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The impact of obstructive sleep apnea-hypopnea syndrome on cognitive impairment in patients monitored at the University Clinics of Kinshasa, Democratic Republic of the Congo

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ABSTRACT

Introduction

Cognitive impairment is common in patients with obstructive sleep apnea-hypopnea syndrome (OSAHS), particularly in severe cases, but it often remains underdiagnosed. OSAHS is a respiratory disorder characterised by repeated pauses in breathing during sleep. The resulting intermittent hypoxia can impair brain function and lead to cognitive deficits, including issues with attention, memory, and executive functioning.

Purpose

This study aimed to describe the cognitive profile of patients with OSAHS treated at the University Clinics of Kinshasa.

Methods

This was a cross-sectional, analytical study conducted over a 10-month period among patients aged 18 years and older. Variables studied included sociodemographic, anthropometric, and clinical data, as well as results from the MoCA scale and polysomnography. Statistical analyses were performed using Pearson's chi-square test or Fisher's exact test for qualitative variables, and Student's t-test for quantitative variables ($p < 0.05$).

Results

Of the 121 patients included (mean age = 50 ± 11 years), 66% (n = 80) were male. Severe OSAHS was the most prevalent (38%, n = 46), and 42% of patients were severely obese. Mild cognitive impairment was identified in 45.4% (n = 55) of participants. A significant association was observed between the severity of OSAHS and the presence of cognitive impairment ($p < 0.001$).

Conclusion

This study highlights a high prevalence of cognitive impairment in patients with OSAHS, especially in its severe forms. These findings emphasise the need for cognitive screening in the clinical management of OSAHS patients.

INTRODUCTION

Obstructive sleep apnea-hypopnea syndrome (OSAHS) is a chronic respiratory disorder characterised by repeated pauses in breathing during sleep, caused by partial or complete obstruction of the upper airway. These interruptions lead to oxygen desaturation and sleep fragmentation, which compromise sleep quality and result in significant systemic consequences.

Beyond its respiratory effects, OSAHS is increasingly recognised for its neurocognitive impact. Intermittent hypoxia and sleep deprivation associated with OSAHS can disrupt higher brain functions, including memory, attention, concentration, and executive functioning (Becker et al., 2020; Javaheri et al., 2017; Lau et al., 2010). These disruptions negatively affect quality of life, work performance, and patient safety.

Globally, OSAHS affects approximately 10% to 30% of adults, with severe forms present in 4% to 6% of the population (Senaratna et al., 2017). However, it remains largely underdiagnosed due to its often-subtle symptoms and lack of awareness. Studies in Europe and Asia have highlighted its high prevalence and its significant association with cognitive impairment (Li et al., 2021; Pengo et al., 2020).

Despite the abundance of global data, OSAHS remains underexplored in sub-Saharan Africa, where the prevalence appears to be underestimated. In South Africa, for example, up to 20% of adults are believed to be affected (Sofola et al., 2021). However, few studies have focused on its cognitive consequences, even though risk factors such as obesity, hypertension, and metabolic diseases are increasing in the region.

In the Democratic Republic of Congo (DRC), particularly in Kinshasa, epidemiological data are scarce. Nonetheless, rapid urbanisation, nutritional transitions, and the increasing prevalence of comorbidities suggest that OSAHS cases are on the rise (Mbimbi et al., 2019; Tete Okake et al., 2023). In resource-limited countries, the diagnosis of OSAHS is hindered by the high cost and limited accessibility of polysomnography, and treatment often remains delayed or unavailable. This increases the risk of preventable complications, particularly cognitive and cardiovascular issues, with a direct impact on patients' quality of life (Mbimbi et al., 2019; Ntima-Nsiemi et al., 2022; Pengo et al., 2020).

This study, therefore, aims to evaluate the association between the severity of OSAHS and cognitive impairment in adults monitored in Kinshasa.

METHODS

Study Design and Period

This was a cross-sectional, analytical study conducted from 15 July 2023 to 28 April 2024 in the ENT Department, in collaboration with the Pulmonology and Internal Medicine Departments of the University Clinics of Kinshasa. The study population included 132 patients aged 18 years and above, all diagnosed with OSAHS via polysomnography.

Inclusion Criteria

We included all patients aged 18 years and above who had OSAHS confirmed by polysomnography, were lucid, literate, had normal otoscopic examination findings, and no history of neuropsychiatric disorders.

