-39	17	47.2	16	44.4	1	2.8	2	5.6	0.000
40-59	24	33.8	22	31.0	21	29.6	4	5.6	
60-80	3	10.0	7	23.3	16	53.3	4	13.3	
Gender									
Male	13	17.5	25	33.8	29	39.2	7	9.5	0.000
Female	31	49.2	20	31.7	9	14.3	3	4.8	

*p= Value obtained through the chi-square test

Table 1: Percentage of sleep apnea degrees according to age and gender variables, Salvador, Bahia, 2011 to 2012.

Source: Author, 2025

Daily Activities, Feeling of Fatigue, and Ability to Remain Alert.									
Variables	None		Small		Moderate		Very Large		p*
	N	%	N	%	N	%	N	%	
Gender									
Male	14	18.9	28	37.8	20	27.1	12	16.2	0.004
Female	5	7.9	12	19.1	24	38.1	22	34.9	

*p= Value obtained through the chi-square test

Table 2: Daily activities, feeling of tiredness, and ability to stay alert, according to gender. Salvador, Bahia, 2011-2012

Source: Author, 2025

(27.1%) categories. Among those without complaints, the proportion of men (18.9%) was more than twice that of women (7.9%).

These figures show significant symptomatic differences between the genders. Although men had a higher prevalence of moderate and severe apnea, women reported a greater perception of impact on their daily activities and emotional functioning. This finding reinforces the observation that the intensity of reported symptoms is not necessarily linked to the clinical severity of apnea, but rather to how individuals experience and express their symptoms. This indicates that, although higher rates of apnea occur among men, it is women who seem to suffer more intensely from the effects of the syndrome in their routine and emotional well-being.

This difference suggests that the impact of OSA may be more devastating in women, revealing not only a physiological issue, but also a social and behavioral one. This reinforces the need for gender-sensitive clinical protocols, both in diagnosis and in the choice of therapeutic strategies.

This difference can be attributed to physiological and psychosocial aspects, such as greater recognition, perception, and reporting of symptoms by women. Studies indicate that hormonal factors, distinct sleep patterns, and greater predisposition to anxiety may contribute to this heightened sensitivity. As discussed by Silva *et al.*¹⁹, these particularities reinforce the importance of a differentiated approach in the diagnosis and treatment of OSA, considering not only objective clinical findings but also the subjective profile and demands of each patient.

The data obtained in this study did not allow us to establish a direct statistical association between the severity of OSA and cognitive impairment in all domains evaluated. Table 2, for example, shows significant differences in relation to gender, but does not provide sufficient basis to affirm a direct relationship between the degree of apnea and cognitive functions. Nevertheless, descriptive analysis of the questionnaires revealed that patients with higher levels of complaints reported significant difficulties in maintaining attention, performing daily tasks, and dealing with emotional issues, especially in the moderate to very high impact categories, suggesting a possible trend that deserves further exploration in future studies.

These findings, although limited in terms of statistical correlation with the severity of apnea, are consistent with the specialized literature, which points out that sleep fragmentation and nocturnal hypoxemia are central factors in the cognitive impairment of patients with OSA. These conditions directly affect brain regions such as the prefrontal cortex and hippocampus, which are responsible for executive functions, memory, and emotional regulation. Thus, although the present study does not allow us to confirm this relationship conclusively, the patterns of complaints reported by the participants reinforce the importance of considering these domains in the clinical approach to OSA.

All information collected through the questionnaire relevant to this study was organized based on the frequency of responses to each item and can be viewed more clearly in FIGURE 1.

