

Original Research Article

A STUDY ON THE INCIDENCE OF OBSTRUCTIVE SLEEP APNEA IN THE PATIENTS PRESENTED WITH ACUTE ISCHEMIC STROKE IN A TERTIARY CARE HOSPITAL IN SOUTH INDIA

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ABSTRACT

Background: Obstructive sleep apnea (OSA) is an under-recognized but important risk factor for ischemic stroke and may adversely affect recovery if left untreated. This study aimed to determine the incidence of OSA among acute ischemic stroke patients and analyze its effect on outcomes.

Materials and Methods: A prospective observational study was conducted over 18 months in a tertiary hospital stroke unit. Adults ≥ 18 years with acute ischemic stroke confirmed by CT/MRI were enrolled. High-risk patients were screened using STOP-BANG and underwent polysomnography. Patients were stratified by OSA severity and compared for demographic, clinical, and outcome parameters.

Results: Of 45 patients, 82.2% had OSA, with moderate severity being most common (40%). Obesity ($p = 0.02$) and smoking ($p = 0.04$) were significantly associated with OSA. Severe OSA was strongly linked to unfavorable outcomes (75%, $p < 0.001$). The STOP-BANG score showed high specificity (100%) and positive predictive value (100%) for OSA detection.

Conclusion: OSA is highly prevalent in ischemic stroke patients, significantly impacting recovery. Routine screening with STOP-BANG and timely management may improve outcomes and reduce morbidity.

Keywords: Obstructive sleep apnea, Ischemic stroke, STOP-BANG, Polysomnography, Functional outcome.

INTRODUCTION

Stroke is one of the leading causes of mortality and long-term disability worldwide, with ischemic stroke representing nearly 85% of all cases. In recent years, growing research has focused on the role of sleep-related breathing disorders, particularly obstructive sleep apnea (OSA), as both a risk factor and a complication of stroke. OSA is characterized by recurrent episodes of complete or partial upper airway obstruction during sleep, leading to intermittent hypoxia, sleep fragmentation, and sympathetic overactivity. These physiological consequences may promote endothelial dysfunction, hypertension, arrhythmias, and inflammatory changes, all of which increase cerebrovascular risk.^[1] The association between OSA and ischemic stroke is well established. Repeated cycles of hypoxia and

reoxygenation in OSA patients contribute to oxidative stress, vascular dysfunction, and neurocognitive decline, all of which may increase both the risk of stroke and the likelihood of poor outcomes. Importantly, OSA is not only a risk factor for ischemic stroke but also commonly occurs after stroke, suggesting a bidirectional relationship.^[2] Epidemiological evidence indicates that the prevalence of OSA among stroke patients is extremely high. A study conducted in Spain's Stroke Belt reported that 84.7% of acute ischemic stroke patients had undiagnosed OSA, with many cases being moderate to severe.^[3] Similarly, a study in Taiwan found that 91.2% of stroke patients had OSA in the acute stage, with 70% suffering from moderate to severe disease. Older patients, especially those aged 65 years and above, were at significantly higher

risk.^[4] These findings emphasize the importance of routine screening for OSA in stroke populations.

The timely diagnosis of OSA in patients with acute ischemic stroke carries substantial clinical implications. Evidence shows that early initiation of therapy, particularly continuous positive airway pressure (CPAP), improves neurological outcomes, reduces mortality, and enhances quality of life. For instance, early screening and treatment of OSA following stroke led to better functional recovery, reduced disability scores, and improved patient-reported health outcomes.^[5] Similarly, a pilot study demonstrated that non-invasive ventilation initiated within 48 hours of stroke resulted in better prognosis, improved daily functioning, and greater lesion shrinkage on neuroimaging compared to controls.^[6] Another study found that CPAP therapy significantly improved NIHSS scores, Barthel index, and functional independence in acute ischemic stroke patients with OSA.^[7]

