ORIGINAL ARTICLES

PHILIPPINE JOURNAL OF OTOLARYNGOLOGY-HEAD AND NECK SURGERY VOL. 40 NO. 1 JANUARY – JUNE 2025

Diagnostic Accuracy of STOP-BANG Score in Detecting Obstructive Sleep Apnea Among Patients at the Rizal Medical Center

Arianna Danielle M. Nano, MD
Michael Alexius A. Sarte, MD
Giancarla Marie C. Ambrocio, MD
Precious Eunice R. Grullo, MD, MSc

Department of Otorhinolaryngology
Head and Neck Surgery
Rizal Medical Center

ABSTRACT

Objective: To determine the sensitivity, specificity and positive predictive value of the STOP-BANG questionnaire in diagnosing Obstructive Sleep Apnea (OSA) in adults admitted for polysomnography at the Rizal Medical Center from January 2019 to June 2024.

Methods:

Design: Review of Records
Setting: Tertiary Government Training Hospital
Participants: 166 adult patients

Results: A total of 166 patient records were included with an average age of 35.6 ± 12 years, BMI of 29.3 ± 6.44 and 67% were male. The STOP-BANG questionnaire had a sensitivity of 77% to screen for all (AHI ≥ 5), mild (AHI = 5-14.9), moderate (AHI = 15-19.9), and severe OSA (AHI > 30), respectively. The specificity was 62% and the area under the curve was 0.717 for all, mild, moderate and severe OSA.

Conclusion: A STOP-BANG score of 3/8 can predict the presence of OSA with a sensitivity of 77% and specificity of 62% with AUC of 0.717. The increase in score does not predict the severity. Further research can be done to identify other co-morbidities associated with OSA.

Keywords: *apnea; obstructive sleep apnea; STOP-BANG; sleep; polysomnogram*

Obstructive Sleep Apnea (OSA) is a recurring partial or complete collapse of the airway that occurs during sleep, with long-term effects leading to increased mortality. Examples of which are higher incidence of cardiovascular diseases, increased risk of occupation-related injuries and increased risk for motor vehicular accidents.[1] Diagnosis of OSA relies on polysomnography, the gold-standard[1,2] which can be costly, time-consuming and not readily available and accessible in our country.[3] Several screening tools were developed to identify patients with OSA. The most well-known of these screening tools are the Epworth Sleepiness Scale (ESS), the Berlin questionnaire and the STOP-BANG questionnaire.[1] Among these three, the STOP-

Correspondence: Dr. Giancarla Marie C. Ambrocio
Department of Otorhinolaryngology
Head and Neck Surgery
Rizal Medical Center
Bagong Ilog, Pasig Blvd., Pasig City 1600
Philippines
Phone: +63 998 550 5409
Email: giancarlaambrocio@gmail.com

The authors declared that this represents original material that is not being considered for publication or has not been published or accepted for publication elsewhere in full or in part, in print or electronic media; that the requirements for authorship have been met by all the authors, and that each author believes that the manuscript represents honest work.

Disclosures: The authors signed disclosures that there are no financial or other (including personal) relationships, intellectual passion, political or religious beliefs, and institutional affiliations that might lead to a conflict of interest.

Presented at the Philippine Society of Otolaryngology-Head and Neck Surgery Analytical Research Contest (1st Place), October 23, 2024 (Online via Zoom)

Data availability and sharing statement: Datasets for the study are publicly available in the data repository listed: Zenodo [https://zenodo.org/] with DOI: 10.5281/zenodo.15069709

BANG questionnaire is said to have the highest sensitivity, albeit with low specificity in predicting OSA.[2,4] Several meta-analyses showed that the STOP-BANG questionnaire is well-validated, and had a good performance in predicting OSA, regardless of age, sex, and presence of comorbidities.[1,2,5,6]

Waseem *et al.* attempted to investigate the diagnostic performance of STOP-BANG in the screening of OSA patients from different cultural groups including Arabs, Africans, Chinese, Indian, Malay, Caucasian and Japanese.[2] Their study showed that the best predictor of a moderate-severe classification of OSA is a STOP-BANG score of 4 and above.[1] Meanwhile, Oshita *et al.* showed that a STOP-BANG score of 5 and above is most predictive of moderate-severe OSA for the Japanese population.[1] The Philippine Clinical Practice Guidelines (CPG)[3] on the diagnosis and management of OSA was published in 2016 through the collaboration of the Philippine Society of Sleep Medicine (PSSM), Philippine College of Chest Physicians Council on Sleep Medicine (PCCP), and Philippine Academy of Sleep Surgeons (PASS). In this CPG, the STOP-BANG was recognized as a screening tool for surgical patients but was identified to have low accuracy for OSA diagnosis. Despite being recognized as validated internationally, the STOP-BANG questionnaire was not yet advocated for diagnosis of OSA in non-surgical patients.[3]

Currently, to the best of our knowledge, based on a search of HERDIN Plus, the WHO Western Pacific Region Index Medicus (WPRIM), the Directory of Open Access Journals (DOAJ), MEDLINE (PubMed and PubMed Central) using the search terms "Obstructive sleep apnea", "STOP-BANG", and "Philippines", there is no published study in English on the STOP-BANG's diagnostic accuracy for OSA in the Philippine setting.

