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ORIGINAL ARTICLE

Lung Function and Respiratory Symptoms Features of Smoker among University Students

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ABSTRACT

Introduction: Smoking habit still becomes one of the problems in Indonesia with the high number of active smokers in university students. Smoking is one of the causes of several conditions of respiratory symptoms and risk factor of multiple case of lung function impairment. This study aimed to examine characteristic of lung function and respiratory symptoms and its relationship in active smokers among university student in Depok, Indonesia.

Methods: This was a cross-sectional study using American Thoracic Society (ATS) questionnaire for respiratory symptoms and Brinkman index for smoking habits. Lung function was examined using EasyOne® Air Spirometer.

Results: This study was participated by 116 male university students who are active smokers. This study found that majority of respondents fell into the mild category of smoking habit (96.56%) and complained of respiratory symptoms (74.14%). This study found lung function impairment in 15.5% respondents (8.6% obstructive and 6.9% restrictive disorder). There was no significant relationship between smoking habits with respiratory symptoms and lung function impairment among respondents.

Conclusion: This study found the characteristics of smoking habits in male university students were categorized as mild smoking habit, followed by the appearance of respiratory symptoms and lung function impairment. However, there was no significant relationship between smoking habits and respiratory symptoms or lung function. This issue needs to be paid attention to strengthen the campaign to prevent smoking initiation and to help smoking cessation among young adults as early as possible.

INTRODUCTION

Smoking is one of the main public threats in the world, with approximately 8 million people died in 2017 caused by tobacco-related disease. Globally the highest prevalence of tobacco use is found in males aged 15 years old and older (in 2000 around 50%), however, it starts to decline and is projected to reach 35% in the year of 2025. In Indonesia, estimation in 2018 for crude adjusted prevalence of cigarette smoking among people aged 15 years old and older was 31.1% (lower-upper limit: 24.5-38.3%), with male prevalence was 60.4% (lower-upper limit: 47.7-74.4%).¹ Based on Indonesia

Basic Health Research (Riset Kesehatan Dasar (RISKESDAS)) data in 2018, smoking proportion of population above 10 years old was about 24.3%

(95%CI:24.1-24.4) in daily smokers with Lampung as the province with the highest smoking proportion (28.1% (95%CI:27.5-28.8)).² Overall, the prevalence of smoking in daily and occasionally smoker among population above 10 years old was 28.8%, decreasing compared to 2013 which was 29.3% in Indonesia.³ Global Adult Tobacco Survey: Indonesia Report 2011 found among those who smoked tobacco, 34.6% smoked cigarettes such as kretek, white cigarette, or hand-rolled. The prevalence of kretek smoking among college and university-educated people was lowest (25.6%) compared with graduated primary school (33.9%). Moreover, the average age of initial start smoking daily is 17.6 years old, and college or university educated people start at higher age (19.5 years old).⁴

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Cigarette use in Indonesia especially in teens and males is quite high even though cigarette has negative effect on health, especially on death numbers and complications of chronic diseases. The high number of cigarette use is a multifactorial problem that may be caused by social environment and the effect of addiction that enables a smoker to quickly release fatigue. On the other hand, the activity of smoking is highly related with human respiratory system which could cause disease such as chronic obstructive pulmonary disease (COPD), tuberculosis, worsening asthma condition, chronic respiratory symptoms (cough, phlegm, wheeze, dyspnea), and reduced lung function.⁵ In daily life, respiratory system has the role to provide daily oxygen needs for the human body, while not much studies have examined the habit of smoking in students especially in Indonesia. This results in a lack of sufficient data about the lung physiology and respiratory symptoms. Therefore, this study discussed lung function and respiratory symptoms in male university students who smoke in university environment.

METHODS

This was a cross-sectional method observational study to analyze the relationship between the frequency of cigarette use as independent variable and the variable of respiratory symptoms and lung function as dependent variables. It was conducted in July until November 2019, located in university around Depok, Indonesia.

There were 116 male university students who are active smoker participated in this study. The research samples were the population that fulfills the inclusion criteria of male smoker and registered as university student. The exclusion criteria were the subjects who were unable to complete filling American Thoracic Society (ATS) questionnaire for respiratory symptoms and Brinkman index questionnaire for smoking habits. This study used EasyOne®Air Spirometer, ndd Medical Technologies, Inc., to perform lung examination. Sampling technique used in this study was consecutive sampling. Sampling was continuously performed until it reached the minimum amount of sample calculated by sample size formula. Spirometry was conducted by trained medical students to collect data of lung function from respondents. Respondents underwent spirometry examination at least 3 reproducible forced manoeuvres, namely reproducibility of <150 ml between the two highest force expiratory volume in 1 second (FEV₁) values. The highest FEV₁ and force vital capacity (FVC) were selected for analysis. Data were retrieved and a pulmonologist performed interpretation of all lung function data and graded it for acceptability according to ATS/European Respiratory Society (ERS) criteria.

