



Sleep apnea screening through a news portal using the STOP-bang questionnaire

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Abstract

Purpose Obstructive sleep apnea (OSA) affects up to 936 million adults globally and is linked to significant health risks, including neurocognitive impairment, cardiovascular diseases, and metabolic conditions. Despite its prevalence, OSA remains largely underdiagnosed. This study aimed to enhance OSA awareness and risk assessment using the STOP-Bang questionnaire in a telemedicine format.

Methods During a six-week campaign on a popular Latin American news portal, 5,966 adults completed the STOP-Bang questionnaire. Participants reporting moderate or severe OSA risk were advised to seek clinical evaluation.

Results Among respondents, 44.7% were identified as having a moderate-to-high risk for OSA. Key risk factors included snoring, witnessed apneas, hypertension, male gender, older age, high BMI, and larger neck circumference. Statistical analyses showed significant associations between these variables and OSA risk.

Conclusions This study highlights the importance of increasing OSA visibility and early detection in the general population. Despite limitations such as selection bias and potential false negatives/positives with the STOP-Bang tool, the findings demonstrate the potential of media campaigns to raise awareness and prompt early medical consultation. Future efforts should include follow-up assessments to evaluate healthcare-seeking behavior and confirm OSA diagnoses, contributing to improved public health outcomes.

Keywords Obstructive sleep apnea · STOP-Bang questionnaire · Telemedicine · Public health · Awareness · Risk assessment

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Introduction

Obstructive sleep apnea (OSA) is prevalent across various severities in up to 50% in the general population, affecting up to 936 million adults aged 30 to 69 years old [1–3]. OSA poses clinical challenges, including neurocognitive impairment, with deficits in verbal memory, and attention reported across different cultures and age groups [4–7].

Additionally, OSA correlates with an elevated risk of cardiovascular diseases such as hypertension, where up to 80% of patients have OSA, and cardiac arrhythmias, largely attributed to heightened nocturnal blood pressure levels [8–11], as well as metabolic conditions such as type 2 diabetes and obesity [9, 12]. Moreover, OSA not only affects those diagnosed but also poses a public safety risk, as individuals with OSA are more likely to be involved in car accidents due to impaired alertness and reaction times [13, 14]. Despite its high prevalence, OSA’s occurrence varies depending on factors such as sex and age. Men exhibit

a higher OSA prevalence compared to women, with studies indicating an approximately 10% difference across age groups, potentially influenced by underdiagnosis in women [15–17]. Age is another significant factor, with individuals over 40 at increased risk, and prevalence peaking in those over 60, with up to 90% in males and 78% in females [3].

However, reported prevalence statistics do not reflect the actual number of patients diagnosed and treated for OSA. The high percentage of undiagnosed cases, estimated between 80% and 90%, leads to unpredictable epidemiology and substantial financial burdens (USD 150 billion) [18, 19]. These increases in costs have led to some insurance companies in the US applying cost-cutting measures for OSA treatment such as pre-authorization policies, which can lead to delayed treatment, reduced access to care, and increased costs to the individual patient [20]. Overall, the underdiagnosis of OSA underscores the need for improved visibility in the community and among primary care physicians to facilitate early detection [21, 22].

The current study aims to give public visibility to an underdiagnosed disease and address OSA diagnosis challenge, by using the STOP-bang questionnaire in a telemedicine format. The STOP-bang is standardized, self-administered, and easy to respond to questionnaire [23, 24]. The STOP-Bang was featured on a widely circulated Latin American news portal for several weeks. This news portal has a large outreach, reporting 138 M daily visits from Spanish speaking readers (<https://mediakit.infobae.com/audiencia/>). The initiative will enable the assessment of OSA risk within the general population while enhancing awareness and understanding of OSA.

