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VALIDATION OF THE SLOVENE VERSION OF THE STOP-BANG QUESTIONNAIRE IN A PRIMARY PRACTICE SETTING

VALIDACIJA SLOVENSKE RAZLIČICE VPRAŠALNIKA STOP-BANG ZA UPORABO V AMBULANTAH NA PRIMARNEM NIVOJU ZDRAVSTVENEGA VARSTVA

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ABSTRACT

Aim: The aim of our study was to validate the Slovene translation of the STOP-BANG (SBQ) questionnaire for use in the primary practice setting.

Methods: We recruited 158 randomly selected visitors at four primary practice clinics who came to the practice for any reason. Participants completed the Slovene SBQ and underwent type 3 respiratory polygraphy, which was analysed by an experienced somnologist. The SBQ was previously translated in to Slovene and validated for the sleep clinic.

Results: Of 158 participants, 153 had valid recordings. The mean age of the participants was 49.5 years (±13.0 years), and 47.7% were male. OSA was identified in 49.0% of the participants. The questionnaire, with a cutoff of ≥3, demonstrated an area under the curve of 0.823 for any OSA (REI≥5), 0.819 for moderate and severe OSA (REI≥15) and 0.847 for severe OSA (REI≥30). Sensitivity was 65.3%, 81.8%, and 90.0%, and specificity was 87.2%, 73.3% and 65.0% for any, moderate to severe and severe OSA, respectively.

Conclusions: The Slovene translation of the SBQ is a reliable instrument for OSA risk stratification in the primary practice setting.

Keywords:
Family medicine
Obstructive sleep apnea
Primary practice setting
STOP-BANG questionnaire
Validation

IZVLEČEK

Namen: *Namen naše študije je bil preveriti veljavnost slovenskega prevoda vprašalnika STOP-BANG (SBQ) za uporabo v ambulantah na primarni ravni zdravstvenega varstva.*

Metode: *Naključno smo izbrali 158 obiskovalcev v štirih ambulantah družinske medicine, ki so tja prišli iz kateregakoli razloga. Udeleženci so izpolnili slovensko različico SBQ in doma opravili respiratorno poligrafijo tipa 3, katero je analiziral izkušen somnolog. SBQ je bil v Slovenščino že preveden in validiran za uporabo v laboratorijih za motnje spanja.*

Rezultati: *Od 158 udeležencev jih je 153 imelo veljavne posnetke. Povprečna starost preiskovancev je bila 49,5 leta (± 13,0 leta); 47,7 % jih je bilo moških. OSA je bila identificirana pri 49,0 % preiskovancev. Vprašalnik z mejno vrednostjo ≥ 3 je pokazal površino pod krivuljo 0,823 za katerokoli OSA (REI ≥ 5), 0,819 za zmerno in hudo OSA (REI ≥ 15) in 0,847 za hudo OSA (REI ≥ 30). Občutljivost je bila 65,3 %, 81,8 % in 90,0 %, specifičnost pa 87,2 %, 73,3 % in 65,0 % za katerokoli, zmerno do hudo in hudo OSA odnosno.*

Zaključek: *Slovenski prevod vprašalnika STOP-BANG je zanesljivo orodje za stratifikacijo tveganja za OSA na primarnem nivoju zdravstvenega varstva.*

Ključne besede:
družinska medicina
obstruktivna apneja v spanju
primarno zdravstveno varstvo
vprašalnik STOP-BANG
validacija

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1 INTRODUCTION

Obstructive sleep apnea (OSA) is the most common sleep related respiratory disorder (1) and a standalone risk factor for various clinical conditions, such as hypertension, stroke, depression and diabetes (2). Furthermore, OSA constitutes a notable contributor to motor vehicle accidents (1). It is linked to a rise in overall mortality rates, especially attributed to coronary artery disease (1, 3).

In order to establish a diagnosis, a sleep study is required. There are several types of sleep study available, and the gold standard is a traditional laboratory type 1 polysomnography (PSG). Increasingly, however, home-based type 3 polygraphy (PG) is being used as it is easier to perform, cheaper, and more mobile (4, 5). The various types of sleep studies are listed in Table 1.