Respondents were also asked to refrain from smoking for 4 hours before examination. The predicted values for FEV₁ and FVC were based on Pneumobile Project Indonesia survey of normal lung function reference values for determining percentage of predicted normal FEV₁ and FVC values. Obstruction disorder defined by a FEV₁/FVC ratio <0.75 and restrictive disorder defined by FVC <0.8. Smoking habits were obtained using Brinkman index, defined by number of cigarettes consumed per day multiplied by years of smoking. It was classified into 3 subgroups based on the value of Brinkman index; mild category (Brinkman index 0-200), moderate category (Brinkman index 201-600), and heavy smoker (Brinkman index >600). Information about respiratory symptoms, such as cough, sputum, wheezing, shortness of breath, was collected using existing validated questionnaires: ATS Division of Lung Disease questionnaire.

Data were presented as size group (percent) and mean ± standard deviation or median (minimum-maximum) for qualitative and quantitative variables, respectively. The respondents' socio-demographic characteristics were reported using descriptive statistics. Obtained data was analyzed with non-parametric Mann-Whitney test, T-test independent, and Spearman bivariate correlation. All analyses were conducted using SPSS version 20.

This study was approved by the Ethics Committee of the Faculty of Medicine, Universitas Indonesia with regards of the protection of human rights and welfare in medical research (approval number: KET-864/UN2.F1/ETIK/PPM.00.02/2019). In addition, the respondents were provided written approval for their involvements in this study.

RESULTS

There were a total of 116 respondents willing to follow the whole process of the study. The sociodemographic characteristics of respondents were evaluated using univariate analysis technique which consisted of age, body mass index (BMI), educational background, income type, weekly allowance, and the existence of smoker in the family (Table 1).

Characteristics of smoking habits were evaluated using Brinkman index, a multiplication between the amount of cigarette smoked daily with duration of smoking in years. This showed that majority of respondents belong to the mild category (112 respondents, 96.56%) and only 4 respondents are included in moderate-severe category (3.44%). Distribution of obtained Brinkman index data had median of 45 with minimum score 1 and maximum score of 260.

Table 1. Sociodemographic characteristic distribution of respondents

Characteristics	Number n = 116	Percentage (%)
Age		
Average ± SD *Median (Min-Max)	*20.0 (17.0-24.0)	
BMI		
Average ± SD *Median (Min-Max)	24.4 ± 4.7	
BMI		
Underweight (<18,5)	10	8.6
Normal weight (18.5 – 22.9)	38	32.8
Overweight (>23.0)	68	58.6
Weekly allowance		
< Rp.1,000,000.00	71	61.21
> Rp.1,000,000.00	45	38.79
Educational background		
Faculty of natural science	48	41.37
Faculty of social science	68	58.63
Existence of smoker in the family		
Smoker in the family	71	61.21
No smoker in the family	45	38.79

Table 2. Abnormality of spirometry in respondents

Type of abnormality	Number of respondent (%)
Obstruction	10 (8.6%)
Restriction	8 (6.9%)
Mixed	-

Characteristics of smoking habits were evaluated using Brinkman index, a multiplication between the amount of cigarette smoked daily with duration of smoking in years. This showed that majority of respondents belong to the mild category (112 respondents, 96.56%) and only 4 respondents are included in moderate-severe category (3.44%). Distribution of obtained Brinkman index data had median of 45 with minimum score 1 and maximum score of 260.

Majority of respondents had respiratory symptoms (86 respondents, 74.14%) and 25.86% (30 respondents) had no respiratory symptoms. Respiratory symptoms found in respondents were cough (n = 38; 32.8%), sputum (n = 51; 44%), wheezing (n = 53; 45.7%), dyspnea (n = 14; 12.1%), rhinorrhea (n = 19; 16.4%), and chest pain (n = 2; 0.2%). Wheezing, mucus production, and cough were the most common respiratory symptoms reported in this study. However, all subjects who had respiratory symptoms were not in acute respiratory infection condition.

