
Comparison of Lung Capacity of Smokers and Non-smokers in University Sports Students

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Abstract

Smoking is known to have adverse effects on lung health. Study shows that regular exercise is known to improve of the respiratory system health. Sports students are a group that has physical activity and exercise that meets the physical activity standards of 150 minutes of moderate intensity of aerobics physical activity per week, but many of the students are smoker. This study aims to determine the lung capacity of sports science study program students who smoke compared to students who do not smoke. This study was a cross-sectional study in which 32 male students of sports science departement Universitas Muhammadiyah Cirebon with an average age of 20 ± 1.28 years, an average body weight of 56.45 ± 8.26 kg, and a height of 165.58 ± 7.15 cm, were divided into two groups namely: smoking group ($n = 16$), and non-smoking group ($n = 16$). Subjects were asked to answer a questionnaire related to smoking habits and then the lung capacity of the research sample was measured using an SP70B spirometer (Contec Medical System Co., Ltd., China). Most of the smoking group (75%) consumed 1-5 cigarettes per day, with an average of 4.73 ± 3.15 years of smoking. The results of the measurement of force vital capacity (FVC) of the smoking group amounted to 3.31 ± 0.42 L with an average predicted %FVC is 74%. While the non-smoking group had an average FVC is 3.6 ± 0.6 L with an average %FVC is 80%. The results of the paired sample test found that there was a significant difference between the FVC of subjects who smoked and those who did not smoke with a significance value of 0.000 ($P < 0.05$). The group of smoker students actively exercised had significantly lower lung capacity values than the group of students who actively exercised but non smoker. Non-smoker students had significantly better FVC (L) than smoker students ($p=0.000$). Thus, smoker students but actively exercised have lung capacity values that are at risk ($FVC < 80\%$).

Keywords: *Smoker students, exercise, lung capacity*

INTRODUCTION

The number of active smokers in Indonesia is increasing every year. According to a survey by Badan Pusat Statistik (BPS) in 2024, the number of active smokers aged ≥ 15 years in Indonesia raise from 28.26% in 2022 to 28.62% in 2023. So, by 2023 there will be at least 70 million Indonesians who are active smokers, BPS said that 7.4% of them are young smokers. BPS estimates that young smokers aged 10-18 years who smoke reach around 5.18 million people, out of a smoking population in Indonesia in 2023 of around 952 thousand smokers aged 10-14 years and around 2.93 million smokers aged 15-18 years.

Smoking is a habit that is very common in various layers of Indonesian society, especially among young people, even very difficult to eliminate. In fact, smoking is very dangerous because a cigarette contains more than 4,000 types of chemical compounds, 400 harmful substances, and 43 cancer-causing or carcinogenic substances (p2ptm.kemkes.go.id). One of the harmful substances in cigarettes is carbon monoxide (CO) which is a gas that can poisonously reduce oxygen levels in the blood, so that it can reduce concentration and the onset of dangerous diseases. In addition, cigarettes also contain tar which is a dangerous substance that causes cancer (carcinogenic) and various other diseases. There are other harmful substances in cigarettes, namely nicotine, a substance that causes addiction (addiction) (p2ptm.kemkes.go.id). So smoking is difficult to eliminate.

Tobacco cigarette consumption is a major risk factor for cardiovascular and respiratory diseases, more than 20 types or subtypes of cancer, and a range of debilitating health conditions. Each year, more than 8 million people die from tobacco use (WHO, 2024). Most tobacco deaths occur in low- and middle-income countries, which are often the target of intensive tobacco industry interference and marketing. In Indonesia about 225,700 people die from smoking or other tobacco-related diseases (WHO, 2020).

Tobacco cigarettes can also be deadly to non-smokers. Passive smokers are at 4 times the risk of active smokers (<https://fk.ui.ac.id/>). Exposure to tobacco smoke has also been implicated in poor health outcomes, causing 1.2 million deaths each year. Nearly half of all children breathe air polluted by secondhand smoke and 65,000 children die each year from diseases related to secondhand smoke. Smoking

during pregnancy can cause several lifelong health conditions for the baby (WHO, 2024).

According to the Ministry of Health, smoking at a young age has an impact: impaired learning achievement, impaired intelligence and learning ability, impaired lung development, easily infected with diseases such as meningitis, middle ear infections, pneumonia, bronchitis, asthma, lymphoma, leukemia and difficulty recovering when sick because the immune system decreases. (p2ptm.kemkes.go.id). This can also have an economic impact on individuals and the government to overcome health costs and prevent the adverse effects of these diseases (koran-jakarta.com). In addition, the level of productivity of young people who become active smokers also needs to be questioned.

Regular physical activity and exercise have been found to provide significant physical and mental health benefits. In adults, physical activity contributes to the prevention and management of non-communicable diseases such as cardiovascular disease, cancer, and diabetes, as well as reducing symptoms of depression and anxiety, improving brain health, and may improve overall health (WHO, 2018).

