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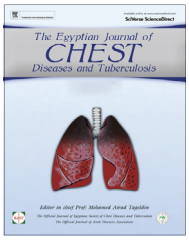

ORIGINAL ARTICLE

Comparison of four sleep questionnaires for screening obstructive sleep apnea

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KEYWORDS

Obstructive sleep apnea;
Polysomnography;
Berlin questionnaire;
Epworth Sleepiness Score;
STOP questionnaire;
STOP-Bang questionnaire

Abstract *Background:* The increased prevalence of obstructive sleep apnea (OSA) mandates the presence of simple but accurate tools to identify patients with this disorder for early detection and prevention of various serious consequences. This study aimed at comparing four sleep questionnaires as regards their predictive probabilities for OSA.

Methods: A cross-sectional study included 234 patients presenting to the sleep clinic. Four sleep questionnaires (Berlin, Epworth Sleepiness Scale [ESS], STOP, and STOP-Bang) were administered to the patients and scoring of the results of the questionnaires was done. Overnight attended polysomnography (PSG) was done for all patients and was considered the gold standard for the diagnosis of OSA. The sensitivity, specificity, positive and negative predictive values of the four questionnaires were calculated.

Results: Of 234 screened patients; 87.1% had OSA, whereas 93.3%, 90.2%, 95.5%, and 68.3% were classified as being at high risk by the Berlin, STOP, STOP-Bang questionnaires and ESS, respectively. The STOP-Bang, Berlin and STOP questionnaires had the highest sensitivity to predict OSA (97.55%, 95.07% and 91.67%, respectively), moderate-to-severe OSA (97.74%, 95.48% and 94.35%, respectively) and severe OSA (98.65%, 97.3% and 95.95%, respectively), but with a very low specificity for OSA patients (26.32%, 25% and 25%, respectively), moderate-to-severe OSA patients (3.7%, 7.41% and 25.93%, respectively) and severe OSA patients (5.36%, 10.71% and 19.64%, respectively), while the ESS had the highest specificity to predict OSA, moderate-to-severe OSA and severe OSA (75%, 48.15% and 46.43%, respectively) but with the lowest sensitivity (72.55%, 75.71% and 79.73%, respectively).

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Conclusions: The sensitivity of Berlin, STOP and STOP-Bang questionnaires was very high yet, the low specificity of these questionnaires results in increased false positives and failure of exclusion of individuals at low risk.

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Introduction

Obstructive sleep apnea (OSA) is a common disorder affecting at least 2% to 4% of the adult population [1]. It is estimated that nearly 80% of men and 93% of women with moderate-to-severe sleep apnea are undiagnosed [2].

Although the ''gold standard'' for diagnosis of OSA is laboratory polysomnography (PSG); however, the occurrence of OSA is far more prevalent than can be handled by the available sleep laboratories. Therefore, a screening tool is necessary to stratify patients based on their clinical symptoms, their physical examinations, and their risk factors, in order to ascertain patients at high risk and in urgent need of PSG and/or further treatment and patients at low risk who may not need PSG [3].

A number of screening questionnaires and clinical screening models have been developed to help identify patients with OSA [4–13]. The Berlin questionnaire was developed in 1996 at the Conference on Sleep in Primary Care in Berlin-Germany. It is a validated instrument that is used to identify individuals who are at risk for OSA in primary and some non-primary care settings [14–17]. The STOP questionnaire was developed in 2008 in an attempt to establish an easy-to-use questionnaire for OSA screening in surgical patients. It is a 4 questions questionnaire related to snoring, tiredness during the daytime, stopped breathing during sleep, and hypertension. An alternative scoring model incorporating BMI, age, neck circumference, and gender into the STOP questionnaire, was termed the STOP-Bang questionnaire [18]. The Epworth Sleepiness Scale (ESS), created by *Murray Johns* in 1990, is a validated self-administrated 8-item questionnaire that measures subjective daytime sleepiness [19].

This study aimed at comparing four established sleep questionnaires regarding their predictive probabilities for OSA.

Materials and methods

Study design

This cross-sectional study aimed at predicting high risk of OSA based using four questionnaires in comparison to the objective assessment using the standard overnight attended PSG on all the recruited patients. All patients were interviewed by a sleep specialist and answered to the following four clinical questionnaires: Berlin, STOP, and STOP-Bang questionnaires as well as the ESS.

Patients

The study was conducted over 234 patients in the sleep disorders laboratory of Ain Shams university hospital as well as over patients attending in a private sleep disorders clinic in Cairo city. Anthropometric measures including body weight, height, body mass index (BMI), and neck circumference (NC) as well as gender were documented for all patients. Patients who did not complete their questionnaires and those who did not undergo PSG or did not complete their PSG study were excluded from the present study. The study was approved by the institutional ethics committee.

Methods

Questionnaires. Berlin Questionnaire. The Berlin questionnaire (Appendix 1) has 11 questions grouped in 3 categories. The first category comprises 5 questions concerning snoring, witnessed apneas, and the frequency of such events. The second category comprises 4 questions addressing daytime sleepiness, with a sub-question about drowsy driving. The third category comprises 2 questions concerning history of high blood pressure ($>140/90$ mmHg) and BMI of >30 kg/m^2. Category 1 and 2 were considered positive if there was $\geqslant 2$ positive responses to each category, while category 3 was considered positive with a self-report of high blood pressure and/or a BMI of >30 kg/m^2. Study patients were scored as being at ''high risk'' of having OSA if scores were positive for two or more of the three categories. Those patients who scored positively on less than two categories were identified as being at ''low risk'' of having OSA [20].

STOP & STOP-Bang Questionnaires. The STOP questionnaire (Appendix 2) consists of the following four questions: S—''Do you **S**nore loudly (louder than talking or loud enough to be heard through closed doors)?'' T—''Do you often feel **T**ired, fatigued, or sleepy during daytime?'' O—''Has anyone **O**bserved you stop breathing during your sleep?'' P—''Do you have or are you being treated for high blood **P**ressure?''. An extended scoring model incorporating four additional parameters into the STOP questionnaire namely **B**MI (BMI >35 kg/m^2), **A**ge (>50 years old), **N**eck circumference (NC >40 cm), and **G**ender (male), was termed the STOP-Bang questionnaire (Appendix 3). The answers to all questions of STOP and STOP-Bang questionnaires were designed in a simple yes/no format and the scores range from a value of 0 to 4 and 0 to 8 for STOP and STOP-Bang questionnaires, respectively. Both questionnaires score subjects as either ''high risk'' or ''low risk'' for OSA. Answering yes to 2 or more questions in STOP questionnaire and 3 or more questions in STOP-Bang questionnaire is considered ''high risk'', whereas answering yes to less than 2 questions in STOP questionnaire and less than 3 questions in STOP-Bang questionnaire is considered ''low risk'' [18].

Epworth Sleepiness Scale. The ESS (Appendix 4) is a self-administrated questionnaire that asks subjects to rate how likely they would have dozed (fallen asleep) in 8 specific situations or activities that are commonly met in daily life. The chance of dozing is rated on a scale of 0–3 (0 = would never dose, 1 = slight chance of dozing, 2 = moderate chance of dozing, and 3 = high chance of dozing). The total ESS score is the sum of 8-items scores and can range between 0 and 24. The higher the score, the higher the person's level of daytime sleepiness as follows: normal, 0–10; and excessive daytime

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