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Determining the risk of Obstructive Sleep Apnea (OSA) using STOP-BANG Questionnaire – An Observational Study

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Abstract

Background: Patients with diagnosis of obstructive sleep apnea (OSA) and those with undiagnosed OSA have greater chances for adverse dental effects. The early identification of OSA patients can help alleviate associated adverse dental effects. STOP-BANG questionnaire is an efficient, reliable and produce valid assessments in the diagnosis of OSA.

Aim: The aim of this study was to determine the risk of OSA using STOP-BANG questionnaire.

Materials and method: Patients who reported to the departmental OPD were screened regarding snoring and difficulty in breathing during sleep. Those who presented with the above clinical indications were distributed the STOP-BANG questionnaire. A total of 30 patients with OSA were selected after screening. Out of the total sample, 13patients were at high risk, 7 at intermediate risk and 10 at low risk of OSA.

Results: The overall mean age of the studied patients was 45.63±8.62years. 33.34% constituted of low risk, 23.33% of intermediate and 43.33% constituted of high risk OSA patients. The cutoff point of STOP-BANG questionnaire for the diagnosis of OSA patients in this study was 2.5 with the power of study being 80% and 95% confidence interval.

Conclusion: The results of this study support that a correlation exists between STOP-BANG score and the severity of OSA. The STOP-BANG score can be used to not only identify cases with any

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degree of OSA but also prioritize the ones who are more likely to have moderate to severe disease. Therefore STOP-BANG questionnaire should be considered as an optimal screening tool and that the score can be used for making more reasoned clinical decisions.

Keywords: Obstructive sleep apnea, OSA, Sleep apnea, STOP-BANG.

Introduction

Obstructive sleep apnea (OSA) is a condition characterized by recurrent and intermittent episodes of complete or partial upper airway obstruction during sleep, ultimately resulting in fragmented sleep and daytime sleepiness.(1) Majority cases of OSA are associated with the risk of developing by obesity, coronary artery disease, hypertension, and diabetes.(2) In cases of the surgical patients with OSA, medications given for sedation, administration of anesthesia, and pain control may increase the upper airway collapsibility by decreasing the muscle activity of the genioglossus which leads to worsening of OSA.(1) Since the prevalence rate of Obstructive sleep apnea(OSA)/Obstructive sleep apnea hypopnea syndrome (OSAHS) is high, it is recognized as a major health issue and serious condition.(3) Patients with OSA are at an increased risk for myocardial infarctions, strokes, and other associated outcomes leading to decreased quality of life.(4),(5)

Dentistry's role in sleep disorders is becoming progressively significant, especially in management of patients having just snoring problem and mild to moderate OSA. The dental clinician has the opportunity to evaluate and assist the patients at a variety of levels, beginning with the confirmation of a sleep-related disorder, referring the patients to another physician for evaluation, and assisting in the management of sleep disorders. The main predisposing factor for OSA is obesity. Craniofacial anomalies like retrognathia andmicrognathia may also predispose to OSA, in non-obese patients. OSA is diagnosed on the basis of the case history, physical examination and the investigations such as polysomnography, split-night testing, limited channel testing, and oximetry. The standard diagnostic aid in determining if a patient has OSA or not is nocturnal attended polysomnography, which requires an overnight stay in a sleep facility. The less invasive procedures are to be preferred to the more invasive options as far as the treatment is concerned. Behaviour modification would be the first and simplest treatment option, followed by the application of oral devices suitable to the patient, especially in the cases with mild to moderate OSA. For the patients with moderate to severe OSA, continuous positive airway pressure (CPAP) and surgical options are chosen.(6)

The gold standard for the diagnosis of OSA is considered Polysomnography (PSG), but its use is limited since it requires special sleep clinics/centers, expert technicians, and admission in sleep laboratory (mostly overnight), which is relatively expensive, and also the long waiting lists.(7) Most of the screening questionnaires regarding OSA and clinical screening models have been used for patients who suspected to suffer from OSA as a predictor screening tool before PSG. (8)
Chung et al. developed the STOP-BANG questionnaire in 2008.(9) It is a simple, applicable screening method which includes four subjective items [snoring, tiredness, observed apnea, and high blood pressure (STOP) and four demographics items body mass index, age, neck circumference, and gender (BANG)]. Depending on the population being studied and the diagnostic criteria used to define OSA, the prevalence rate differs. However, on an average the range OSA is

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2% to 26% in the general population, but with more than 80% of patients being undiagnosed.(10) It is estimated that nearly 80% of the males and 93% of females with moderate to severe sleep apnea are undiagnosed.(11)