Table 3. Characteristics of lung function in respondents

Characteristics	Average ± SD *Median (Min-Max)
FEV ₁ /FVC ratio (%)	*87.2 (49.6-100)
Predicted FVC (%)	96.8 ± 13.5
Predicted FEV ₁ (%)	93.2 ± 13.3
FVC (L)	4.1 ± 0.6
FEV ₁ (L)	3.5 ± 0.6

Table 4. Comparison of Brinkman index score in respondents based on respiratory symptoms and lung function

Variable	Brinkman index Median (Min-Max)	p value
Respiratory symptoms		0.148
No	32 (2-220)	
Yes	48 (1-260)	
Lung function		0.860
Normal	45 (1-260)	
Abnormal	45 (15-140)	

Lung function impairment was measured using parameter FEV₁, FVC, and ratio of FEV₁/FVC. This study found lung function impairment in 15.5% respondents and normal lung function in 84.5% respondents. Lung function impairment of 8.6% (10 respondents) is categorized as obstructive and 6.9% (8 respondents) is categorized as restrictive disorder (Table 2). Average FEV₁/FVC ratio was 87.2% (min-max 49.6%-100%). Value of predicted FVC, predicted FEV₁, FVC (liter), and FEV₁ (liter) had normal data distribution (p = 0.02) and consecutive average value as shown in Table 3.

To see the relationship between smoking habits and respiratory symptoms, analysis was performed to compare the value of Brinkman index in the group with respiratory symptoms and the group without respiratory symptoms. Based on Kolmogorov Smirnov normality test, the data of Brinkman index value had abnormal distribution. Then the analytical test used for data of two unpaired groups was non-parametric Mann-Whitney test. The median value of Brinkman index in respondents with and without respiratory symptoms were 32 and 48, but there was no significant relationship between Brinkman index with respiratory symptoms (p > 0.05) as shown in Table 4.

The median of Brinkman index score in respondents of normal and abnormal lung function was similar with the same score of 45 and there was no significant relationship found between Brinkman index score and lung function (p value > 0.05).

DISCUSSION

Data in this study was taken with non-probability sampling method with consecutive sampling technique. Data obtained in this study does not represent the overall distribution of student characteristics, but is a demographic distribution of subjects that fulfill the inclusion criteria of the study. The median age in this study was 20 and majority of respondents (81%) were in the age range of 16-21 years old, similar to the usual age range of university students in Indonesia. Moreover, the majority of respondents were categorized as overweight based on BMI (58.6% with average $24.4 \pm 4,7$). In contrast with this study, Habib, *et al.* found BMI of smoker university students ($22.7 \pm 1,8$) was within normal category.⁶ Dare, *et al.* in England found current-smokers were less likely to become obese than never-smokers, but no significant relationship found in the youngest group (below 40 years old).⁷

The majority of academic discipline respondents come from social science faculty which were 68 respondents from a total of 116 respondents. There have been no previous study that shows characteristics about the academic background of smokers. This study found a lot more smokers from social major compared with those from natural science, however, there was no significant difference.

From financial perspective, this study did not follow the theory that says higher allowance will increase prevalence of smoking. This study showed the majority of smokers have low weekly allowance (below Rp.1,000,000,00). It is in contrast with a study conducted by Heo, *et al.* which stated that more weekly allowance is correlated with increasing risk for smoking.⁸ This could be explained by low price of cigarettes in Indonesia compared to other countries. Another reason would be there are so many tobacco brands with various prices. Moreover, it is possible for smokers to buy only a couple of cigarettes from the vendors. Therefore, it probably would not interrupt the stability of their allowance. However, data in Korea showed increasing price of tobacco with average 29% by Korean government for all brands turned to make decreasing smoking rate among Korean male by 7.5 percentage points. Moreover, a study conducted by Kim, *et al.* found that increasing price had resulted in reduction of tobacco smoking around 27.7% among 15,110 students of middle and high schools nationwide.⁹

This study also found that most respondents who smoke have a family member in the same house who also have smoking habits. This finding supports the study conducted by Hill, *et al.* who found that smoking

habits in parents contribute to smoking habits in their children. The correlation is very strong that even if the parents forbid their children from smoking and have good family management, they still will have tendency to smoke. On the other hand, with parents who do not have smoking habits, supervision and tight family roles will significantly decrease risk of smoking in teenagers.¹⁰

This study found majority of respondents were mild category of Brinkman index. It is similar to the study conducted by Amelia, *et al.* which also used Brinkman index among male smokers across different age range and found that all smokers in the age range of 15 to 24 years old was categorized as mild.¹¹ Suzuki, *et al.* also found the median score of Brinkman index from university students in Japan was in mild category (median = 150; min-max = 58.8-207.5).¹² Majority of smokers aged 16-25 years old were included in mild category because the duration and amount of cigarettes they smoked were not as many as older aged smokers. Another study by Sundari, *et al.* found that daily cigarettes smoked was in the range 5-25 cigarettes per day with mean of participant age was 33 years old (SD 10.3 years). They started to smoke mostly since 20 years old.¹³ Haddad, *et al.* found the majority of university students who smoke started when they were 15 years old. These results showed that smokers aged 16-25 years old have just been smoking cigarettes for around 1-10 years.¹⁴ Therefore, the Brinkman index of the smokers in the age of undergraduate student will most likely be in mild category.