The result of such a study is expressed by the apnea-hypopnea index (AHI) for PSG and respiratory event index (REI) for PG, which indicate the average number of apneas and hypopneas per hour of sleep or bedrest, respectively (6). Based on the number of these events, OSA is categorised as mild (5≤AHI/REI<15), moderate (15≤AHI/REI<30) and severe (AHI/REI≥30) (7).

Estimates suggest that nearly 1 billion adults aged 30–69 years worldwide could have OSA (8). Roughly 80% of individuals experiencing moderate-to-severe OSA are believed to remain undiagnosed (7).

Sleep studies are time consuming, labour intensive, and can be costly (9, 10). For this purpose several risk stratification questionnaires have been developed in order to assess the pretest probability of OSA (5). Such screening methods have become important, especially in primary care (11).

The STOP-BANG questionnaire (SBQ) was developed as a preoperative screening tool for OSA (12). Due to its practicality and high sensitivity, the SBQ has been validated in surgical and sleep clinic settings worldwide. However, its validity has been explored to a much lesser extent in the general population and in primary care settings (13-15).

We have previously published the details pertaining to the translation, adaptation, test-retest reliability, and internal consistency as well as the validation of the Slovene SBQ in a sleep laboratory setting (16).

The aim of the current study was to validate the Slovene version of the SBQ in a primary practice setting.

2 METHODS

2.1 Study design and setting

We conducted a cross-sectional study which took place in four family medicine practices in Slovenia.

Primary practice physicians (specialists in family medicine) recruited patients by using a randomisation protocol. This protocol was based on randomly generated numbers and would select one out of the first ten patients to visit the practice on a given day. If the doctor wished, he or she could invite additional consecutive patients on the same day.

Table 1. Types of sleep studies.

	Type 1 PSG	Type 2 PSG	Type 3 PG	PG Type 4 PG
Location				
At home	-	✓	✓	✓
Sleep disorder laboratory (sleep lab)	✓	-	-	-
Under real-time technician supervision	✓	-	-	-
Channels				
Chest movement	✓	✓	✓	-
Snoring	✓	✓	✓	-
Airflow	✓	✓	✓	-
Arterial blood oxygen saturation	✓	✓	✓	✓
Heart rate	✓	✓	✓	✓
Electroencephalography	✓	✓	-	-
Electromyography	✓	✓	-	-
Electrooculography	✓	✓	-	-
Electrocardiography	✓	✓	-	-

Legend: PSG = polysomnography, PG = polygraphy
Adapted from: Patil SP. What every clinician should know about polysomnography. Respir Care. 2010;55(9):1179–1195.

Primary practice physicians briefly introduced OSA and the study to their randomly selected patients, taking care to inform them of the potential impact of an OSA diagnosis, especially its more severe forms, on their ability to drive safely. They also emphasised that OSA treatment could affect this. After the initial verbal presentation, patients were given a comprehensive written explanation of the purpose of the study, the protocol and the risks involved. Candidates were encouraged to ask additional questions before giving their informed consent and were reassured that they could choose to discontinue their participation in the study at any time without the need for further procedures or giving any reasons for discontinuation.

2.2 Participants

The participating physicians invited randomly selected adult patients who had visited their practice for any reason.

Participants had to be between 18 and 70 years of age at recruitment. Exclusion criteria were pre-existing sleep-disordered breathing, regular use of sedatives, tranquilizers or opioids (including tramadol), heart failure, neuromuscular disease, psychiatric disorders, severe COPD (stage D), use of psychoactive substances or excessive alcohol consumption.

2.3 Data collection

The inclusion of patients in each primary practice took place between August 1, 2018, and August 1, 2022.

A registered nurse employed in each primary practice setting facilitated communication with the participating candidates and scheduled their appointments. Upon arrival, patients completed a simple questionnaire asking them their age and gender and rechecking the inclusion and exclusion criteria, and then completed the Slovenian version of the SBQ. Each affirmative answer to the eight SBQ questions yielded a score of one, giving the SBQ score a range from zero to eight. The nurse then gave detailed instructions on how to use the device correctly, including a test dawn of the PG device, and a simple diagram of the process was also given to the participant for future reference. All candidates underwent at home ambulatory type 3 polygraphy, putting the equipment on themselves later that evening.