Methods

Participants

During a six-week campaign, a series of videos covering the clinical symptoms and impact of OSA, such as its impact on cardiovascular morbidity, and road accidents were published on the Infobae news portal along with a weekly article covering more details of OSA. The readers were given a QR code and a link to complete the STOP bang questionnaire. The following provides an example: <https://www.infobae.com/salud/2023/04/07/le-cuesta-concentrarse-o-se-duerme-mientras-realiza-algunas-actividades-participe-de-la-primera-encuesta-sobre-calidad-del-sueno-en-america-latina/>. The questionnaire was in Spanish, and responses were only included for those over 18 years old. Respondents who were at moderate or severe OSA risk were contacted immediately to seek advice from their clinicians for further evaluation.

STOP-bang data collection

In total, 5,966 participants provided responses to the STOP bang questionnaire and were included in the study. Within the questionnaire, a set of yes/no questions are asked, all through self-report: Do you snore loudly, are you tired or fatigued during the day, do you choke or gasp during sleep, do you have hypertension, are you over 50, is your neck circumference over 43 cm for men and 41 cm among females, is your gender male, and is your BMI over 35. Each yes response generates a point (except for the question of gender, where being a male adds one point). The total score is between 0 and 8; with a final score up to 2 being low-risk of OSA, 3 and 4 being mid-risk, and 5 and above being high risk. Age and BMI (calculated from the participants weight and height) are also recorded separately in the questionnaire for separate analyses.

Statistical analysis

The 8 variables measured in the yes/no questions of the STOP-bang questionnaire are categorical and were therefore statistically compared to the participants' overall OSA risk-group (either low or high-middle risk) with a Chi-squared test, together with odds.

ratio calculations (Table 1). The continuous variables of age and BMI were compared to OSA risk-group with 2-sample t-tests.

Ethical approval

The Ethical Committee of the Zonal Hospital of Trelew, Chubut, Argentina, granted approval for the study in accordance with internationally accepted ethical standards, including the Council for International Organizations of Medical Sciences (CIOMS), the Declaration of Helsinki, and the World Medical Association's guidelines.

Patent

The intellectual property rights for the study include the authorization from the University Health Network, Toronto, Ontario, Canada to use the STOP-Bang questionnaire for academic research / non-commercial use for sleep apnea assessment, "as detailed in United States Provisional Patent Application No. 61/974,319, titled "SYSTEM AND METHOD FOR SLEEP APNEA ASSESSMENT," with a priority date of April 2, 2014.

Table 1 Categorical variables associated with OSA risk

Variable	Low risk N=3297		High- middle risk N=2669		Total N=5966		OR	CI 95%		p
	n	%	n	%	n	%		low	high	
Snoring	379	11.5	1,817	68.1	2,196	36.8	16.4	14.4	18.8	<0.001
Tiredness	1790	54.3	2,040	76.4	3,830	64.2	2.7	2.4	3.1	<0.001
Apnea	168	5.1	1,149	43	1,317	22.1	14.1	11.9	16.8	<0.001
Hypertension	152	4.6	1,128	42.3	1,280	21.5	15.1	12.7	18.2	<0.001
Over 50 years old	505	15.3	1,368	51.3	1,873	31.4	5.8	5.1	6.6	<0.001
Neck >43 cm (male)/ >41 cm (female)	192	5.8	1,137	42.6	1,329	22.3	12	10.2	14.2	<0.001
Male gender	1181	35.8	2,078	77.9	3,259	54.6	6.3	5.6	7.1	<0.001
BMI >35	88	2.7	480	18	568	9.5	8	6.4	10.1	<0.001

Table 2 Continuous variables associated with OSA risk

Variable	Low risk N=3297		High- middle risk N=2669		Total N=5966		T	p
	mean	SD	mean	SD	mean	SD		
Age	40.5	10.9	50.2	11.9	44.9	12.3	32,5	<0.001
BMI	25.4	4.4	30	5.6	27.5	5.5	35	<0.001