The pathophysiological link between OSA and ischemic stroke extends beyond intermittent hypoxia to include inflammatory and atherosclerotic mechanisms. Patients with OSA exhibit elevated levels of pro-inflammatory cytokines such as TNF- α , NF- κ B, and CRP, which contribute to endothelial dysfunction, plaque instability, and atherosclerosis.^[8] OSA-induced hypoxia has been likened to ischemia-reperfusion injury, which activates inflammatory cascades, worsens vascular damage, and predisposes to stroke.^[9] Moreover, studies have confirmed that OSA independently contributes to carotid atherosclerosis in ischemic stroke patients, further highlighting its role in cerebrovascular pathology.^[10] In India, the burden of OSA among stroke patients is under-recognized despite the rising prevalence of obesity, hypertension, and diabetes, which are key risk factors for both conditions. A prospective study in Rajasthan reported that 36% of patients with acute ischemic stroke had OSA, with obesity and high daytime sleepiness being strong predictors. Importantly, these patients demonstrated significantly poorer neurological recovery during hospitalization and worse functional outcomes at one month compared to non-OSA patients. This emphasizes the need for early OSA screening in Indian stroke populations, particularly among high-risk groups.^[7]

Beyond being a risk factor for ischemic stroke, OSA worsens post-stroke complications. Patients with both OSA and stroke have a higher prevalence of arrhythmias, which significantly impairs long-term functional recovery. Dysphagia, another common post-stroke complication, has also been strongly associated with OSA, thereby increasing the risk of aspiration pneumonia and poor outcomes.^[2,6] These findings highlight that untreated OSA not only predisposes to stroke but also complicates recovery in the post-stroke phase.

Taken together, the evidence clearly demonstrates that OSA is highly prevalent in patients with acute ischemic stroke and significantly impacts outcomes.

While international studies have consistently reported high incidence rates, Indian data remain limited. Considering India's growing burden of lifestyle-related risk factors, it is critical to assess the incidence of OSA among Indian stroke patients. Identifying and managing OSA early in the course of ischemic stroke may not only improve acute outcomes but also reduce recurrence, morbidity, and long-term disability. This study, therefore, seeks to address this gap by investigating the incidence of obstructive sleep apnea in patients presenting with acute ischemic stroke in an Indian setting.

MATERIALS AND METHODS

Study Design: This was a prospective observational study conducted to determine the incidence of obstructive sleep apnea (OSA) in patients with acute ischemic stroke and its effect on outcomes. Patients were enrolled at admission, evaluated with standardized tools, and followed up at defined intervals. No experimental intervention was introduced beyond routine care.

Study Setting: The study was carried out in the Department of Neurology, JSS Hospital, Mysuru, a tertiary care teaching hospital with a dedicated stroke unit, sleep laboratory, and advanced neuroimaging facilities. The setting provided comprehensive evaluation and follow-up of stroke patients.

Study Duration: The study was conducted over 18 months, allowing adequate patient recruitment and follow-up. Assessments were performed at admission, discharge, one month, and three months to capture both early and short-term outcomes.

Participants – Inclusion and Exclusion

Adults ≥ 18 years with acute ischemic stroke confirmed by CT/MRI within 72 hours were included. Patients with pre-existing neurological disease, chronic respiratory illness, unstable cardiac conditions, prior CPAP/BiPAP or oxygen use, or inability to undergo polysomnography were excluded.

Study Sampling: A consecutive sampling method was used, where all eligible patients admitted during the study period were screened and enrolled. High-risk patients for OSA were identified using questionnaires and confirmed with polysomnography.

Study Sample Size: Sample size was calculated from expected OSA prevalence in stroke patients with 95% confidence and 10% error margin. Recruitment continued until the required sample size was achieved within the 18-month period.

Study Groups: Patients were stratified into groups based on OSA severity measured by the apnea-hypopnea index (AHI): no OSA (<5), mild (5–15), moderate (15–30), and severe (>30). These groups were compared for stroke severity and outcomes.

Study Parameters: Parameters included demographics, vascular risk factors, stroke severity (NIHSS), functional outcome (MRSS), OSA

measures (STOP-BANG, ESS, PSG), echocardiography, carotid Doppler, lipid profile, hospital stay, and follow-up outcomes.

Study Procedure: After confirmation of ischemic stroke, baseline data were recorded, and OSA screening was done using STOP-BANG and ESS. High-risk patients underwent polysomnography, and stroke outcomes were assessed at admission, discharge, one month, and three months.

Study Data Collection: Data were collected using structured forms covering clinical, demographic, and investigative findings. Follow-up assessments were recorded systematically, and data were anonymized and stored securely for analysis.

Data Analysis: Data were analyzed using appropriate statistical tests. Continuous variables were expressed as mean $\pm$ SD or median (IQR) and compared using t-test or Mann–Whitney U test, while categorical data were analyzed using chi-square or

Fisher’s exact test. Logistic regression identified predictors of poor outcomes.