PG recordings were made using the Alice NightOne (Phillips Respironics, Murrysville, Pennsylvania, USA), a type 3 PG, which has an effort belt, cannula, oximeter, and a built-in body position sensor with microphone providing seven channels of data (body position, pressure flow, snoring, respiratory effort, blood oxygen saturation, plethysmography and pulse rate).

Manual scoring of all PG recordings was performed by a European accredited somnologist and neurologist at the University Hospital of Ljubljana, who was blinded to the SBQ scores. Based on the REI, OSA was categorised as mild (5≤REI<15), moderate (15≤REI<30) or severe (REI≥30). Recordings of less than 3 hours were considered insufficient. The evaluation was conducted in accordance with the current standards of the American Academy of Sleep Medicine (AASM) (17, 18).

A total of 158 patients were included. Fifteen had technically unsuitable PG recordings due to issues such as dislocation of nasal cannula, pulse oximeter malfunction and missing or short recordings. In nine cases, the recording was repeated. Six patients declined to repeat the recordings. The final analysis included 153 patients with a mean age of 49.5 years (±13.0 years), of whom 73 (47.7%) were male.

2.4 Statistical analysis

The patients' characteristics were presented with the mean (standard deviation) in the case of normally distributed numerical variables, median (interquartile range) in the case of non-normally distributed numerical variables, and frequencies (%) in the case of categorical variables. The correlation between SBQ and REI was assessed using Pearson's correlation coefficient (r). To assess the predictive validity of the SBQ, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for different REI cutoff values. We conducted an analysis of the receiver operating characteristics (ROC) and utilised Youden's index, which provided the optimal threshold value based on the longest vertical distance from the diagonal line to the ROC curve (or the point on the curve closest to the upper-left corner).

Statistical analysis was conducted using SPSS version 15.0 (SPSS Inc., Chicago, Illinois, USA), and JASP version 0.16.4 (Jasp Team, University of Amsterdam, Netherlands).

2.5 Ethical approval

Ethical approval to conduct the study was obtained from the National Medical Ethics Committee of the Republic of Slovenia (NMEC), No. 0120-80/2018/7.

3 RESULTS

A total of 153 participants were included, of whom 75 (49.0%) were diagnosed with OSA based on a manual REI≥5. The detailed classification into OSA severity levels and descriptive statistics of the sample are provided in Table 2.

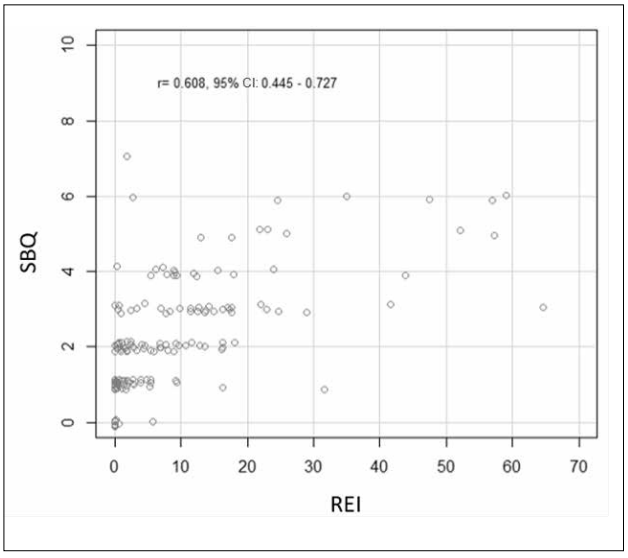
Table 2. Descriptive statistics of the primary screening sample for OSA in a primary practice setting.