Results

Categorical data

All 8 variables measured in the STOP-Bang questionnaire were significantly associated with OSA risk, meaning that there was a significant difference in prevalence of all variables measured in the low and high-middle risk OSA risk groups. The differences in prevalence ranged from a 15.3% difference in BMI (2.7% in low-risk vs. 18.0% in high- mid-risk) up to a 55.6% difference in snoring prevalence (11.5% in low-risk vs. 68.1% in high-mid risk). Examining the odds ratios, with all ratios above 1, and all confidence.

ratios in ranges above 1, suggesting that in all 8 variables, a “yes” answer means a significantly higher chance of being at a high-to-mid risk of developing OSA. Odds of being in the mid-to-high OSA category were highest in the presence of snoring (odds ratio of 16.4) and closest to the chance score of 1, but still high, in the variable of tiredness (odds ratio of 2.7) (Table 1).

Continuous data

In total, from the 5,966 STOP bang responses collected, with 3297 of those participants were classified as low-risk (a score up to 2 out of 8), and 2,669 as mid-to-high-risk (a score of 3 and above, making 55.3% of respondents at a low-risk of OSA, and 44.7% at a mid-to-high risk (Table 2).

Overall, the average participant age and BMI were 44.9 years old and 27.5 respectively. T tests showed that both age and BMI as raw reported numbers were significantly associated with OSA risk. Both lower ages and BMIs (40.5

years old and BMI of 25.4) were seen in the low-risk OSA group, compared to higher ages and BMIs (50.2 years old and BMI of 30).

Discussion

The study aimed to expand the visibility, evaluate the risk, and assess the characteristics of OSA in Spanish-speaking adults. Using the STOP-Bang questionnaire, advertised in a popularly read news portal, provided the potential of a large outreach and participation from the general population. The study included a large sample size of over 5000 respondents, well balanced between male and female participants (54.6% male, 46.4% female), and used a news portal as a sampling method, advertising the STOP-bang survey. The findings displayed that almost half of respondents (45%) had a moderate to high risk of OSA. Participants were more likely to have a moderate/high OSA risk when reporting the following: tiredness, being over 50 years of age, male gender, and a BMI over 35 kg/m². They were highly likely to have a moderate/high OSA risk when reporting: snoring, witnessed apneas, hypertension, and a neck circumference over 43 cm for males, and over 41 cm for females.

Several findings in the current study align with existing population-based literature on OSA. Firstly, the higher probability of men, advanced age, high BMI, and those with hypertension being diagnosed with OSA has been previously displayed [3, 15, 17, 25, 26]. Larger neck circumference, independent to but heavily correlated with high BMI, has been linked to OSA in previous literature and was also supported in the current study [27–29]. However, despite the STOP-BANG questionnaire being a highly sensitive

screening tool for predicting OSA risk (93% sensitivity for Apnea-Hypopnea Index > 15, with a cut-off score of 3 indicating low risk and not requiring a sleep analysis), and its use across over 40 geographic regions among medical professionals and researchers [23, 30–33], there is a gap in the literature regarding its outreach and application in the general population in non-clinical settings, such as its advertisement in a news portal, which to our knowledge has never been done before. This becomes more apparent considering our findings, where respondents in the general population were at 33% severe risk and 45% moderate-to-severe risk of OSA, compared to a study in those being treated with preexisting sleep disorders who displayed 39% severe risk and 58% for moderate-to-severe risk [34]. This comparable prevalence in OSA risk between patients in sleep clinics and the general population suggests that the current accepted prevalence of up to 38% is an underestimation [3, 19]. Therefore, the current study demonstrates a higher level of OSA risk in healthy participants in comparison to the currently accepted rates, reinforcing the value of advertising questionnaires in a news portal or other form of advertisement that is viewed by the general population. The STOP-BANG questionnaire is used in the current study to assess OSA risk. It must be noted that this is an indirect measure but has been found to be a highly sensitive and specific indicator of OSA in the general population, across a range of geographic and linguistic modalities, displaying high levels of validity [24, 30–32, 34, 35].

