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Association between risk factors and the risk level of obstructive sleep apnea in medical students Surabaya, Indonesia

Gokmalina Clementin Odile [1,*], Wardah Rahmatul Islamiyah [2], Achmad Chusnu Romdhoni [3] and Fidiana [2]

[1] *Medical Program, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.*
[2] *Department of Neurlology, Dr. Soetomo General Academic Hospital, Universitas Airlangga, Surabaya, Indonesia.*
[3] *Department of Ear, Nose, and Throat, Dr. Soetomo General Academic Hospital, Universitas Airlangga, Surabaya, Indonesia.*

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Abstract

Introduction: Medical students are one group that is susceptible to sleep disorders. One of the symptoms experienced in the medical student is Excessive Daytime Sleepiness (EDS), which is one of the most common and most important symptoms of Obstructive Sleep Apnea (OSA).

Aim: This study aims to determine the association between the level of risk of developing OSA with risk factors such as age, gender, smoking, alcohol consumption, and obesity as seen from BMI, neck circumference (NC), and Mallampati score in medical students.

Methods: An analytical observational study using Berlin and STOP-BANG questionnaire as an instrument to screen OSA. The study was conducted from April 2021 until August 2021 in the Faculty of Medicine Universitas Airlangga.

Result: There were 87 participants aged 18-21 years old. The mean age was 19.71±0.70 years old. The bivariate analysis between BMI and risk level of OSA showed significant results as well as neck circumference using both Berlin criteria ($p<0.05$) and STOP-BANG criteria ($p<0.05$). For gender, the result showed significant results with Berlin criteria ($p<0.05$) but insignificant with STOP-BANG criteria ($p>0.05$). Meanwhile, the results of the bivariate analysis between age, Mallampati score, alcohol consumption, and smoking showed insignificant results both with Berlin criteria ($p>0.05$) and STOP-BANG criteria ($p>0.05$).

Conclusion: Gender, BMI, and neck circumference are related to the risk level of OSA using Berlin criteria, but only BMI and neck circumference are related to the risk level of OSA using STOP-BANG criteria in Surabaya medical students.

Keywords: Obstructive Sleep Apnea; Medical student; Risk factor; STOP-BANG questionnaire; Berlin questionnaire

1. Introduction

Medical students are one group that is susceptible to sleep disorders [1]. This can happen due to academic demands, organizational activities, and lifestyle changes that make students have to manage their schedules as well as possible. However, not all students can manage their schedules well. As a result, many students use their break time for other activities. This can lead to a decrease in health and student productivity. One of the health problems that can be

* Corresponding author: Gokmalina Clementin Odile
Medical Program, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.

experienced is Excessive Daytime Sleepiness (EDS), which is one of the most common and most important symptoms of Obstructive Sleep Apnea (OSA) [2].

OSA is a sleep disorder characterized by respiratory arrest with repeated episodes and partial or complete airway obstruction, which results in recurrent apnea or hypopnea. Obstruction usually occurs because the dilator muscles of the upper airway collapse during sleep, causing the obstruction [3]. OSA itself is pretty dangerous if it is not handled correctly due to sleep disturbances at night which causes excessive sleepiness during the day so that students cannot function optimally and cannot absorb the subjects properly during lectures due to disturbed concentration. In addition, OSA is associated with hypertension, metabolic syndrome, diabetes, heart failure, coronary heart disease, arrhythmias, stroke, pulmonary hypertension, and neurocognitive and mood disorders [4].

This danger can be anticipated by conducting an initial screening of medical students. Ideally, screening is done by polysomnography (PSG) which is the gold standard in diagnosing OSA. However, the STOP-BANG questionnaire (SBQ) and the Berlin questionnaire (BQ) can also be used because PSG has limitations, such as high cost, time-consuming, and limited access to examinations [5]. In addition, the dangers of OSA can also be anticipated by knowing and controlling controllable risk factors such as obesity, alcohol consumption, smoking, and uncontrollable risk factors such as craniofacial anatomy, race, genetics, age and gender [6]. Therefore, this study aims to determine the relationship between the level of risk of developing OSA with risk factors such as age, gender, smoking, alcohol consumption, and obesity as seen from BMI, neck circumference (NC), and Mallampati score in medical students.