	ALL	Non-OSA (REI 0-4.9)	Mild (REI 5-14.9)	Moderate (REI 15-29.9)	Severe REI≥30
N	153	78 (51%)	42 (27.5%)	23 (15%)	10 (6.5%)
age (years)	49.7±13.1	43.6 (±12.9)	55 (±11.7)	58.5 (±7)	54.1 (±7.6)
sex (m)	73 (47.7%)	30 (38.5%)	21 (50%)	13 (56.5%)	9 (90%)
BMI (kg/m²)	28.0±4.9	26.1 (±4.1)	29.1 (±4.9)	30.6 (±4.4)	33 (±5.4)

Legend: BMI = body mass index; OSA = obstructive sleep apnea; REI = respiratory event index; N = number of participants

The correlation between the SBQ and manual REI, as assessed by the Pearson correlation coefficient, was significant (p<0.00), and the details are presented in Figure 1.

The sensitivity, specificity, positive (PPV) and negative predictive values (NPV) at different SBQ cutoff values and for different severities of OSA are given in Table 3.



Legend: REI = respiratory event index; SBQ = STOP-BANG questionnaire

Figure 1. Scatterplot of manual REI against the Slovene SBQ in a primary practice setting.

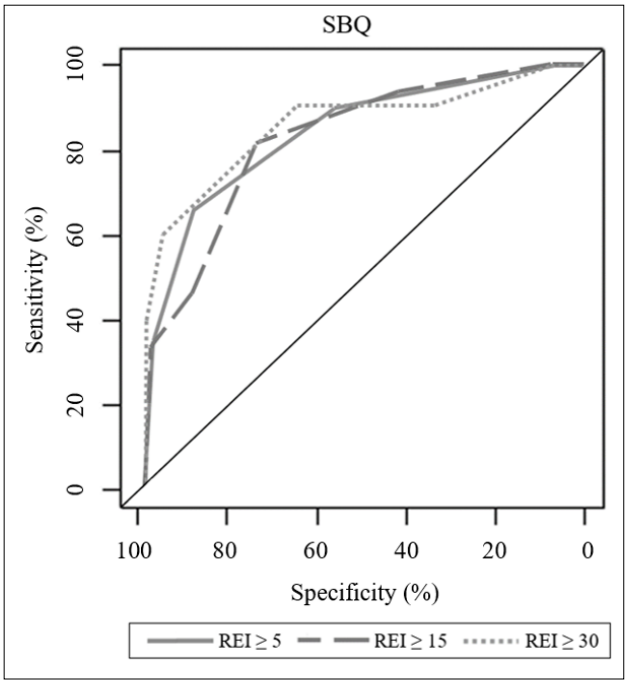
Table 3. Diagnostic characteristics of the Slovene SBQ in a primary practice setting at different SBQ cutoff values for different severities of OSA.

SBQ cutoff	n (%)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
			REI≥5		
1	74 (48.4)	98.7 (94.7-100)	11.5 (5.1-19.2)	51.7 (49.7-54)	90.9 (66.7- 100)
2	67 (43.8)	89.3 (81.3-96)	56.4 (44.9-66.7)	66.3 (60.6-72.2)	84.8 (75.5-93.8)
3+	49 (32)	65.3 (54.7-76)	87.2 (79.5-93.6)	83.1 (74.6-91.1)	72.3 (66.3-79.3)
4	26 (17)	34.7 (24-45.4)	96.2 (91-100)	90 (77.8-100)	60.5 (56.6- 65)
5	12 (7.8)	16 (8-25.3)	97.4 (93.6-100)	86.7 (65-100)	54.7 (52.1-57.6)
6	5 (3.3)	6.7 (1.3-13.3)	97.4 (93.6-100)	72.7 (33.3-100)	52.1 (50.3-53.9)
7	0 (0)	0 (0-0)	98.7 (96.2-100)	0 (0-0)	50.7 (50-51)
8	0 (0)	0 (0-0)	100 (100-100)	0 (0-0)	51.0 (51-51)
			REI≥15		
1	33 (21.6)	100 (100-100)	8.3 (4.2-13.3)	23.1 (22.-24.1)	100 (100-100)
2	31 (20.3)	93.9 (84.8-100)	41.7 (33.3-50)	30.8 (27.2-34.7)	96.3 (90.6-100)
3+	27 (17.6)	81.8 (66.7-93.9)	73.3 (65-80.8)	45.8 (37.7-55.4)	93.7 (89-97.9)
4	15 (9.8)	45.5 (27.3-63.6)	88.3 (82.5-94.2)	51.7 (36.7- 68.8)	85.5 (81.7-89.6)
5	11 (7.2)	33.3 (18.2-48.5)	97.5 (94.2-100)	78.9 (57.1-100)	84.2 (81.1-87.4)