Study Parameters

The variables of interest included:

- **Sociodemographic data:** age, sex, province of origin, ethnicity, marital status, education level, occupation, religion, and socioeconomic status.
- **Anthropometric data:** weight, height, and waist circumference to calculate body mass index (BMI).
- **Clinical data:** smoking and alcohol use, history of diabetes mellitus, obesity, hypertension, stroke, and family history of deafness.
- **Cognitive data:** Montreal Cognitive Assessment (MoCA) scale results.

Operational Definitions

- **Cognitive impairment:** Defined as a total MoCA score < 26/30 (Trzepacz et al., 2015). The interpretation follows Julayanont et al. (2015):
  - ≥ 26: no cognitive impairment
  - 18–25: mild cognitive impairment
  - 10–17: moderate cognitive impairment
  - < 10: severe cognitive impairment
- **OSAHS diagnosis and classification:** Defined according to the American Academy of Sleep Medicine (AASM) criteria (Sateia, 2014), including:

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- ≥ 5 obstructive apnoea or hypopnoea events per hour with symptoms (e.g., snoring, excessive daytime sleepiness, morning headaches), or
- ≥ 15 events per hour regardless of symptoms.

OSAHS severity was categorised using the Apnoea-Hypopnoea Index (AHI):

- Mild: 5–15 events/hour
- Moderate: 15–30 events/hour
- Severe: >30 events/hour

- **Educational attainment:** Classified into four levels—primary, secondary, higher/university, and postgraduate.
- **Age progression:** Defined as individuals aged 18 years or older.
- **Tobacco use:** Included all current or former use of tobacco products, including smoked and snuff.
- **Alcohol use:** Defined as regular consumption of at least one alcoholic beverage per day.
- **Hypertension:** Defined as a systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg on two separate readings (Chobanian et al., 2003).
- **Diabetes mellitus:** Diagnosed based on fasting plasma glucose > 126 mg/dL or documented use of antidiabetic medication (American Diabetes Association, 2008).

Data Collection

Data collection was carried out by the principal investigator, assisted by two physicians—one from the ENT department and one from Neuropsychiatry—both of whom had been trained for this purpose. A trained technician conducted polysomnography. Convenience sampling was used.

Statistical Analysis

Data were processed using Microsoft Excel 2019 and analysed using IBM SPSS Statistics version 26.0. Categorical variables were presented as frequencies and percentages. Quantitative data were reported as means and standard deviations (SD). Comparisons were made using Pearson's chi-square test for categorical variables and Student's t-test for continuous variables. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

This study was approved by the National Ethics Committee under reference number 542/CNES/BN/PMMF/2024. The study complied with the ethical principles of respect for persons (anonymity), beneficence, and justice.

RESULTS

Study Population

We evaluated a total of 132 patients aged 18 years and above with OSAHS confirmed by polysomnography, regardless of gender. After excluding 11 patients who did not complete all stages of the assessment, we retained 121 patients, who constituted the final study population.

General Characteristics of the Study Population

Table 1 summarises the general characteristics of the study population. The age distribution was symmetrical, with a mean age of 50 ± 11 years (range: 19–65 years). There was a male predominance (66.7%, n = 80), with a sex ratio of 2:1. Most participants were married (62.8%, n = 76) and had attained university-level education (63.6%, n = 77). Nearly half (48.7%, n = 59) reported alcohol consumption, and 17.4% (n = 21) had a history of smoking. Among the participants, 14.8% (n = 18) had diabetes, and 34.7% (n = 42) had hypertension.