2. Material and methods

2.1. Study Population

This study was an analytical observational study. The study was conducted from April 2021 until August 20201 in the Faculty of Medicine, Universitas Airlangga. The population in this study was all medical program student class of 2019 in Faculty of Medicine Universitas Airlangga. The inclusion criteria were an active medical student class of 2019 and are willing to participate in the research. The exclusion criteria were having a history of respiratory disease. This study uses total sampling as a sampling method.

2.2. Obstructive Sleep Apnea

In this study, the risk level of OSA was measured by the STOP-BANG questionnaire and Berlin questionnaire. STOP-BANG questionnaire, developed by Chung *et al.* [7] in 2008 that consisted of 8 questions about snoring (S), tiredness (T), observe apnea (O), blood pressure (P), BMI (B), age (A), neck circumference (N), and gender (G). The participant is categorized as high risk if they answer ≥ 3 questions with yes [8]. If the participant answered < 3 questions with yes, they were categorized as OSA low risk.
Berlin questionnaire was developed in 1996 [9] and consisted of 10 questions divided into three categories. The first category consists of 5 questions about snoring, the second category consists of 4 questions about Excessive Daytime Sleepiness (EDS), and the third category consist of 1 question about the history of hypertension and obesity (BMI ≥ 30kg/m2) [10]. Participants are categorized as high risk when there are two or more positive categories [11].

2.3. Sociodemographic Data

Sociodemographic information was collected with a questionnaire containing several questions about age, gender, alcohol consumption, smoking, history of respiratory disease, height, weight, BMI, neck circumference, and Mallampati score. Participants measured their weight, height, and neck circumference individually with the help of other people around them. Weight, height, and neck circumference measurement using a scale, microtome, and tape measure. BMI was measured by dividing weight by square of height and then categorized using the Asia Pacific BMI criteria. Meanwhile, neck circumference was measured in the middle of the neck, between mid-cervical and mid anterior of the neck or below Adam's apple in males [12]. The neck circumference is large when > 40 cm in males and > 35 cm in females [13]. For the Mallampati score, participants were asked to take a photo of the oral cavity using a camera device, and later it would be assessed by an ENT specialist doctor.

2.4. Data Analysis

Data were analyzed using a univariate analysis for the subject's distribution, frequency, and characteristics. Then, data were analyzed with bivariate analysis to see if there was any correlation between risk factors of OSA like age, gender, BMI, neck circumference, Mallampati score, alcohol consumption, and smoking with OSA risk level in medical students using Fisher Exact Test and Likelihood ratio. All statistical analyses were performed by SPSS 23.0.

3. Results

Eighty-seven subjects were obtained, with 27 males and 60 females. The age range of the participants is from 18-21 years, with an average age of 19.71±0.70 years. The majority of respondents had normal BMI and NC with average 22.07±3.93 kg/m^2 and 33.70±3.59 cm. In addition, for the Mallampati score, most of the respondents belonged to class II, followed by class III. For consumption of alcohol and cigarettes, most respondents did not consume both.

