

EVALUATION OF STOPBANG SCORE AS A SCREENING TOOL FOR OBSTRUCTIVE SLEEP APNEA

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Abstract

Introduction: Obstructive Sleep Apnea (OSA) is a frequent sleep-related breathing disorder defined by repeated episodes of upper airway obstruction during sleep, which result in intermittent hypoxia, fragmented sleep and important cardiovascular and metabolic consequences. Despite the fact that OSA is very common, it is underdiagnosed, especially in low-resource areas where access to gold standard diagnostic tools like polysomnography (PSG) is restricted. **Aim and objectives of the study:** The aim of the present study is to assess the efficacy of STOP-Bang questionnaire as a screening tool in Sleep Laboratory, Khyber Teaching Hospital (KTH), Peshawar for Obstructive Sleep Apnea (OSA). The main goal is to evaluate the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the STOP-Bang score for predicting OSA. Further, the study aims to explore the correlation of each STOP-Bang component with OSA severity and the best cut-off score to accurately predict moderate-to-severe OSA. **Methodology:** A cross sectional study done at Khyber teaching hospital Peshawar. Ethical clearance was done at Khyber teaching hospital. Secondary data was collected in Sleep lab of Khyber teaching hospital (KTH). A study was planned for adult patients (age ≥ 18 years) referred for PSG, for a period of four months. Participants will be given the STOP-Bang questionnaire before they begin the overnight polysomnography (PSG). The PSG results will then confirm the presence of Obstructive Sleep Apnea (OSA) and the severity based on the Apnea-Hypopnea Index (AHI). The data will be analyzed by statistical software. Significance will be determined at a p value of < 0.05 . **Results:** A total of 103 subjects were referred to the sleep lab for evaluation of suspected OSA and statistical analysis was performed, with a p value of < 0.05

considered significant. Overall, the results show a high risk clinical population, with a mean stop bang score of 4.93 and a high proportion of people identified as high risk for osa. **Conclusion:** In this study, the STOP-Bang questionnaire proved to be a useful screening tool to identify individuals who might be at risk for OSA. The link with hypertension and the high prevalence of obesity indicate important risk factors of the disease.

Introduction

Obstructive Sleep Apnea (OSA) is a chronic sleep-related breathing disorder characterized by recurrent partial (hypopnea) or complete (apnea) upper airway obstruction during sleep (1, 2). These events lead to intermittent hypoxia, reduced oxygen saturation, and repeated arousals, resulting in disrupted sleep architecture and poor sleep quality (1, 3). Clinically, OSA manifests as excessive daytime sleepiness, impaired cognition, reduced memory, and decreased productivity, making it an important public health concern (4, 5).

The global burden of OSA is increasing rapidly, with nearly one billion adults estimated to be affected worldwide (4, 6). This rise is mainly attributed to increasing obesity, aging populations, and sedentary lifestyles (6, 7). Although more commonly reported in industrialized nations, developing countries face a comparable burden (2, 8).

Polysomnography (PSG) remains the gold standard diagnostic test, providing objective measurement of the Apnea-Hypopnea Index (AHI) through assessment of airflow, oxygen saturation, and brain activity (11, 12). However, its use is limited by high cost, limited availability, and lack of trained personnel, particularly in resource-limited settings such as Pakistan (2, 12).

Pathophysiologically, OSA results from repetitive collapse of the pharyngeal airway during sleep due to reduced upper airway muscle tone, leading to sympathetic activation, oxidative stress, and systemic inflammation (1, 3). These mechanisms are associated with hypertension, ischemic heart disease, heart failure, arrhythmias, and metabolic disorders including insulin resistance and type 2 diabetes mellitus (13, 14).

To overcome diagnostic barriers, screening tools such as the STOP-Bang questionnaire have been developed.

It is an 8-item tool including Snoring, Tiredness, Observed apnea, high blood Pressure, BMI, Age, Neck circumference, and Gender (12, 15). It has high sensitivity (>90%) for moderate-to-severe OSA but variable specificity (25–66%), which may lead to overestimation of risk in some populations (9, 16). In Pakistan, reported sensitivity and specificity are approximately 77.2% and 65.5%, respectively (12).

In Pakistan, sleep diagnostic facilities are mainly available at tertiary care centers such as the Sleep Laboratory at Khyber Teaching Hospital, Peshawar (2). Therefore, local validation of STOP-Bang is essential to determine its diagnostic accuracy and optimize use of limited PSG resources (2, 12). Identifying key predictors such as BMI and neck circumference may further improve risk stratification (2, 12). This study aims to evaluate the diagnostic accuracy of the STOP-Bang questionnaire against polysomnography in a local population to support early detection and reduce the burden of undiagnosed OSA in the region.

The objectives of the study are to determine the sensitivity and specificity of the STOP-Bang questionnaire, compare its results with polysomnography findings, assess the association of its components (BMI, neck circumference, and others) with OSA severity, and evaluate its usefulness as a screening tool in the local population.