This study aims to determine the sensitivity, specificity, and positive predictive value of the STOP-BANG questionnaire in diagnosing Obstructive Sleep Apnea (OSA) in patients admitted for polysomnography at the Rizal Medical Center from January 2019 to June 2024.

METHODS

With Rizal Medical Center Institutional Review Board (RMC IRB 2023-ORL-#033-RP-1.III) approval, this retrospective review considered records of patients admitted for polysomnography at the Rizal Medical Center from January 2019 to June 2024. Records of patients greater than 18 years old were considered for inclusion. Those with incomplete documentation of STOP-BANG scores and AHI were excluded.

Permission to retrieve the admission documents and official polysomnogram results were requested both from the hospital's medical records section, and the ENT department. The primary investigator collated the following information using Microsoft© Excel version 16.89.1 (Microsoft Corp., Redmond, WA, USA): 1) patient age, 2) sex, 3) comorbidities, if with any, 4) BMI, 5) itemized and total STOP-BANG scores and 6) corresponding patient apnea-hypopnea index.

The STOP-BANG screening tool is an acronym composed of 8 questions answerable with "yes" or "no". The questions for STOP ("Snoring", "Tired", "Observed", and "Pressure") are subjective responses from the patient, whereas BANG ("BMI, Age, Neck Circumference, Gender) are objective measures done by the clinician who assessed the patient before undergoing polysomnogram. An answer of yes will correspond to 1 point per question, with a possible maximum score of 8 points.[1] *(Figure 1)* The tool was administered prior to admission of patients for polysomnogram.

	Yes	No
STOP		
Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?	1	0
Do you often feel tired, fatigued, or sleepy during daytime?	1	0
Has anyone observed you stop breathing during your sleep?	1	0
Do you have or are you being treated for high blood pressure?	1	0
BANG		
BMI >30 kg/m^2)or 35 kg/m^2)?	1	0
Age over 50 years old?	1	0
Neck circumference>40 cm?	1	0
Gender male?	1	0

Figure 1. STOP-BANG Questionnaire (reproduced from Oshita et al.1 under a CC-BY-4.0 international license)

Descriptive statistics, such as mean and standard deviation for numerical or frequency and percentage for categorical data, were used to summarize demographic and clinical characteristics of patients. Stepwise multivariable binary logistic regression analyses were performed to categorize obstructive sleep apnea (OSA) severity groups (combination of mild, moderate and severe) based on AHI score in terms of STOP-BANG components. Odds ratio values and 95% confidence intervals were generated as a measure of association. To determine the sensitivity and specificity, the Youden index was used. On the other hand, to determine the predictive value of STOP-BANG score for detecting OSA, the Receiver operating characteristic (ROC) curve analysis was done. Bonferroni correction was used with a determined significance value of 0.042 to minimize false positive rate. Data analysis was run using SPSS version 27 software (IBM Corp., Chicago, IL, USA).

RESULTS

Out of 264 patient records considered for inclusion, 166 met inclusion and exclusion criteria and were included. The patients' ages ranged from 21-78 years with an average of 35.6 ±12 years. Majority of the patients (67%) were males. The average BMI was 29.3 ± 6.44, the

majority of which were obese (40.7%). A total of 145 (87.3%) were found to have OSA (AHI>=5) with 56% of them having severe OSA.

The most common subjective items in the STOP-BANG questionnaire with affirmative answers were snoring (87.3%) and waking up tired (69.9%). Gender (62.7%) and hypertension (25.9%), on the other hand, were the most common objective factors present. Tallying the patients' comorbidities, hypertension was noted to be the most common in 43 patients (69.2%) followed by allergic rhinitis in 8 patients (12.3%). Metabolic diseases exist in 5 patients (7.7%), same with 5 patients (7.7%) having cardiovascular diseases. Other diseases noted were hyperuricemia, non-alcoholic fatty liver disease in one patient, Venous insufficiency and congenital adrenal hyperplasia.

Stepwise logistic regression was done among the components of STOP-BANG to check which item was the strongest predictor of OSA. Findings showed that the component "tired" had a significant p-value of .021. Comparing normal patients and those diagnosed with OSA, regardless of its severity, those who are feeling tired during the day ("tired") strongly predicts the likelihood of having a significant AHI result. Moreover, patients who answered "tired" were found to be three times more likely to be non-normal compared to those who did not.