This study found 74.1% of all respondents had respiratory symptoms which at least contained one of the symptoms such as cough, phlegm, wheezing, dyspnea, rhinorrhea, and chest pain. The most common respiratory complaints were wheezing, phlegm, and cough. Almost similar with this study, Hawari, *et al.* found that wheezing (42%), rhinorrhea (52.7%), and cough (43.8%) were dominant symptoms in university students across from 4 countries (Egypt, Jordania, Morocco, and Oman).¹⁵

This study showed that majority of respondents have normal lung function (84.5%). 18 respondents with lung function impairment were grouped into obstructive (8.6%) and restrictive disorder (6.9%). All respondents with obstructive disorder were included in mild degree based on ATS/ERS interpretation strategy. This study did not collect data history of asthma and perform bronchodilator test. Therefore, causal possibility of the obstructive disorder could not be examined. Respondents with restrictive disorder were categorized as mild. Since chest X-ray was not performed, therefore,

this study could not exclude possibility of fibrosis or tuberculosis scar in the lungs as one of the possible restrictive cause. Another reason could be related with BMI since this study found 58.6% of respondents were overweight (BMI > 23).

This study shows different value of spirometry parameter compared to previously published studies. Habib, *et al.* found lower FEV1/FVC ratio (81.50 ± 10.86), FVC (3.58 ± 1.37 L), and FEV1 (4.44 ± 1.18 L) in university students in Saudi Arabia.⁶ Basuki, *et al.* also found lower FVC (2.7 L) and FEV1 (2.1 L) among smokers aged 15-44 years old in university environment.¹⁶ Another study by Bird, *et al.* among students aged 13 to 15 years old showed FEV1/FVC ratio (83.50 ± 14.15) and predicted FEV1 ($62.88 \pm 10.25\%$) were lower compared to this study.¹⁷ The differences occur probably because of characteristic features between studies that influence lung function results. Some conditions could influence lung function in humans, such as previous history of lung disease (tuberculosis, pneumonia), BMI, smoking habits, age, and other factors. Furthermore, difference of smoking habit involves the number of cigarette smoke, duration of smoking, depth of inhalation, and other variables. Respondents with more amount of cigarette consumption/day will increase the risk of deterioration of FEV1/FVC ratio.¹⁸

This study did not find correlation between Brinkman index and respiratory symptoms, however, it showed that higher Brinkman index score leads towards increasing respiratory symptoms. Report from United States Public Health Service mentioned that many studies have found causal relationship between active smoking and respiratory symptoms among adults such as cough, phlegm, wheezing, and dyspnea.¹⁹

Isabel, *et al.* and Jawed, *et al.* found a dose-dependent relationship between smoking habit and lung function.^{18,20} In contrast to those studies, however, no relationship between smoking habit and lung function was found in this study. Limitation of this study did not include non-smoker respondents for comparison. The duration of cigarette smoking and range of age probably were factors which made these differences.

LIMITATIONS

This study has several limitations, one of them is the technique of obtaining data such as demographic component, smoking habits, and respiratory symptoms which were obtained based on the results of interview and guided questionnaire filling (recall bias). Normal spirometry results from respondents found in this study still have a risk to become abnormal in the future caused

by the long term effect of smoking cigarettes. Another limitation would be this study did not perform chest X-ray to assess any abnormality in the lungs.

CONCLUSION

To conclude, this study found the characteristics of smoking habits in male university students which were categorized as mild smoking habit (96.6%) with the median value of 45. This is followed by the appearance of respiratory symptoms of 74.1% with the most often symptoms were wheezing, mucus and cough, and also lung function disturbance of 15.5% with the FEV1/FVC median ratio of 87.2% (49.6-100%). Nevertheless, there was no significant relationship between smoking habits and respiratory symptoms or lung function. This study represents the condition of smoking habits in university students in Indonesia seen from the perspective of respiratory symptoms and lung function, which has not been published by many studies. Most of the students who smoke fell into the mild category, however, this issue needs to be paid attention to strengthen the campaign to prevent smoking initiation and to help smoking cessation among young adults as early as possible.

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Conflict of Interest

The author stated there is no conflict of interest in this study.

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Authors' Contributions

Conceptualization: NJZ, TD. Data curation: NJZ, TD. Formal analysis: NJZ, TD, AW. Funding acquisition: None. Methodology: NJZ, TD, AW. Project administration: NJZ, TD. Writing – original draft: NJZ, TD. Writing – review & editing: NJZ, TD, AW. All authors have read and agreed to the published version of the manuscript.

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