Table 1:
Distribution of the study population by general characteristics

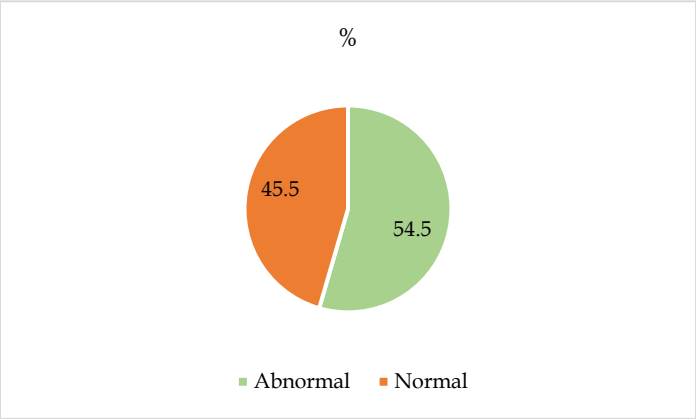
Variable	n (%)
Sex	
Male	80 (66.7)
Female	41 (33.3)
Marital Status	
Married	76 (62.8)
Single	26 (21.5)
Divorced	3 (2.4)
Common-law	13 (10.8)
Widowed	3 (2.4)
Education Level	
University	77 (63.6)
Secondary	44 (36.4)
Alcohol Use	
Reported	59 (48.7)
Absent	62 (51.3)
Smoking	
Reported	21 (17.4)
Absent	100 (82.6)
Comorbidities	

Variable	n (%)
Diabetes Mellitus	18 (14.8)
Hypertension	42 (34.7)
Body Mass Index	
Normal	7 (6.0)
Overweight	13 (11.0)
Moderate Obesity	41 (33.8)
Severe Obesity	42 (34.7)
Morbid Obesity	18 (15.0)

Cognitive Profile of Patients with OSAHS

The mean score on the MoCA assessment was 25 ± 2, indicating that 45.4% of patients (n = 55) had cognitive impairment.

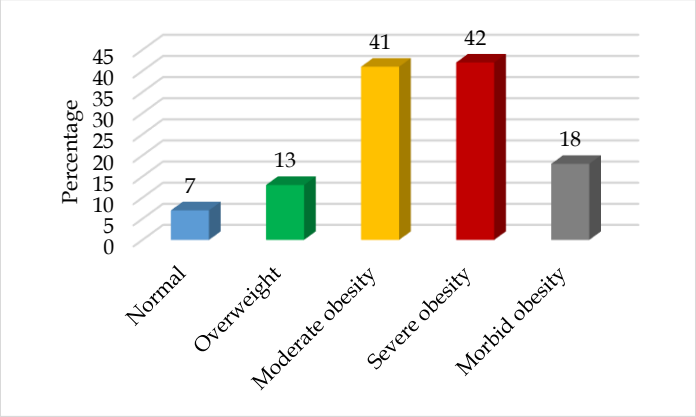
Figure 1:
Cognitive profile of patients with OSAHS



Body Mass Index of Patients with OSAHS

As shown in **Figure 2**, the majority of patients (83%) were classified as obese. Severe obesity was most prevalent (n = 42), followed by moderate obesity (n = 41).

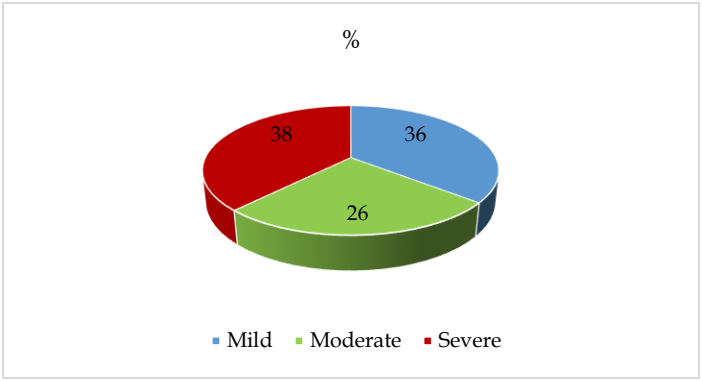
Figure 2:
Distribution of patients with OSAHS by BMI values



Apnea-Hypopnea Index of the Study Population

Figure 3 illustrates the distribution of OSAHS severity: mild (36%), moderate (26%), and severe (38%), with severe OSAHS being the most prevalent.

Figure 3:
Apnea-Hypopnea Index profile of the study population



Patient-Reported Complaints

Table 2 shows that daytime sleepiness was the most commonly reported symptom (74%, n = 89), followed by sleep apnea (51.1%, n = 62), physical fatigue (49%, n = 59), and lack of concentration (39%, n = 47).