Exercise can potentially have a good effect on the respiratory system. When physically active, the heart and lungs work harder to supply the extra oxygen the muscles need. Exercise also makes the lungs and heart stronger. As physical fitness increases, the body becomes more efficient at getting oxygen into the bloodstream and transporting it to working muscles (American Lung Association, 2024). The benefits of physical activity also apply to people with chronic lung diseases such as asthma or chronic obstructive pulmonary disease (COPD), who are therefore encouraged to engage in regular physical activity (Garcia-Aymerich, Lange, Benet, Schnohr, & Antó, 2006)(Garcia-Aymerich, et al, 2006). Studies show that higher activity is associated with a lower risk of hospitalization and all-cause mortality in COPD patients (Garcia-Aymerich et al., 2006).

Students of the Sports Science Study Program Universitas Muhammadiyah Cirebon (UMC), especially semester 2, have sports practice lecture activities that require students to be physically active. Semester 2 students routinely carry out course sports activities, namely: soccer, volleyball, and basketball with each 2 SKS or 2 x 50 minutes per course. So, at least in a week students do sports activities for

300 minutes / week. This, the researcher estimates that the WHO recommended physical activity is 150-300 minutes per week of moderate intensity aerobic activity (WHO, 2018). This recommendation is known to provide health and fitness benefits for a person.

However, the effects of physical exercise on lung function have not been well documented. Only limited data are available on the effect of physical activity on lung function, especially in heavy young smokers. A study of how smoking and physical activity affect lung function may be expected to find that smoking negatively affects, and physical activity positively affects on lung function. Here, we examined the effects of smoking and exercise on the lung function of sports study program in University.

METHODS

The study was a cross-sectional study, to determine the lung capacity of Sport Science students at Universitas Muhammadiyah Cirebon who smoke and do not smoke. Sports Science students who smoke (smokers) and non smoker are studying for about 1st year have their lung capacity measured in FVC dan %FVC and then compared with non smokers students.

Research Subject

The population of this study were all students of Sports Science at Muhammadiyah University of Cirebon. The sample technique used was purposive sampling with the criteria of Sports Science students of Universitas Muhammadiyah Cirebon semester 2, male, aged 18-25 years, did not have a history of respiratory diseases such as asthma, and COPD, tuberculosis and others, and were willing to be research subjects

Instrument

The research instrument used was a smoking habit questionnaire and measurement of lung capacity with a SP70B spirometer (Contec Medical System Co., Ltd., China). Spirometer is the most common pulmonary function test, and it is widely used in the assessment of lung function to provide objective information used in the diagnosis of lung diseases and monitoring lung health (Suryanto & Chandra, 2020). The data taken were force vital capacity (FVC) in liters (L) and

predicted percentage of force vital capacity (%FVC). Percent of FVC (%FVC) shows an abnormal value is <80% (Bakhtiar A & Tantri E, 2017)

Procedure

The research procedure includes the following: (1) Completion of the smoking habit questionnaire; (2) Measurement of force vital capacity (FVC) in liters (L) and prediction of the percentage of force vital capacity (FVC); (3) Data analysis; (4) Conclusion.

Data Analysis

Data was collected and then normality test was conducted. Data will be tested Paired Samples Test if the data distribution is normal. If it is not normal, a non-parametric method test is used, namely the Mann-Whitney test. Data processing was performed using SPSS Statistics 22 software (IBM, USA).

RESULTS

The study was conducted on June 11 and June 24, 2024 at the Sport Science Laboratory of the Faculty of Health Sciences, University of Muhammadiyah Cirebon. Samples that met the criteria amounted to 32 men (16 smoking, 16 non-smoking), with an average age of 19.76 ± 1.06 years, with an average body weight of 56.46 ± 8.26 kg, and an average height of 165.59 ± 7.15 m. The smoking habits are presented in the following table. The smoking habits are presented in the following table.

Table 1. Total Cigarettes Consumption of Smoking Subjects

Smoking consumption per day (pc)	Frequency (n)	Percentage (%)
1-5	12	75
6-10	3	18,25
11-15	1	6,75

The average length of smoking of subjects who smoke is 4.73 ± 3.15 years, with a range between 1-12 years. there is 1 students who have been smoking for 12 years or since elementary school age.

It is known that the mean FVC (L) of subjects who smoke is lower at 3.31 L with a standard deviation of 0.43, while the mean of subjects who do not smoke is 3.6 L with a standard deviation of 0.6. The same is seen in the prediction of the

percentage of FVC of subjects who smoke with subjects who do not smoke respectively 73.97% and 79.69%. The results of lung capacity measurements with a spirometer are presented in the following table.