The knowledge or clinical suspicion of the condition is the key to this process concerning OSA patients prior to the administration of any anesthetic, sedative, or narcotic agent. The diagnosis of OSA is the challenge. As previously stated, there is a high incidence of OSA in the general population, and it would be burdensome and cost-prohibitive attempting to screen all patients with polysomnography. In addition, there are problems with patient acceptance of treatment options such as losing weight or use of airway modalities, such as CPAP, and patients may also be reluctant to participate in a sleep study, ultimately leading them to be undiagnosed. Many different instruments/tools and processes have been documented to screen for OSA ranging from simple questionnaires to complex computer programs, over the time. 8 questionnaires, 18 regression models, neural networks, and algorithms were found by a recent meta-analysis that could be classified as clinical prediction tests for OSA.(12) However, the majority of these instruments and processes of the above mentioned were designed for use in asleep clinic and are usually not well suited for the busy environment such as the preoperative area in a hospital or dental clinic. Therefore, based on this an efficient screening instrument was required. An ideal screening instrument should be reliable, produce valid data for diagnosis, and also be easy to use. This could significantly alter the treatment plan for patients with OSA as well as decrease the probable risks for negative outcomes.

The purpose of this study was to determine the risk of obstructive sleep apnea (OSA) using STOP-BANG questionnaire.

Materials and Methods

Study setting:

The study was conducted in the Department of Prosthodontics, Nagpur from September 2019 to March 2020. Institutional ethical clearance was obtained before commencing the study. Patients who reported to the departmental OPD were screened for snoring and difficulty in breathing during sleep. A written informed consent was taken from the patients who presented with the above clinical indications. A total of 30 patients of the age group 18-60, suspected to suffer from OSA were selected after initial screening and STOP-BANG questionnaire was distributed to them. All patients in the study underwent thorough evaluation with emphasis on age, sex, occupation, and symptoms suggestive of OSA (excessive daytime sleepiness, nocturnal choking, snoring, witnessed apnea, etc.), OSA screening questionnaire (STOP-BANG questionnaire), and general examination with stress on BMI (kg/m^2) and neck circumference (cm) were performed.

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Name _____
Height _____ Weight _____
Age _____ Male / Female _____

STOP-BANG Sleep Apnea Questionnaire

Chung F et al Anesthesiology 2008 and BJA 2012

STOP		
Do you SNORE loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	No
Do you often feel TIRED, fatigued, or sleepy during daytime?	Yes	No
Has anyone OBSERVED you stop breathing during your sleep?	Yes	No
Do you have or are you being treated for high blood PRESSURE?	Yes	No

BANG		
BMI more than 35kg/m2?	Yes	No
AGE over 50 years old?	Yes	No
NECK circumference > 16 inches (40cm)?	Yes	No
GENDER: Male?	Yes	No

TOTAL SCORE		

High risk of OSA: Yes 5 - 8

Intermediate risk of OSA: Yes 3 - 4

Low risk of OSA: Yes 0 - 2

Figure 1: STOP-BANG questionnaire

The calculation of sample size was carried out based on the previous literature by Suliman in 2017(13) using Cochran Formula for sample size estimation:

$$n = \frac{Z_{\alpha/2}^2 * p * (1-p)}{E^2}$$

Where;

$Z_{\alpha/2}$ is the level of significance at 5% level of significance i.e. 95% Confidence interval = 1.96

P= Cut-off point of STOP-BANG questionnaire for the diagnosis of OSA patients = 2.5 = 0.025

E = Error of margin = 6% =0.06

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$$n = \frac{1.96^2 * 0.025*(1-0.025)}{0.06^2}$$

= 26.01 = 30 patients needed in the study

Study description:

The STOP-BANG questionnaire has a total of 8 items all scored by choosing either Yes or No. The first 4 items are from the STOP questionnaire (1. **S**-''Do you **snore** loudly [louder than talking or loud enough to be heard through closed doors]?'', 2. **T**-''Do you often feel **tired**, fatigued, or sleepy during the daytime?'', 3. **O**-''Has anyone **observed** you stop breathing during your sleep?'', and 4. **P**-''Do you have or are you being treated for high blood **pressure**?''). The final 4 items (the BANG portion) are based on 4 demographic items chosen from the STOP questionnaire (1. **B** -"**body** mass index >35 kg/m^2?", 2. **A** -"**age** over 50 years?", 3. **N** -"**neck** circumference >40 cm, and 4. **G** -"**gender**: male?").(9)

Scoring:

All 8 items have a mandatory choice of either Yes or No responses, and scores range from 0 to 8. A height chart, weighing scale and a measuring tape are required to determine the height, bodyweight and neck circumference of the patients. The instrument units of measure for body weight and neck circumference are metric but Imperial or US Standard units can easily be converted to metric."Yes" responses to 3 or more items indicate a high risk of OSA, and "Yes" responses to less than 3 items are a low risk of OSA. While being able to identify a high- and a low-risk category initially, instrument reliability testing assisted in identifying a middle range for OSA.