Table 1 Distribution of General Characteristics of 87 medical student in Surabaya

Characteristic	Frequency (N=87)	Percentage (%)	Mean±SD
Age (years)			
< 20 years	31	35.6	19.71±0.70
≥ 20 years	56	64.4	
Gender			
Male	27	31.0	-
Female	60	69.0	
BMI (kg/m2)			
Underweight (<18.5)	11	12.6	22.07±3.93
Normal (18.5-22.9)	47	54.0	
Overweight (23-24.9)	11	12.6	
Obesity I (25-29.9)	14	16.1	
Obesity II (>30)	4	4.6	
NC (cm)			
Normal	78	89.6	33.70±3.59
Large	9	10.3	
Mallampati			
I	9	10.3	-
II	33	37.9	
III	27	31.0	
IV	18	20.7	
Alcohol			
Yes	1	1.1	-
No	86	98.9	
Smoking			
Yes	3	3.4	-
No	84	96.6	

Table 2 shows the analysis of the risk factor variable with the level risk of OSA. There is a statistically significant relationship found between the risk factor of gender (p=0.028), BMI (p=0.008), and NC (p=0.027) with the risk level of OSA with the Berlin criteria. Meanwhile, for STOP-BANG criteria, statistically only found a relationship between risk factors for BMI (p=0.009) and NC (p=0.010). The risk factors for age, Mallampati score, alcohol consumption, and smoking were not statistically associated with the level of OSA risk.

Table 2 Correlation between risk factor and the risk level of OSA according to Berlin and STOP-BANG questionnaire

Characteristic	Berlin Questionnaire				P value	STOP-BANG Questionnaire				P value
	High Risk		Low Risk			High Risk		Low Risk		
	N=3	%	N=84	%		N=2	%	N=85	%	
Age										
< 20 years	1	33.3	30	35.7	1.000[a]	1	50	30	35.3	1.000[a]
≥ 20 years	2	66.6	54	64.3		1	50	55	64.7	
Gender										
Male	3	100	24	28.6	0.028[a]	2	100	25	29.4	0.094[a]
Female	0	0	60	71.4		0	0.0	60	70.6	
BMI										
Underweight (<18.5)	0	0	11	13.1	0.008[b]	0	0	11	12.9	0.009[b]
Normal (18.5-22.9)	0	0	47	56.0		0	0	47	55.3	
Overweight (23-24.9)	1	33.3	10	11.9		0	0	11	12.9	
Obesity I (25-29.9)	0	0	14	16.7		0	0	14	16.5	
Obesity II (>30)	2	66.7	2	2.4		2	100	2	2.4	
NC										
Normal	1	33.3	77	91.7	0.027[a]	0	0	78	91.8	0.010[b]
Large	2	66.7	7	8.3		2	100	7	8.2	
Mallampati										
I	0	0	9	10.7	0.205[b]	0	0	9	10.6	0.501[b]
II	1	33.3	32	38.1		1	50	32	37.6	
III	0	0	27	32.1		0	0	27	31.8	
IV	2	66.7	16	19.0		1	50	17	20.0	
Alcohol										
Yes	0	0	1	1.2	1.000[a]	0	0	1	1.2	1.000[a]
No	3	100	83	98.8		2	100	85	98.8	
Smoking										
Yes	0	0	3	3.6	1.000[a]	0	0	3	3.5	1.000[a]
No	3	100	81	96.4		2	100	83	96.5	

[a]Fisher's Exact test, significant if $p<0.05$; [b]Likelihood Ratio test, significant if $p<0.05$

4. Discussion

From the results of this study, there was no relationship between age and the risk of developing OSA, both based on the Berlin criteria and the STOP-BANG criteria. However, this is not in line with the research conducted by Harris and Octaviana [14] in 2013 using the STOP-BANG questionnaire. Another study on OSA prevalence found that OSA in men with AHI ≥ 10 and women with AHI ≥ 15 was most commonly found in the 65-100year age group [15]. The thing that might cause the results of this study to be different from previous studies is that the respondents are less varied, whereas the age group of respondents is only limited to the age of 20 years.

As for the gender risk factor, there was a significant relationship with the Berlin criteria, but no significant relationship was found with the STOP-BANG criteria. A study of OSA prevalence in the general adult population stated that OSA prevalence in men ranged between 13-33% and in women ranged between 6-19% [16]. The possible underlying mechanism is the difference in fat tissue accumulation in men and women, wherein in men, the accumulation of fat tissue around the neck, trunk, and abdomen is more dominant [17]. Besides, men have longer pharyngeal segments and greater upper airway resistance during sleep than women [18].