Table 2:
Distribution of patients by symptoms reported

Symptom	Frequency (n, %)
Nighttime snoring	47 (38.8)
Daytime sleepiness	89 (74.0)
Sleep apnea	62 (51.1)
Tinnitus	44 (36.4)
Morning headache	37 (31.0)
Physical fatigue	59 (49.0)
Lack of concentration	47 (39.0)

Association Between Cognitive Impairment and OSAHS Severity

A significant association was found between cognitive impairment and OSAHS severity. Among patients with cognitive impairment, 67.3% had severe OSAHS ($p < 0.001$), as shown in **Table 3**.

Table 3:
Association between cognitive impairment and Apnea-Hypopnea Index

MoCA Score	Mild SAHOS	Moderate SAHOS	Severe SAHOS	p-value
Abnormal (Yes)	1 (1.8%)	17 (30.9%)	37 (67.3%)	< 0.001
Normal (No)	42 (63.6%)	15 (22.7%)	9 (13.6%)	

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Association Between Cognitive and Neurobehavioral Disorders and Sociodemographic Factors

Table 4 shows that alcohol consumption, tobacco use, diabetes, hypertension, tinnitus, daytime sleepiness, poor concentration, hearing loss, and BMI were all significantly associated with cognitive impairment (all $p < 0.005$).

Table 4:
Association Between Cognitive and Neurobehavioral Disorders and Sociodemographic Factors

Variable	OSAHS with Cognitive Impairment n (%)	OSAHS without Cognitive Impairment n (%)	Risk Ratio	p-value
Alcohol Use	35 (59.3%)	24 (40.7%)	0.30	< 0.0001
Diabetes Mellitus	14 (77.8%)	4 (22.2%)	0.10	< 0.0001
Tobacco Use	14 (66.7%)	7 (33.3%)	0.30	< 0.0001
Hypertension	27 (64.3%)	15 (35.7%)	0.30	< 0.0001
Tinnitus				0.005
• Yes	27 (61.4%)	17 (38.6%)	0.36	
• No	28 (36.4%)	49 (63.6%)		
Daytime Sleepiness				0.005
• Yes	36 (40.4%)	53 (59.6%)	2.15	
• No	19 (59.4%)	13 (40.6%)		
Lack of Concentration				0.001
• Yes	30 (63.8%)	17 (36.2%)	0.28	
• No	25 (33.8%)	49 (66.2%)		
Apnea-Hypopnea Index (AHI)				< 0.001
• Mild	1 (2.3%)	42 (97.7%)		
• Moderate	17 (53.1%)	15 (46.9%)		
• Severe	37 (80.4%)	9 (19.6%)		
Hearing Loss				< 0.001
• Normal	10 (20.0%)	40 (80.0%)		
• Mild	42 (63.6%)	24 (36.4%)		
• Moderate	3 (60.0%)	2 (40.0%)		

DISCUSSION

General Characteristics of the Study Population

In our series, the mean age was 50 ± 11 years, with a median of 50 years and an age range of 19 to 65 years. The population showed a predominance of male participants. A multicentre study by Tete et al. (2023) similarly reported a mean age of 46 ± 14 years among a comparable population, confirming regional consistency in OSAHS demographics.

Age is a well-established risk factor in the development of cognitive impairment. These impairments tend to develop gradually due to age-related neural changes such as cerebral atrophy, reduced cerebral blood flow, and impaired synaptic plasticity, all of which increase brain vulnerability to stressors like intermittent hypoxia. The mean age of 50 in our study population reflects a pivotal phase where neurodegeneration may be accelerated by hypoxia, a hallmark of OSAHS.

Pathophysiologically, intermittent hypoxia in middle-aged and older individuals leads to:

- **Age-amplified oxidative stress** due to weakened antioxidant defenses (Lavie, 2015; Baril et al., 2015).
- **Exacerbated neurogenic inflammation** resulting from age-related immune dysregulation (Baril et al., 2015; Mander et al., 2017).
- **Increased blood-brain barrier degradation**, facilitating the entry of inflammatory and neurotoxic agents (Kasemsuk, 2023).

Our study also revealed a male predominance (66.7%), consistent with previous findings (Solelhac et al., 2024; Niama Natta et al., 2019; Konan et al., 2021). Men are more frequently diagnosed with OSAHS and are more susceptible to cognitive deficits associated with the syndrome. Tete et al. (2023) also identified male sex as a significant risk factor for OSAHS.