Table 2. Lung Capacity Measurement Results

	Smokers		Non-Smokers	
	Mean	SD	Mean	SD
FVC (L)	3,31	0,43	3,6	0,6
FVC (%)	74	9,30	80	9,10

SD: Standard Deviation, FCV: *Force Vital Capacity*

The measurement data was then tested for normality using the Shapiro Wilk test with the results of $P = 0.79$ ($P > 0.005$) in the smoking group and $P = 0.55$ ($P > 0.005$) indicating normal data. To determine the difference in data then conducted an independent test with paired samples test with the following results:

Table 3. Paired Samples Test in FVC (L)

	FVC(L)	SD	P
Smokers	3,31	0,43	0,000*
Non-Smokers	3,6	0,6	

*significant different ($P < 0,05$)

Based on the paired samples test, it was found that there was a significant difference in the FVC of subjects who smoked with those who did not smoke with a significance value is 0.000 ($P < 0.05$). This means that the FVC of subjects who do not smoke is significantly better than subjects who smoke.

Table 4. Paired Samples Test in FVC (%)

	Prediksi FVC (%)	SD	P
Smokers	74	9,30	0,129
Non-Smokers	80	9,40	

Based on the mean predicted value of FVC (%) subjects who do not smoke have a better value than subjects who smoke. However, based on the paired samples test, it was found that there was an insignificant difference. FVC prediction presentation of subjects who smoke with those who do not smoke with a significant value of 0.129 ($P < 0.05$).

DISCUSSION

Based on the paired samples test, it was found that there was a significant difference in FVC (L) of subjects who smoked compared to subjects who did not smoke with a significance value of 0.000 ($P < 0.05$). This means that the FVC of subjects who do not smoke is significantly better than subjects who smoke. This is in accordance with previous research using the results of a t-test between active smokers and non-smokers who exercise obtained a significance of 0.017 smaller than 0.05 (< 0.05), it can be concluded that there is a significant difference between the two, where the cardiorespiratory endurance of non-smokers who exercise is better than active smokers who exercise.

The group of students who smoked showed a predicted %FVC is $74 \pm 9.30\%$. This shows an abnormal value because it is $< 80\%$ (Bakhtiar A & Tantri E, 2017). Further examination with an expert doctor is needed to diagnose whether the subjects' lung conditions are problematic or not. A lower FVC indicates a decrease in expiratory flow velocity and normal capacity which indicates a risk of obstruction. In obstruction, airflow is greater but vital capacity may decrease as a result of trapped air (Bakhtiar A & Tantri E, 2017)

The researchers concluded that although the subjects were physically active it did not make their lung capacity better while still actively smoking. Studies show that there is a strong correlation between increased physical fitness and better lung function in healthy youth in the non-smoking population (Liu et al., 2024). In the smoker subjects in this study, 2 subjects were found to have %FEV $> 80\%$, where the subjects were active. It is mentioned in research that people who smoke and exercise regularly have higher lung capacity compared to people who do not exercise at all (Taher, van Silfhout, & Nazir, 2019). Other study conclude that Physical activity did not affect smoker lung function, but the absence of physical activity significantly worsened lung function ((Dugral, Balkanci, & Ekizoglu, 2019). However, when people quit smoking, it can improve symptoms of respiratory problems and bronchial hyperresponsiveness, and prevent lung function decline (Willemse, et al, 2004). Smoking cessation programs also significantly improve overall FVC and FEV1 regardless of the success or failure of actual smoking cessation (Iwabayashi, Hashimoto, & Tomioka, 2023).

Youth smoking is a complex phenomenon. Despite the known negative effects of smoking, the number of smokers is not decreasing but increasing and the age of smokers is getting younger. There are many reasons behind smoking behavior in youth. Smoking behavior is not only caused by factors from within, but also by environmental a number of adolescents what causes them to smoke, the results showed that the most memenagruhi smoking behavior is the perceived psychological satisfaction and permissive attitude of parents towards youth smoking behavior and peer environment. The permissive attitude of parents and the peer environment to adolescent smoking behavior amounted to 38.4%, while psychological satisfaction contributed 40.9% to smoking behavior. Smoker families are very instrumental to the smoking behavior of their children compared to non-smoker families. While the peer environment has a very important meaning for adolescents. The need to be accepted and the effort to avoid peer group rejection is a very important need. Adolescents do not want to be rejected and avoid being called “sissy” smoking for adolescents is also a symbolization, symbolization of power, masculinity, courage and maturity (Ng, Weinehall, & Öhman, 2007). Smokers often prioritize self-satisfaction over rational thinking due to smoking behavior. A survey showed that almost all smoker subjects in a study ignored health factors, environmental factors and financial factors, they also found it difficult to quit smoking because smoking has become a habit and addiction to addictive substances and they believe that smoking is beneficial to themselves. (Trio Febriyantoro, 2016).

The results of this study can be a consideration for policy makers from the campus level and local governments that education and prevention programs for cigarette use still need to be promoted from a young age. This research still has many weaknesses such as not specifically measuring the physical activity of the research subjects, not considering the level of fitness, lifestyle patterns and food intake or the risk of exposure to pollution in the subject's environment that might affect the results of the study.

CONCLUSIONS

The group of amoker students actively exercised had significantly lower lung capacity values than the group of students who actively exercised but non smoker.

Non-smoker students had significantly better FVC (L) than smoker students ($p=0.000$). Thus, smoker students but actively exercised have lung capacity values that are at risk ($FVC < 80\%$).

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