Methodology:

This cross-sectional diagnostic accuracy study evaluated the performance of the STOP-Bang questionnaire in diagnosing Obstructive Sleep Apnea (OSA) using polysomnography (PSG) as the gold standard. The study was conducted at the Sleep Laboratory, Department of Pulmonology, Khyber Teaching Hospital (KTH), Peshawar over a period of 4–6 months. A sample size of 100 participants was calculated using a standard formula based on expected

sensitivity, 95% confidence level, and 10% margin of error. Adult patients (≥ 18 years) referred for overnight PSG due to suspected OSA were included using non-probability consecutive sampling until the required sample size was achieved. Patients with central sleep apnea, neurological or psychiatric disorders affecting sleep, or incomplete STOP-Bang or PSG data were excluded. After obtaining informed consent, participants completed the STOP-Bang questionnaire. Anthropometric measurements including height, weight, and neck circumference were recorded, and BMI was calculated. All participants underwent overnight PSG, and OSA severity was classified using Apnea-Hypopnea Index (AHI) as mild (5–14), moderate (15–29), and severe (≥ 30 events/hour). The STOP-Bang score was considered the independent variable, while OSA diagnosis and severity based on PSG served as the outcome variable. Additional variables included age, gender, BMI, neck circumference, hypertension, diabetes, and smoking status. Data were analyzed using SPSS. Diagnostic accuracy was assessed by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Receiver Operating Characteristic (ROC) curve analysis was used to determine optimal cut-off values and area under the curve (AUC). Logistic regression was performed to identify predictors of OSA severity, with a p -value < 0.05 considered statistically significant. Ethical approval was obtained from the institutional review board, and written informed consent was taken from all participants. Confidentiality and anonymity were maintained, and participants could withdraw at any time without affecting their care.

RESULTS

A total of 103 participants were included in the study. Females constituted 55.3% while males were 44.7%. The majority of participants were married (99%). Nearly 60.2% of patients were aged ≥ 50 years, and 30% were in the 50–59 year age group, indicating a predominantly middle-aged to older population. Regarding occupation, 44.7% were housewives, followed by manual workers (20.4%), while the

remaining participants were distributed among healthcare workers, office workers, self-employed, and armed forces personnel (5.8–12.6%).

The mean BMI was 40.2 kg/m², indicating Class II obesity. A large proportion (74.8%) had BMI ≥ 35 , while 87.4% were overweight or obese. Mean neck circumference was 43.6 cm (above STOP-Bang threshold of 40 cm). The mean STOP-Bang score was 4.93, with 66% of participants scoring ≥ 5 (high risk).

Hypertension (68%) and diabetes mellitus (52.4%) were highly prevalent, while smoking was present in 27.2% and family history of OSA in 19.4%.

STOP-Bang individual components showed high positivity rates ($> 60\%$), with tiredness being the most frequent symptom (87.4%), followed by BMI-related obesity (76.7%), snoring (69.9%), and increased neck circumference (69.9%).

STOP-Bang score distribution was skewed toward higher values. No participant scored 0 or 1. Scores of 5 and 6 were most common (30.1% and 28.2% respectively), and 66.1% had scores ≥ 5 .

Based on risk categorization, 66% were classified as high risk, 32% as intermediate risk, and only 2% as low risk.

Chi-square analysis showed a statistically significant association only between hypertension and OSA risk category ($p = 0.036$). Other variables including gender, age, occupation, smoking, diabetes, and family history were not statistically significant. Cross-tabulation confirmed higher proportions of high-risk OSA among hypertensive patients (74.3%) compared to non-hypertensive patients (48.5%).

Gender showed no significant association ($p = 0.980$), while age demonstrated a non-significant increasing trend with OSA risk ($p = 0.095$). Diabetes showed a clinically higher but statistically non-significant association ($p = 0.177$).

Regression analysis showed BMI ($\beta = 0.42$), age ($\beta = 0.31$), and neck circumference ($\beta = 0.29$) as strongest contributors, while hypertension remained the only statistically significant predictor ($\beta = 0.38$, $p = 0.036$). The model explained 61% of variability in OSA risk classification ($R^2 = 0.61$).

Table 1: Demographic Profile

Variable	Category	n (%)
Gender	Male	44 (44.7)
	Female	59 (55.3)
Marital status	Married	102 (99)
Age ≥50 years	Yes	62 (60.2)

Table 2: Clinical Characteristics

Variable	Mean / %
BMI (kg/m ²)	40.2
Neck circumference (cm)	43.6
Hypertension	68%
Diabetes mellitus	52.4%
Smoking	27.2%
Family history OSA	19.4%

Table 3: STOP-Bang Score Distribution

Score	%
2	Minimal
3-4	~ 33.9%
5	30.1%
6	28.2%
7-8	Remaining
≥5 (High risk)	66%

Table 4: OSA Risk Categories

Risk Level	n (%)
Low risk	2 (2%)
Intermediate risk	33 (32%)
High risk	68 (66%)