Reliability:

The desire to have an instrument that could be reliable when measuring smaller increments (not just AHIs >5) resulted in testing the STOP-BANG for a range of sensitivities. The STOP-BANG sensitivities ranged from 83.6% for AHI of greater than 5, 92.9% for AHI of greater than 15, and 100% for AHI of greater than 30. These test results indicate that the STOP-BANG is sensitive to identifying OSA over a range of AHIs, including patients with low, moderate, and severe OSA. Chung et al(9) directly attributed this gain in sensitivity to the addition of the body mass index, age older than 50 years, neck circumference of more than 40 cm, and gender (male) into the scoring scheme of yes/no responses.

Validity:

According to Chung et al (9), higher scores on the STOP-BANG were associated with the occurrence of postoperative complications. This indicates that STOP-BANG has some predictive properties. Validity testing in 2012 demonstrated that higher scores in the range of 7 to 8 on the STOP-BANG were indicative of moderate to severe OSA.(14) Among obese patients, STOP-BANG scores identified patients at risk for difficult airways to manage ($P < .001$).(15)

Statistical analysis:

Statistical analysis was performed by considering descriptive analytic measures such as frequency and percentage, using the statistical software SPSS 27.0 version.

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Results

The results show that the patients included in the study comprised of 2 patients (6.66%) in the age group of 21-30 years, 6 patients in (20%) in the age group of 31-40 years, 11 patients (36.67%) in the age group of 41-50 years and 11 patients (36.67%) in the age group of 51-60 years. The mean age of the study sample was 45.63±8.62.

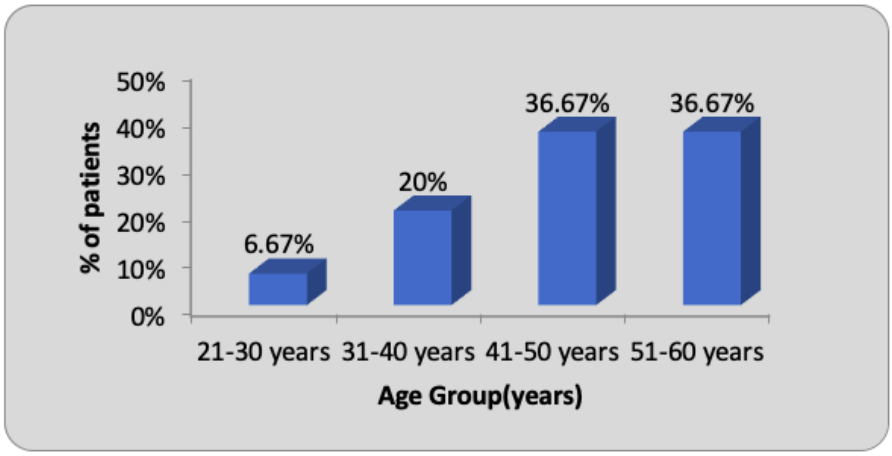

Figure 2: Age wise distribution of patients

All the patients included in the study i.e. 30 (100%) claimed to snore louder than talking or loud enough to be heard through closed doors. 16 patients (55.33%) stated that they often felt tired, fatigued or sleepy during day time, but 14 patients (46.67%) did not have such complaint.

SR. NO.	QUESTIONS	OPTIONS	FREQUENCY (N)	PERCENTAGE (%)
1	Do you SNORE loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	30	100
		No	0	0
2	Do you often feel TIRED, fatigued, or sleepy during daytime?	Yes	16	53.33
		No	14	46.67
3	Has anyone OBSERVED you stop breathing during your sleep?	Yes	6	20.00
		No	24	80.00
4	Do you have or are you being treated for high blood PRESSURE?	Yes	18	60.00
		No	12	40.00

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5	BMI more than 35kg/m^2?	Yes	2	6.67
		No	28	93.33
6	AGE over 50 years old?	Yes	11	36.67
		No	19	63.33
7	NECK circumference > 16 inches (40 cm)?	Yes	15	50.00
		No	15	50.00
8	GENDER: Male?	Yes	13	43.33
		No	17	56.67

Table 1: Masterchart

20% i.e. 6 patients have claimed that other people have observed them stop breathing in their sleep, meanwhile 24 patients (80%) denied this. Out of the total sample size, 18 patients (60%) were being treated for high blood pressure, the rest 12 patients (40%) were not. Only 2 patients (6.67%) had BMI more than 35kg/m^2, and 28 patient's (93.33%) BMI was less. 36.67% patients comprised of the age over 50 years, and the rest 63.33% were less than that. Neck circumference was greater than 16 inches (40cm) in half of the total sample size i.e. 15 patients (50%) and it was smaller than that in the other 50% cases. This study comprised of 13 male patients (43.33%) and 17 female patients (56.67%).