The STOP-BANG components which were affirmative of moderate and severe classification were: 1) "observed" for those observed to have stopped breathing during sleep; and 2) male "gender." Those who were either observed to have episodes of breath-holding during sleep ("observed") or were males ("gender"), were found to be 2.4 times more likely to have moderate to severe OSA classification.

For factors predictive of severe OSA classification, most were more than 50 years of age ("age"), or had answered yes on the "tired", "observed", and "pressure" STOP-BANG components. The patients who were more than 50 years old were 5.3 times more likely to have severe OSA. As for the "tired", "pressure", and "observed" components, those with severe OSA were noted to manifest being tired and have breath holding episodes during sleep 2.3, 2.2, 2.1 times, respectively.

In terms of the relationship of the STOP-BANG to the AHI score, a receiving operating characteristic (ROC) value of 0.717 under the curve showed a significant value.

The optimal cut-off score was determined using the Youden index. A minimum score of 3 out 8 in the STOP-BANG questionnaire would give a 76.6% sensitivity and specificity of 62%. Patients who obtained a score of more than 3 would have a 76.6% chance of having OSA, while those who scored less than 3 had a 62% chance of not having the condition.

At a minimum value of 3 out 8 in the STOP-BANG questionnaire, there was an 82% sensitivity that a patient had a moderate or severe OSA. On the other hand, the specificity value showed that there was a 53% chance of not having a moderate or severe OSA.

Table 1. STOP-BANG components predictive of having OSA

Predictor/s	Odds ratio	95% CI		P-value
		LL	UL	
Component predictor of OSA				
Snoring	2.5	0.8	7.8	.109
Tired	3.0	1.2	7.6	.021
Observed	3.0	1.0	8.6	.042
Pressure	3.0	1.2	7.6	.085
BMI	3.6	0.5	28.0	.225
Age	9.1	0.5	155	.127
Neck circumference	3.6	0.5	28.0	.225
Gender	1.3	0.5	3.3	.577
Component predictor of Moderate and Severe classification				
Observed	2.4	1.1	4.9	.020
Gender	2.4	1.2	4.8	.017
Component predictor of Severe classification				
Tired	2.3	1.1	4.9	.035
Observed	2.1	1.0	4.3	.038
Pressure	2.2	1.0	4.6	.037
Age	5.0	1.6	15.4	.005
Components not predictive of OSA				
Snoring	2.5	0.8	7.8	.109
Neck Circumference	3.6	0.5	28.0	.225
BMI	3.6	0.5	28.0	.225

Table 2. Sensitivity and specificity of STOP-BANG to AHI

Predicted mild, moderate, or severe if STOP-BANG score is greater than or equal to	Sensitivity	1 - Specificity	Youden index
0	1.000	1.000	1.000
1	0.979	0.905	1.074
2	0.890	0.619	1.271
3	0.766	0.381	1.385
4	0.476	0.238	1.238
5	0.228	0.048	1.18
6	0.103	0.048	1.055
7	0.041	0.000	0.041
8	0.014	0.000	0.014

Table 3. Sensitivity and specificity of STOP-BANG to AHI with moderate and severe classification

Predicted moderate and severe if STOPBANG score is greater than or equal to	Sensitivity	1 - Specificity	Youden index
0	1.000	1.000	1.000
1	0.983	0.939	1.044
2	0.915	0.714	1.201
3	0.821	0.469	1.352
4	0.538	0.224	1.314
5	0.256	0.082	1.174
6	0.120	0.041	1.079
7	0.051	0.000	0.051
8	0.017	0.000	0.017

DISCUSSION

Our study showed that the combined score for all the components of STOP-BANG questionnaire in relationship to the AHI score resulted in a significant value under the curve (0.717). This suggests that a significant score in the STOP-BANG questionnaire is predictive of OSA which is consistent with the existing literature.[1,2,5,7] However, in our study, an increase in the total STOP-BANG score could not determine its severity which is in contrast to the results of Oshita *et al.*[1] and Waseem *et al.*,[5] where they were able to determine the severity of OSA as the total STOP-BANG score increases. Thus, in our setting, confirmation of the severity of OSA may still be best identified through polysomnography.

The sensitivity and specificity values for detection of OSA were 77% and 62%, respectively. The positive predictive value was calculated to be 93% at a cut-off STOP-BANG score of 3. For detecting moderate and severe OSA, the same cut-off of 3 presents with an acceptable sensitivity (82%) but low specificity (53%). This can suggest that it may be difficult to distinguish the severity of OSA for the population tested using the STOP-BANG score cut-off values alone. Comparing this to the existing meta-analysis of Hwang *et al.*,[5] the cut-off score was also 3 for predicting all OSA, with highest positive predictive value (86%). However, Hwang *et al.*[5] reported the cut-off score of 6 to be predictive of moderate and severe OSA which was 3 in our study. These differences in findings could be because their meta-analysis included a larger sample size comprised of different ethnicities such as Arabs, Black, Chinese, Indian, Malay, Caucasian and Japanese.