Ethical Considerations: Ethical clearance was obtained from the Institutional Ethics Committee, and written informed consent was taken from patients or their representatives. Confidentiality was maintained, participation was voluntary, and patients diagnosed with OSA were referred for appropriate management.

RESULTS

1. Age and Gender Distribution of the Study

Subjects: Younger patients (<60 years) formed the majority (71.1%) of the study population. Males (73.3%) were more commonly affected than females (26.7%) [Table 1].

Table 1: Age and Gender Distribution of the Study Subjects

Variable	Count	%
Age category		
<50	14	31.1%
51–60	18	40.0%
>61	13	28.9%
Total	45	100.0%
Gender		
Male	33	73.3%
Female	12	26.7%
Total	45	100.0%

2. Comorbidity Distribution among Study

Subjects: Diabetes (62.2%) and dyslipidemia (62.2%) were the most common comorbidities, while

carotid stenosis was present in 42.2% of patients [Table 2].

Table 2: Comorbidity Distribution among Study Subjects

		Count	Column N %
Gender	Male	33	73.30%
	Female	12	26.70%
	Total	45	100.00%
DM	No	17	37.80%
	Yes	28	62.20%
Hypertension	No	20	44.40%
	Yes	25	55.60%
Obesity	No	29	64.40%
	Yes	16	35.60%
Dyslipidemia	No	17	37.80%
	Yes	28	62.20%
2D Echo	Normal	34	75.60%
	Abnormal	11	24.40%
B/L Neck Vessel Doppler–Carotid Stenosis	No	26	57.80%
	Yes	19	42.20%
Stop-bang score–risk of OSA	Low	18	40.00%
	Intermediate	17	37.80%
	High	10	22.20%
Prior MI	No	36	80.00%
	Yes	9	20.00%

3. Incidence of OSA among Ischemic Stroke

Patients: A striking 82.2% of stroke patients had

OSA, highlighting its high prevalence in this population [Table 3].

Table 3: Incidence of OSA among Ischemic Stroke Patients

OSA Status	Count	%
No OSA	8	17.8
OSA Present	37	82.2
Total	45	100

4. Severity of OSA among Stroke Patients (PSG Findings): Moderate OSA (40.0%) was the most

common, followed by mild (24.4%) and severe (17.8%) cases [Table 4].

Table 4: Severity of OSA among Stroke Patients (PSG Findings)

OSA Severity	Count	%
No OSA	8	17.8
Mild	11	24.4
Moderate	18	40.0
Severe	8	17.8

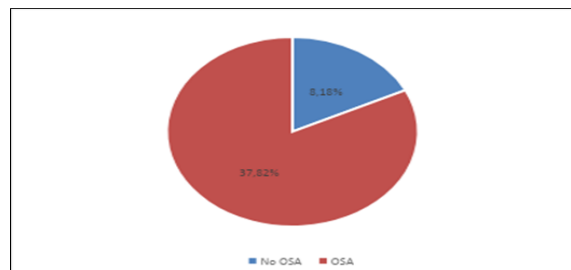


Figure 1: Incidence of OSA among Ischemic Stroke Patients

5. Functional Outcome of Stroke in Relation to OSA Severity: Unfavorable outcomes increased

with OSA severity, reaching 75% in severe OSA cases ($p < 0.001$) [Table 5].

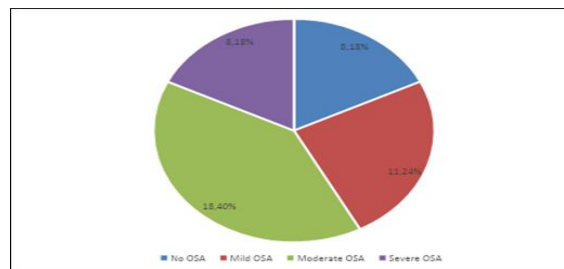


Figure 2: Severity of OSA among Stroke Patients (PSG Findings)

Table 5: Functional Outcome of Stroke in Relation to OSA Severity

	MRSS-FUNCTIONAL OUTCOME			
	Unfavourable		Favourable	
	Count	Row N %	Count	Row N %
No OSA	0	0.0%	8	100.0%
Mild	1	9.1%	10	90.9%
Moderate	3	16.7%	15	83.3%
Severe	6	75.0%	2	25.0%

6. Association of Risk Factors with OSA in Stroke Patients: Obesity ($p = 0.02$) and smoking ($p = 0.04$)

were significantly associated with OSA, while other comorbidities were not [Table 6].