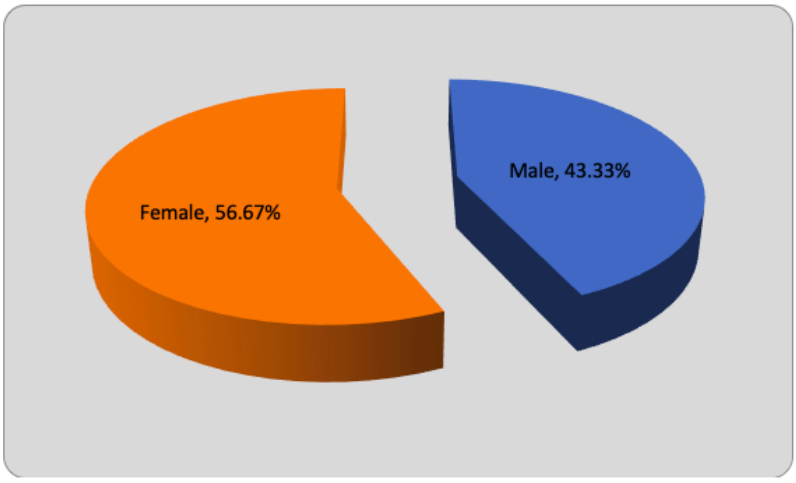

Figure 3: Gender wise distribution of patients

Finally, according to the results obtained, 10 patients (33.34%) were of low risk, 7 patients (23.33%) were of intermediate risk and 13 (43.33%) were of high risk OSA.

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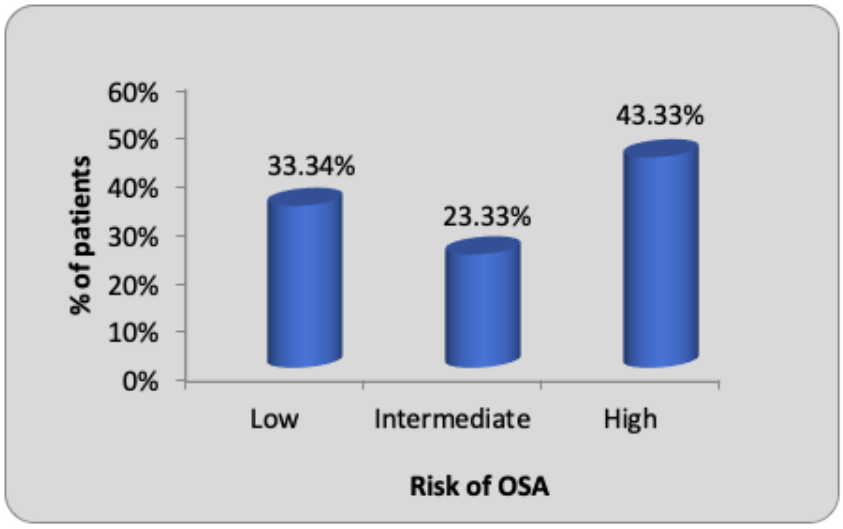

Figure 4: Distribution of patients according to risk of OSA

Discussion

With the increased risk of diseases such as hypertension, diabetes, obesity and coronary artery disease it is necessary to screen and diagnose the patients for obstructive sleep apnea (OSA). Many of such patients remain undiagnosed regarding OSA which can hamper the extent of treatment provided to the patients as well as its outcome. The STOP-BANG questionnaire was designed with an ease of understanding and developed for screening the patients prior to a clinical procedure, for the presence of OSA. Previously used screening methods were tedious to apply, difficult to score, and comparatively time consuming. STOP-BANG has been demonstrated to be reliable and efficient tool, producing valid assessments in the pre-treatment population to screen for OSA which is previously undiagnosed.(9) Therefore, with this foundation the STOP-BANG questionnaire was used to determine the risk of OSA.

In this study it was observed that all 30 participants had a snoring problem. The authors of a study stated that they may have observed a higher snoring rate is that studies focusing on snoring conducted detailed interviews with precise criteria for snoring, whereas this study used simple self-reporting on the STOP-BANG questionnaire.(16) The probable reason for this can be attributed to the constriction in airway space of the patients in supine positions.