Obesity has a relationship with an increased risk of OSA, where obesity can increase fat deposits around the upper airway, causing narrowing of the upper airway lumen and decreasing muscle activity in this region. As a result, airway collapse occurs during sleep [19]. In this study, obesity was indicated by anthropometric measurements of BMI and NC. It was found that an increase in BMI affects the risk of OSA both with the Berlin and STOP-BANG criteria. These results align with the research conducted by Wosu *et al.* in 2014 [20]. In addition, the increase in NC also has a significant relationship with the risk of developing OSA with the Berlin criteria and STOP-BANG criteria. A study found that increasing neck circumference was significantly associated with OSA severity, where neck circumference was an independent risk factor for OSA severity (p=0.001) and an independent risk factor for OSA severity (p=0.001) [21].

An increase in the Mallampati score itself has been one of the risk factors exacerbating apnea. According to research conducted by Rodrigues *et al.* [22], it is stated that there is a positive relationship between the results of the Mallampati score and the AHI, which is an index to measure the severity of OSA. In addition, Nuckton *et al.* [23] stated that the Mallampati score was an independent risk factor for OSA with an Odd Ratio of 2.5 for every 1point increase in Mallampati's score. This is because patients with high Mallampati scores tend to have obstruction, mainly because of the presence of macroglossia, so that it will block the entry of air from the nose and mouth into the lower respiratory tract [22]. In this study, it was found that there was no significant relationship between an increase in Mallampati score and the risk of OSA. This is certainly not in line with previous research. However, the research conducted by Bins *et al.* [24] in 2011 reported that based on the Mallampati score, patients who scored 1-2 had a 1-13% reduced chance of developing OSA. Meanwhile, patients with a Mallampati score of 3-4 have an increased chance of developing OSA by 0-11%, which cannot be statistically significant, so the Mallampati score can be said to have no practical effect value in predicting the presence of OSA.

A meta-analysis study stated an association between alcohol consumption and OSA where the risk of OSA was 1.3 times greater in those who consumed alcohol than those who did not [25]. The underlying mechanism is thought to be because alcohol causes a decrease in the tone of the genioglossus muscle, which is the base of the tongue, so that the patient is prone to upper airway collapse and increases upper airway resistance [25]. However, this is not in line with the results in this study, namely that there was no significant relationship between alcohol consumption and the risk of developing OSA with both the Berlin criteria and the STOP-BANG criteria. This is thought to be because only a few subjects consumed alcohol in this study. In addition, anamnesis regarding alcohol consumption in the subjects of this study is still lacking in depth.

In this study, there was no relationship between smoking and the risk of developing OSA using either the Berlin criteria or the STOP-BANG criteria. These results are consistent with a study that stated no significant relationship between smoking and an increased risk of OSA [26]. The role of smoking in OSA has not yet been explained in detail, but the mechanisms that may be associated with smoking and OSA are inflammation of the upper respiratory tract and neuromuscular disorders in the upper respiratory tract muscles [27].

5. Conclusion

Using the Berlin criteria, there was a significant relationship between gender, BMI, and neck circumference on the risk of developing OSA (p<0.05). Meanwhile, a significant relationship was found between BMI and neck circumference and the risk of developing OSA with the STOP-BANG criteria. Furthermore, age, Mallampati score, and history of consuming alcohol or cigarettes, no significant association were found with the risk of developing OSA (p>0.05) both with the Berlin and STOP-BANG criteria.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

We have no conflict of interest to declare.

Statement of ethical approval

This study has been approved by the Health Research Ethics Committee of the Faculty of Medicine Universitas Airlangga (No. 64/EC/KEPK/FKUA/2021).

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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