Legault et al. (2020) and Zhang et al. (2021, 2023) further observed sex-related differences in cognitive outcomes, with men displaying greater psychomotor decline and women demonstrating increased vulnerability to deficits in prospective memory and fluid intelligence. These observations support the hypothesis that while OSAHS prevalence is higher in men, cognitive consequences may manifest differently across sexes.

Cognitive Impairment and OSAHS

Our study revealed that 45.5% of patients exhibited cognitive impairment, aligning with other studies (Sforza & Roche, 2018; Chung, 2020) that reported cognitive deficits in 40–46% of OSAHS patients, particularly in memory and attention.

The pathophysiological basis for these deficits lies in the repeated nocturnal hypoxia and sleep fragmentation

experienced by OSAHS patients, which impair memory consolidation and disrupt neurochemical balance (Joo et al., 2020). These conditions trigger inflammatory pathways and metabolic changes that lead to neuronal dysfunction (Sforza, 2018).

Factors such as alcohol consumption, smoking, diabetes, and hypertension were also strongly associated with cognitive decline. Boulos et al. (2020) linked such lifestyle behaviours with increased systemic inflammation, which exacerbates neurocognitive symptoms. Diabetic patients, in particular, show heightened risk due to glycaemic dysregulation and hippocampal dysfunction (Mendelson et al., 2019; Magliulo et al., 2022; Luchsinger, 2010).

MoCA scores were significantly lower among patients with severe OSAHS, reinforcing a dose-response relationship between apnea severity and cognitive impairment (Davidescu et al., 2024; Ben Sassi et al., 2021; El Fatouhi et al., 2022). Interestingly, patients with more severe OSAHS often lacked subjective awareness of their cognitive deficits, suggesting the need for routine objective assessments.

Daytime Sleepiness and Its Relationship to Cognitive Impairment

Daytime sleepiness affected 74% of our cohort—a finding supported by Cerri et al. (2023). Excessive sleepiness stems from fragmented sleep and poor quality sleep, which impair cognitive alertness and performance.

Mendelson et al. (2019) identified excessive daytime sleepiness as a predictor of memory and attention deficits. Lee et al. (2020) and Sforza et al. (2018) also demonstrated lower cognitive test scores among sleepy patients.

This symptom correlates strongly with OSAHS severity and nocturnal hypoxia, both of which promote neuroinflammation and cellular damage (Joo et al., 2019; Boulos et al., 2020). African studies further support this link. Adeyemi et al. (2019) in Nigeria and Amoussou-Guenou et al. (2020) in Benin showed that daytime sleepiness is prevalent and linked to diminished cognitive performance in patients with OSAHS.

Determinants of Cognitive Impairment in OSAHS

The determinants of cognitive impairment in our cohort included OSAHS severity, obesity, age, and comorbid depression.

Shen et al. (2019) confirmed that obesity contributes to cognitive dysfunction in OSAHS patients. Zhang et al. (2020) found a direct correlation between AHI levels and cognitive deficits. Moreover, Gozal et al. (2020) showed that early intervention, particularly CPAP treatment, helps mitigate cognitive decline and depression in patients with severe OSAHS.

CONCLUSION

This study assessed the cognitive profile of OSAHS patients and identified factors contributing to cognitive impairment. The findings show a high prevalence of cognitive dysfunction, particularly among middle-aged males, emphasising the importance of cognitive assessment in this vulnerable group.

Pathophysiological mechanisms such as oxidative stress, neuroinflammation, and disruption of the blood-brain barrier were highlighted. These factors are aggravated by aging and comorbidities, making cognitive decline in OSAHS a multifactorial process.

Implications

Our results advocate for early cognitive screening in OSAHS patients. Neurocognitive evaluations, especially objective tests like the MoCA, should be integrated into standard OSAHS management protocols. Daytime sleepiness should also be considered a warning sign of cognitive deterioration.

Limitations

Limitations of the study include a small sample size, lack of a control group, and reliance on a single cognitive screening tool. Socio-educational disparities and unmeasured confounding variables may have influenced the findings.

Strengths

Despite these constraints, the study addresses an under-researched issue in sub-Saharan Africa. Its strength lies in a multidimensional approach combining clinical, sociodemographic, and cognitive data to highlight the importance of OSAHS-related neurocognitive decline in a high-risk population.

Ethical Approval: This study was approved by the National Ethics Committee under reference number 542/CNES/BN/PMMF/2024.

Conflicts of Interest: None declared.

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