53.33% patients claimed to be tired, fatigued or feeling sleepy during daytime, however almost equal number of patients (46.67%) did not face any such problem. The reason for this can be attributed to fragmented sleep caused due to intermittent and recurrent episodes of partial or complete airway obstruction during sleep.(1) When the patients were questioned if anyone had observed them stop breathing during sleep, majority of the patients (80%) denied and only 20% said yes. This can be attributed to the severity of airway obstruction varying in each patient.

Out of the total sample, 60% of the patients agreed on being treated for high blood pressure and 40% did not. It is of prime importance since the combination of comorbid diseases and sensitivity to medications used for its management creates a particular hazard of worsening the obstruction and resulting apnea.(17) This is in accordance with a study done by Chung et al where the author

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claimed that the patients classified by the STOP questionnaire as being at high risk of having OSA had a significantly higher frequency of hypertension and gastroesophageal reflux disease.(9)

Maximum patients (93.33%) in this study had a BMI less than 35kg/m^2, and the rest had BMI greater than that. However, a study by Doshi and associates contradicts this outcome, 70 % patients were obese with a BMI of 30 or higher.(18) This aspect needs to be known since obesity may lead to early disability and loss of job in majority of subjects because of OSA and associated complications like diabetes and coronary artery disease.(19)

63.33% of patients in the present study were above the age of 50 years, and 36.67% patients were below it with a mean age of 45.63±8.62 which is almost similar to study conducted by Doshi and associated, where it was 50±14.(18) Half of the total sample size i.e. 50% patients had neck circumference greater than 16 inches (40 cm) and in another 50% patients it was less than that. When incorporating BMI, age, neck circumference, and gender (BANG) into the STOP model (STOP-BANG), it is claimed to reach a very high level of sensitivity, especially in cases of intermediate and high risk OSA patients. Therefore, if a patient is scored as low risk of OSA by the STOP-BANG questionnaire, it would have a high confidence in order to exclude the possibility of the patient having intermediate to high risk OSA.(9)

The studied group of patients comprised of 56.67% females and 43.33% males. This suggests that risk of OSA was seen more in the females as compared to males. This is in accordance with some studies where the pertinent finding was that women who answered yes to the snoring question were more likely to have OSA which was with reference to previous studies that have identified a positive association with snoring and sleep-disordered breathing in pregnancy.(20),(21) However, in one study this was contradictory since 92% of the total sample comprised of males and the rest females.(18)

The difference between results of different studies maybe due to the different number of cases and variable selection of patients, the target population in different studies to evaluate sleep questionnaires were either ‘patients with sleep disorders’(22) or ‘patients without sleep disorders’(23).

Distribution of the patients in this study according to the risk of OSA was 33.34% for low risk, 22.33% for intermediate risk and 44.33% for high risk. These results are in accordance with the results of a study by Chung et al where the authors found that out of the total sample size of 68.9% where found to have OSA, which on further determination of risk were of 29.4% low risk, 17.5% intermediate risk and 22.0% high risk OSA.(9) Presence of even a single positive clinical finding out of all the 8 STOP-BANG questionnaire options is suggestive of OSA.

Limitations

There are certain limitations which were identified during the course of this study. In this study, the target population comprised patients with symptoms suggestive of OSA which may lead to bias when different questionnaires are evaluated to identify patients at risk for OSA resulting in marked increase in the sensitivity and specificity of the questionnaires. There also was no comparison group

to evaluate outcomes in terms of demographics. Based on the results of this study, an interventional study can be conducted in near future with a larger sample size, where the patients can be treated for OSA by fabricating oral appliances such as the mandibular advancement appliance (MAA) and tongue retaining device (TRD) with respect to their risk category for the condition.

Conclusion

Understanding the need of the human body for airway maintenance and the negative effects of sleep related breathing disorders provides the general clinician as well as a specialist with a more complete perspective in almost all aspects of general dentistry. General dentists play a key role to screen for these disorders and make the appropriate referrals. This helps to bridge the gap between medicine and dentistry and provides a higher level of care for the patients. The STOP-BANG questionnaire is an effective, easy to use and reliable tool which provides early identification of patients with the risk of OSA before undergoing a clinical procedure. Early identification grants extra time for the physician to make appropriate alterations in the treatment plan and also ensure that every patient receives appropriate patient-specific care with respect to their condition.

Conflict of interest

The authors declare that they have no known competing financial interests that could have appeared to influence the work reported in this paper.

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