SBQ cutoff	n (%)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
6	5 (3.3)	15.2 (3-27.3)	98.3 (95.8-100)	72.7 (33.3-100)	80.8 (78.8-83.2)
7	0 (0)	0 (0-0)	99.2 (97.5-100)	0 (0-0)	78.3 (78-78.4)
8	0 (0)	0 (0-0)	100 (100-100)	0 (0-0)	78.4 (78.4-78.4)
			REI≥30		
1	10 (6.5)	100 (100-100)	7.0 (3.5-11.9)	7.0 (6.8-7.4)	100 (100-100)
2	9 (5.9)	90.0 (70-100)	35.7 (28 -44.1)	9.0 (6.8-10.6)	98.1 (94-100)
3+	9 (5.9)	90.0 (70-100)	65.0 (57.3-72.7)	15.4 (11.4-19.6)	99.0 (96.7-100)
4	7 (4.6)	70.0 (40-100)	84.6 (78.3-90.2)	24.2 (14.3-36)	97.6 (95.2-100)
5	6 (3.9)	60.0 (30-90)	94.4 (90.2-97.9)	42.9 (23.5-66.7)	97.1 (95-99.3)
6	4 (2.6)	40.0 (10-70)	97.9 (95.1-100)	58.3 (25-100)	95.9 (94-97.9)
7	0 (0)	0 (0- 0)	99.3 (97.9-100)	0 (0-0)	93.4 (93.3-93.5)
8	0 (0)	0 (0-0)	100 (100-100)	0 (0-0)	93.5 (93.5-93.5)

Legend: CI = confidence interval; NPV = negative predictive value; OSA = obstructive sleep apnea; PPV = positive predictive value; REI = respiratory event index; SBQ = STOP-BANG questionnaire. +The shaded areas indicate optimal values according to Youden's index, which was 3 in for all severities of OSA.

ROC analysis revealed AUC values of 0.823 (95% CI: 0.758–0.888) for any OSA (REI≥5), 0.819 (95% CI: 0.742–0.869) for moderate to severe OSA (REI≥15), and 0.847 (95% CI: 0.695–0.999) for severe OSA (REI≥30). The receiver operating characteristic curves are shown in Figure 2.



Legend: REI = respiratory event index; SBQ = STOP-BANG questionnaire

Figure 2. ROC for the Slovene SBQ in the primary practice setting at the threshold values of manual REI≥5, ≥15, and ≥30.

4 DISCUSSIONS

The Slovene translation of the SBQ showed good correlation with and diagnostic accuracy for OSA in the primary practice setting. At the standard cutoff of ≥3, the SBQ demonstrated an area under the curve of 0.82 for any OSA (REI≥5), 0.82 for moderate and severe OSA (REI≥15) and 0.85 for severe OSA (REI≥30).

The prevalence of OSA (REI≥5) in our primary practice setting was notably high, at 49.0%, with 21.5% exhibiting moderate to severe OSA (REI≥15). Two key factors that may account for this high rate of OSA in primary practice are the age of the patients (with an average age of 49.7 years ±13.1) and the presence of comorbidities. Notably, OSA is more frequently observed in older individuals (19), it often coexists with other chronic diseases (20) and it is older individuals with chronic illness who are more frequent visitors to primary practice clinics (21). Muñoz-Gómez, who validated the Spanish version of the SBQ, using type 3 PG, for primary practice setting, found that 61.5% of the participants had OSA (REI≥5) with 38.8% having moderate and severe OSA (REI≥15). Even higher rates of OSA among patients were reported by Bailes and Fichten and their colleagues, who recruited patients older than 45 years in primary practice. The average age of patients in this study was 57.5 (±11.5) years, with 75% of patients having an AHI≥10, as assessed by PSG (22).