Table 6: Association of Risk Factors with OSA in Stroke Patients

Risk Factor	No OSA n (%)	OSA n (%)	p-value
Obesity	8 (27.6)	21 (72.4)	0.02*
Smoking	0 (0.0)	14 (100)	0.04*
Hypertension	5 (25.0)	15 (75.0)	0.3
Diabetes	2 (11.8)	15 (88.2)	0.4

7. Validity of STOP-BANG Score in Predicting OSA: STOP-BANG showed high specificity (100%)

and PPV (100%), confirming its utility as a screening tool [Table 7].

Table 7: Validity of STOP-BANG Score in Predicting OSA

Parameter	Value (95% CI)
Apparent prevalence	60% (44.3% – 74.3%)
True prevalence	82.2% (67.9% – 92.0%)
Sensitivity	73% (55.9% – 86.2%)
Specificity	100% (51.8% – 100%)
Positive predictive value	100% (81.7% – 100%)
Negative predictive value	44.4% (21.5% – 69.2%)
Diagnostic accuracy	77.8% (62.9% – 88.8%)

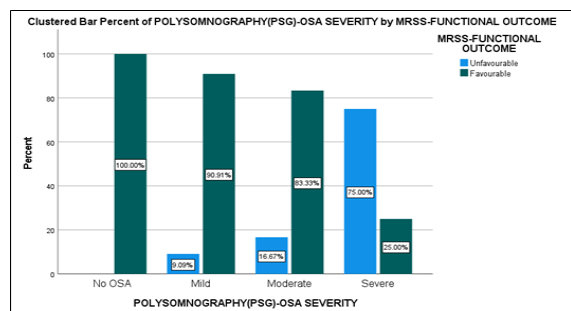


Figure 3: Functional Outcome of Stroke in Relation to OSA Severity

DISCUSSION

This prospective observational study found a very high prevalence of obstructive sleep apnea (OSA) among acute ischemic stroke patients, with 82.2% affected and moderate OSA being the most common (40%). These findings are consistent with international studies. Domínguez-Mayoral et al. (2021) reported OSA in 84.7% of stroke patients in Spain, while Lin et al. (2023) observed a prevalence of 91.2% in Taiwan.^[3,4] Similarly, Shah and Sardana

(2021) from India found a prevalence of 36%, which was lower but still significant, possibly reflecting regional differences in screening intensity and patient demographics.^[11]

The present study also identified obesity and smoking as significant risk factors for OSA in stroke patients. This aligns with prior studies indicating obesity as a strong predictor of OSA severity and prevalence (Xie, 2019).^[2] Smoking, though less consistently reported, has been linked to airway inflammation and increased OSA risk, supporting our findings of 100% OSA prevalence among smokers.

Regarding outcomes, we observed that severe OSA was strongly associated with poor functional recovery, with 75% experiencing unfavorable outcomes ($p < 0.001$). This is in line with earlier studies where OSA was linked to poor neurological recovery, longer hospital stay, and worse functional independence (Benbir & Karadeniz, 2012; Gang, 2013).^[6,7] Although overall OSA presence was not significantly associated with outcomes, the severity gradient highlights the importance of identifying and managing high-risk patients.

The STOP-BANG score in our study showed high specificity (100%) and excellent positive predictive value (100%) for OSA detection, supporting its role as a reliable bedside screening tool. Previous research has also validated STOP-BANG as a practical predictor of OSA risk in stroke populations (Boulos et al., 2019).^[12]

Our findings reinforce that OSA is highly prevalent in ischemic stroke patients, with obesity and smoking as key risk factors, and severity of OSA predicting poor outcomes. These results echo global evidence and emphasize the need for routine OSA screening and early management in stroke care to improve prognosis.

CONCLUSION

This study highlights that obstructive sleep apnea (OSA) is highly prevalent among acute ischemic stroke patients, with severity correlating strongly with poor functional outcomes. Obesity and smoking were significant predictors of OSA, underlining the

importance of risk factor modification. The excellent specificity and predictive value of the STOP-BANG score support its use as an efficient screening tool in stroke care. Routine OSA screening and timely intervention may improve neurological recovery, reduce disability, and lower stroke recurrence in Indian populations.

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