The current study exposes the problem of OSA underdiagnosis in the general population. A possible mechanism in improving this underdiagnosis is increasing awareness [21, 22]. Efforts are being made to integrate technology such as smartphone apps to screen for OSA, which will make knowledge of OSA more accessible [36]. In the case of the current study, by using a sampling technique through a commonly read news portal, various benefits were achieved; increased public awareness, community engagement of what is OSA, and a subsequently representative database of questionnaire answers representative of the general, news-consuming public.

Furthermore, as part of the current studies methodology, questionnaire responses that indicated a moderate or severe OSA risk triggered an instant recommendation to the participant to seek medical advice regarding a possible potential OSA diagnosis. This aspect of the study meant that there was potential for an early intervention in OSA diagnosis, something considered vital in the improvement of OSA medical care in both clinical groups and the general population [37–40]. Overall, this early intervention can lead to physicians having more data available to increase the efficiency of OSA diagnosis. However, it should be noted that the current study does not include data on whether those deemed moderate

to high risk of OSA followed the recommendation given to them, making a follow-up study, through a questionnaire via email to the at-risk groups, an important future direction of this research.

There are some limitations of the current study. Firstly, as non-random sampling was used, there is the possibility of selection bias, limited to those who read the news portal where the study was advertised, with the online modality potentially leading to an exclusion of older adults and those of a lower socio-economic status, due to lack of internet access. Secondly, despite the validity and credibility of the STOP-bang questionnaire [24, 34], its clinical value has been described as limited, with the risk of high false negatives and false positives, possibly due to the self-report nature of the STOP-BANG questionnaire, specifically in non-clinical settings [41, 42]. Future studies could build on questionnaire results from subjects recruited within a given community, with a clinical OSA diagnosis through polysomnography or home sleep testing. This would clinically validate the OSA prevalence found in our study, and lead to the drawing of definitive conclusions of the true OSA prevalence. Furthermore, our study included over 3000 participants who were considered low-risk and did not receive a follow-up recommendation, however, with their average age at 40.5 years, compared to the 50.2 years of the high and middle risk group, future work could follow their progress as their risk of OSA increases.

In conclusion, our large-scale study aimed to enhance awareness of obstructive sleep apnea (OSA) has revealed compelling insights. Nearly half of the surveyed participants demonstrated a moderate-to-high risk of OSA, underscoring the pervasive nature of this condition. Key factors contributing to OSA risk within our sample included snoring, witnessed apneas, hypertension, and a neck circumference exceeding 43 cm in males and 41 cm in females. These findings emphasize the urgency of addressing OSA, given its potential impact on public health. Moving forward, our next steps involve conducting follow-up assessments with participants identified as having a moderate-to-high risk of OSA. Through these follow-ups, we aim to discern whether individuals sought consultation with sleep physicians or primary care physicians to confirm an OSA diagnosis, providing valuable insights into the healthcare-seeking behavior related to OSA risk in our population. This study contributes to the broader endeavor of advancing awareness and understanding of OSA, paving the way for targeted interventions and improved healthcare outcomes.

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Data availability The data that support the findings of this study are not openly available due to reasons of sensitivity, including data privacy. However, these data are available from the corresponding author upon reasonable request, subject to appropriate confidentiality agreements.

Declarations

Ethics approval and consent to participate The Ethical Committee of the Zonal Hospital of Trelew, Chubut, Argentina, granted approval for the study in accordance with internationally accepted ethical standards, including the Council for International Organizations of Medical Sciences (CIOMS), the Declaration of Helsinki, and the World Medical Association's guidelines.

Competing interests The authors declare that they have no conflicts of interest.

Patient consent This study did not require formal informed consent, as it was conducted via a news portal. No personally identifiable information was collected, and participants were not required to provide identifying details. Providing an email address was optional. Participation was voluntary, and all data shared was anonymized to ensure privacy. No images or sensitive information that could identify participants were used.

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