There is no data for the prevalence of OSA in the Slovene general population. A previous study showed an OSA prevalence of 69.6% (REI≥5) in a Slovene sleep clinic, with 47.2% having moderate and severe OSA (REI≥15) (16). The differences in prevalence and severity of OSA in the two environments are to be expected, as there is a gatekeeper system in place in Slovenia and thus all the patients referred to a sleep clinic are in a sense pre-screened.

We found a good correlation between the Slovene version of the SBQ in the primary practice setting and REI. The sensitivity, specificity, NPV and PPV were also impressive. Sensitivity was, however, somewhat lower than in the sleep lab. These differences could be attributed to the small sample sizes, especially in the primary practice setting where the disease prevalence was lower and cases of OSA were on average milder.

The diagnostic ability of the Slovene SBQ, at a cutoff of ≥3, for any OSA (REI≥5) assessed by ROC analysis yielded a high AUC of 0.82, this being even higher than the 0.76 in the Slovene sleep clinic (16). Muñoz-Gómez, who validated the Spanish version of the SBQ for primary practice setting, found an AUC of 0.69 for any OSA (23) and a meta-analysis of sleep clinics showed an AUC of 0.74 (24). The AUC improved for the detection of moderate to severe OSA with the Spanish version in the primary practice setting with an AUC of 0.77 (23), whereas it stayed more or less the same with our version.

Youden's index, which provides the optimal threshold value based on the longest vertical distance from the diagonal line to the ROC curve, was 3 for all OSA severity levels. This threshold value aligns with the classic threshold recommended by Chung (12).

Many studies have been published validating the SBQ in sleep laboratory setting (25), including a Slovene version (16). There have also been studies validating the SBQ in the general population (25), however, publications validating the SBQ in primary practice setting, the most ubiquitous medical setting, are relatively rare. Compounding the problem, there have also been articles claiming to validate the SBQ in a primary practice setting even though only patients suspected of having a sleep disorder were included and then referred to a sleep clinic for a sleep study (11), something we would consider a pre-screened sleep clinic population.

In our study, we made a methodological restriction by setting the maximum age of the participants at 70 years. While this probably had some impact on the representativeness of our sample compared to the broader family medicine clinic demographic, it was strategically employed to optimise participant engagement. We anticipated that this age limit would allow for a more seamless integration of participants into the study, particularly in terms of understanding instructions, correctly completing questionnaires, and proficiently utilising the designated equipment. Furthermore, compliance with continuous positive airway pressure (CPAP) therapy decreases with age, with the adherence of patients decreasing significantly from the age of 65-69 years, and decreasing further with increasing age (26).
The study was further hindered by the COVID-19 pandemic, extending the patient recruitment period from the initially planned one year to four years. This included a two-year hiatus, after which the pace of patient recruitment was slower than anticipated. In addition, the lack of funding for patient recruitment was a significant constraint. Another limitation was the decision to use type 3 PG instead of the gold standard, that is type 1 PSG. Type 3 PG is now routinely used in clinical practice for the diagnosis of OSA, as it has been shown to be a reliable, cost-effective and simpler alternative to PSG (26, 27). However, we were conscious of the limitations of type 3 PG and therefore excluded patients who were regularly taking sedatives, opioids and tranquilizers, as well as patients with heart failure, neuromuscular disease, COPD stage D, and so on, in whom central or mixed types of apnea and other sleep disorders are more common and for whom a type 1 PSG would be preferable according to the AASM guidelines. Our study was not the first to utilize PG for the validation of the SBQ questionnaire, as Reis et al. (27) and Muñoz-Gómez et al. (23) also did so. We are also of the opinion PSG is too complex and impractical for use in a primary practice setting.

5 CONCLUSIONS

With this study, we have confirmed the validity of the Slovene translation of the SBQ as a reliable instrument for OSA risk stratification in the primary practice setting.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

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AVAILABILITY OF DATA AND MATERIALS

Data and material are available upon request.

LLM STATEMENT

During the preparation of this work the authors used Chat GPT-4 to shorten the abstract. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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