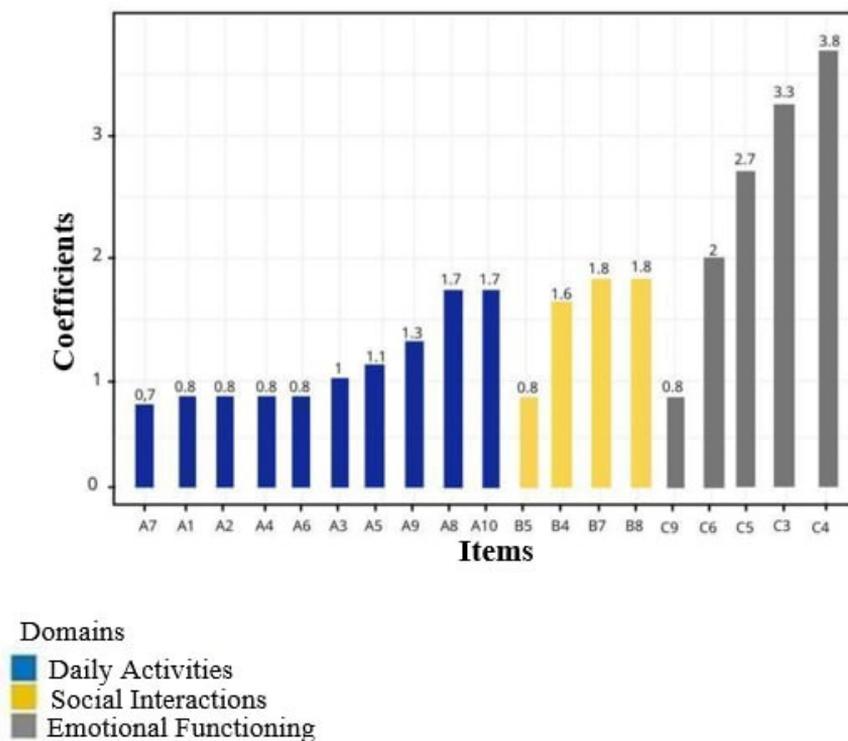


Figure 1: Value of coefficients related to items in the domains of daily activities, social interrelationships, and emotional functioning, calculated using *Cronbach's* coefficient test

Source: Author, 2025

The questionnaire allowed for a detailed assessment of the domains affected by OSA, with emphasis on impairment in daily activities. The items that had the greatest impact were those related to the effort to stay awake during tasks (A3), performing physical activity (A5), difficulties remembering things (A9), performing household tasks (A8), and concentrating (A10). These results corroborate the findings described in the literature, which point to significant impairments in sustained attention, memory, and executive functions in patients with OSA. The studies consulted for theoretical support indicate that such deficits are linked to sleep fragmentation and hypoxemia, which affect brain regions, inducing structural and functional changes, especially in the

hippocampus, prefrontal cortex, and corpus callosum, areas directly involved in memory consolidation, emotional regulation, and performance in complex tasks^{5, 20, 21, 22, 23}.

Attention encompasses a variety of processes and skills that demonstrate how stimuli are received and processed. Sustained attention, in particular, is fundamental in assessing daytime sleepiness, and when compromised, it is associated with an increased risk of accidents. Data from the validated questionnaire applied in this study showed that participants reported significant difficulties in this domain, especially in items A3 (difficulty staying awake during tasks) and A10 (difficulty concentrating), which had high coefficients, indicating a high impact on daily functioning. These fin-

dings reinforce that, although patients with OSA may initially perform similarly to healthy individuals in short-term tasks, as the activity continues, behavioral instabilities, lapses, and longer response times occur, as also evidenced by Weaver²¹ in his analysis of the effects of OSA on neurobehavioral performance.

Regarding social interactions, the highest coefficients were observed in items related to the need for isolation and the search for excuses due to fatigue (B7 and B8). Such behavior can be understood as a coping strategy in the face of the limitations imposed by chronic fatigue, typical of individuals with OSA. Similarly, Amaral *et al.*⁷ highlight that the quality of life of these patients is impaired not only by sleepiness but also by changes in socialization patterns, negatively impacting interpersonal relationships and participation in collective activities.

Executive functions, in turn, are responsible for intentional behaviors involving planning, decision-making, and self-control, functions that depend on the proper functioning of the frontal lobe. The questionnaire revealed significant impacts in these aspects, with frequent reports of demotivation, procrastination, and difficulty starting or completing tasks, especially in items related to emotional functioning and social interactions. Items C3 (frustration), C4 (irritability), and C5 (impatience) stand out, presenting the highest coefficients in the study, evidencing the deterioration of emotional control associated with executive function dysfunction. These data corroborate the evidence in the literature, such as that described by Weaver & George²², which points out that patients with OSA show significant impairments in verbal fluency, sequential thinking, and constructive skills,

even when other cognitive functions remain preserved^{23, 24, 25}.

Therefore, the data obtained from the validated questionnaire, analyzed from the perspective of cognitive and emotional domains, show that OSAS is not limited to a respiratory disorder, but constitutes a systemic disorder that broadly and profoundly compromises the functionality and quality of life of patients^{7, 5, 20, 22, 24, 25}. This further highlights the importance of early identification and appropriate treatment of obstructive sleep apnea, as these are fundamental to preventing the progression of cognitive impairment and improving individuals' well-being²³. Interventions that include neuropsychological support and cognitive therapies should be considered an essential part of treatment, especially for those who have persistent cognitive symptoms even after respiratory stabilization.

CONCLUSION

Cognitive impairment in patients with OSA has shown that the syndrome goes beyond respiratory symptoms, impacting sustained attention, memory, executive functions, and psychological well-being. A higher prevalence of moderate/severe apnea was observed in men, but a higher intensity of self-reported symptoms was observed in women, especially in the emotional and functional domains. The findings reinforce OSAS as a systemic condition and support the need for interdisciplinary management with neuropsychological assessment and support to mitigate deficits and improve the quality of life of its carriers.

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