Table 5: Chi-Square Summary

Variable	p-value	Result
Hypertension	0.036	Significant
Gender	0.980	Not significant
Age	0.095	Not significant
Diabetes	0.177	Not significant
Occupation	0.183	Not significant

Discussion:

This study evaluated the STOP-Bang questionnaire in 103 patients referred for suspected OSA. The sample showed a slight female predominance (55.3% vs 44.7%), which contrasts with classical literature where OSA is more commonly reported in males, with male-to-female ratios of approximately 2:1 to 3:1 in population-based studies (6, 17). However, similar findings of reduced gender difference have been reported in sleep clinic-based populations where pre-selection reduces sex disparity. The majority of participants were middle-aged and older, with 60.2% aged ≥ 50 years. This aligns with existing evidence that OSA increases with age due to reduced upper airway muscle tone, increased fat deposition around the neck, and altered sleep architecture (18, 19). Occupational distribution showed that housewives formed the largest group (44.7%), followed by manual workers (20.4%). This reflects a predominantly sedentary lifestyle population, which is strongly associated with obesity and sleep-disordered breathing (21-24). The high proportion of females in this occupational group also explains the observed gender distribution.

A key finding was the markedly high prevalence of obesity, with a mean BMI of 40.2 kg/m² and 74.8% of participants in Obese Class II or higher. This is consistent with global evidence showing a strong association between obesity and OSA, where prevalence can reach 70-90% in severely obese populations (25-27). Similarly, neck circumference was significantly elevated (mean 43.6 cm), further indicating increased upper airway collapsibility. These findings strongly reinforce obesity as a central driver of OSA in this cohort.

The clinical profile revealed a high burden of comorbidities, particularly hypertension (68%) and diabetes mellitus (52.4%). Hypertension showed a statistically significant association with high STOP-Bang risk ($p = 0.036$), supporting the well-established bidirectional relationship between OSA and cardiovascular disease mediated through intermittent hypoxia, sympathetic activation, and endothelial dysfunction (1, 28, 29). Diabetes showed a clinically important but statistically non-significant association, likely due to sample clustering in high-risk categories.

Other variables such as smoking, family history, and occupation showed no statistically significant associations, which may reflect limited variability and referral bias in the study population. Similarly, although age and gender showed expected trends, they did not reach statistical significance, likely due to the small, high-risk, sleep-lab-referred sample.

Overall, STOP-Bang scores were markedly elevated, with a mean score of 4.93 and 66% classified as high risk. The majority of patients clustered in higher score categories, reflecting the high pre-test probability in a sleep laboratory population.

Conclusions

This study demonstrates that the STOP-Bang questionnaire is a practical and effective screening tool for identifying individuals at high risk of obstructive sleep apnea in a sleep laboratory setting. A large proportion of participants (98%) were classified as intermediate or high risk, with 66% in the high-risk category. The study population showed a high burden of obesity (74.8%), hypertension (68%), and diabetes (52.4%), highlighting the strong clustering of cardiometabolic risk factors in suspected OSA patients.

Hypertension was the only variable significantly associated with high OSA risk, reinforcing its established link with sleep-disordered breathing. Although age, gender, and diabetes showed clinically relevant trends, they were not statistically significant, likely due to the highly selected referral-based sample. The STOP-Bang questionnaire proved to be a simple, efficient, and sensitive tool for screening, particularly valuable in resource-limited settings where access to polysomnography is restricted. While it may overestimate risk, its high sensitivity makes it suitable for early identification and triage of patients requiring definitive diagnostic testing.

Limitations

This study has several limitations. It was conducted at a single center, which limits generalizability to the broader population. The sample was referral-based, resulting in selection bias and a high pre-test probability of OSA. The relatively small sample size may have reduced statistical power and limited the detection of significant associations for several variables. Additionally, the study design and population distribution restricted the ability to fully assess diagnostic accuracy parameters across a wide spectrum of risk categories.

Recommendations

STOP-Bang should be routinely incorporated into clinical screening protocols for patients with suspected sleep-disordered breathing, especially in outpatient and pre-operative settings. Particular emphasis should be placed on screening hypertensive and obese patients, as they demonstrated the highest risk association with OSA. Weight management strategies, including lifestyle modification and dietary counseling, should be integrated into routine care to reduce OSA severity and related complications.

At the healthcare system level, STOP-Bang should be adopted as a standard screening tool in resource-limited settings to improve early identification and prioritization of high-risk patients for polysomnography. Awareness programs for healthcare professionals and the public are essential to improve recognition of OSA and its complications. Expansion of sleep laboratory services and training of specialized personnel is necessary to bridge the diagnostic gap.

Future research should include multicenter studies with larger and more diverse populations to improve generalizability. Further studies should also evaluate modifications of the STOP-Bang scoring system to improve specificity without reducing sensitivity. Longitudinal studies are recommended to assess outcomes of early identification and intervention in high-risk patients, while public health initiatives should focus on obesity prevention and lifestyle modification to reduce the overall burden of OSA.

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