Amongst the components of STOP-BANG, the most frequent factors identified to be recurring in our study, regardless of OSA severity were: 1) experiencing being tired during the day; 2) observation of breath-holding while asleep; 3) elevated BMI; 4) advancing age; and 5) being male. The presence of snoring was not identified to be frequent among those who were confirmed to have OSA. Similarly, increased neck circumference was also not identified in our population to be a frequent factor in determining OSA. Unlike in the study of Oshita *et al.,* BMI, breath-holding, significant neck circumference and hypertension were all identified as significant.[1]

Additional findings in our study showed that the mean age of Filipino patients admitted for polysomnography is 35.6 ± 12 years old, which is younger compared to those included in the research of Hwang *et al.* (57.3 ± 15.2 years).[5] Similar to the previously cited studies, most of the patients tested were males. The BMI of the patients we tested were mostly obese with similar profile to the BMI of the patients of Hwang *et al.*[5]

Our study has several limitations stemming from the small sample size. The available data also came from only one institution which may limit the representability of the findings. In addition, other factors such as anthropometrics, anatomical, that may affect the AHI results were not documented and not included in the categorical data.

As a recommendation for future research, data from different institutions with available sleep centers in the Philippines can be utilized to increase the sample size. Equal distribution of participants in terms of age group and sex can also be considered. Improvement of documentation of patient profile, demographics, anthropometrics may also help in data analysis.

In conclusion, a STOP-BANG score of 3 can predict the presence of OSA among patients tested in the Rizal Medical Center. However, it has limitations in estimating the severity of the condition. To confirm the severity of OSA, polysomnography is still suggested.

REFERENCES

1. Oshita H, Ito N, Senoo M, Funaishi K, Mitama Y, Okusaki K. The STOP-Bang test is useful for predicting the severity of obstructive sleep apnea. *JMA J.* 2020 Oct 15;3(4):347-352. DOI: 10.31662/jmaj.2020-0002; PubMed PMID: 33225107; PubMed Central PMCID: PMC7676986.
2. Waseem R, Chan MTV, Wang CY, Seet E, Tam S, Loo SY, et al. Diagnostic performance of the STOP-Bang questionnaire as a screening tool for obstructive sleep apnea in different ethnic groups. *J Clin Sleep Med.* 2021 Mar 1;17(3):521–32. DOI: 10.5664/jcsm.8940; PubMed PMID: 33112227; PubMed Central PMCID: PMC7927338.
3. Delos Reyes VS, Ojascastro EB, Ceniza RB, Dizon RV Jr, Banzon AG, Jocson M, et al. Philippine clinical practice guidelines on the diagnosis and management of obstructive sleep apnea in adults [Internet]. 2016 Jun; Scribd; [cited 2023 Jul 29]. Available from: https://www.scribd.com/document/455355772/CPG-on-OSA.
4. Tan A, Yin JDC, Tan LWL, van Dam RM, Cheung YY, Lee CH. Predicting obstructive sleep apnea using the STOP-Bang questionnaire in the general population. *Sleep Med.* 2016 Nov-Dec:27-28:66-71. DOI: 10.1016/j.sleep.2016.06.034; PubMed PMID: 27938922.
5. Hwang M, Nagappa M, Guluzade N, Saripella A, Englesakis M, Chung F. Validation of the STOP-Bang questionnaire as a preoperative screening tool for obstructive sleep apnea: a systematic review and meta-analysis. *BMC Anesthesiol.* 2022 Nov 30;22(1):366. DOI: 10.1186/s12871-022-01912-1; PubMed PMID: 36451106; PubMed Central PMCID: PMC9710034.
6. Pivetta B, Chen L, Nagappa M, Saripella A, Waseem R, Englesakis M, Chung F. Use and performance of the STOP-Bang questionnaire for obstructive sleep apnea screening across geographic regions: a systematic review and meta-analysis. *JAMA Netw Open.* 2021 Mar 1;4(3):e211009. DOI:10.1001/jamanetworkopen.2021.1009; PubMed PMID: 33683333; PubMed Central PMCID: PMC7941199.
7. Isaac BTJ, Clarke SE, Islam MS, Samuel JT. Screening for obstructive sleep apnoea using the STOPBANG questionnaire and the Epworth sleepiness score in patients admitted on the unselected acute medical take in a UK hospital. *Clin Med (Lond).* 2017 Dec;17(6):499-503. DOI: 10.7861/clinmedicine.17-6-499; PubMed PMID: 29196349; PubMed Central PMCID: PMC6297704.