Negative Correlation of Smoking Habits With Hemoglobin Levels and Maximum Oxygen Volume Capacity on Students

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Abstract

Smoking habits can potentially affect the decrease in hemoglobin levels and VO$_2$max capacity. The purpose of this study is to investigate the association between smoking behaviors and hemoglobin levels as well as VO$_2$max capacity in college students. This is an analytic research design with a cross-sectional study. In total, there were 14 students had an average age of 21.93 ± 1.38 years, with a normal body mass index of 21.53 ± 1.36 kg/m^2, and an average smoking habit of 1881.07 ± 1907.01 cigarettes/year registered as research subjects. Data collection on smoking habits was carried out using interview survey techniques, hemoglobin levels were measured using Easy Touch GCHb with units of g/dL levels, and the multi-stage 20-m Shuttle Run Fitness Test was used to determine maximum oxygen volume (VO$_2$max). The Pearson product-moment correlation coefficient test with a significance threshold of 5% is used in the data analysis approach. The findings revealed a detrimental relationship between smoking behaviors and hemoglobin levels (r=-0.834; p=0.000) and VO$_2$max capacity (r=-0.669; p=0.009). The study's findings show that smoking behaviors have a detrimental association with hemoglobin levels and VO$_2$max capacity. This shows that the higher the cigarette consumption, the lower the hemoglobin level and VO$_2$max capacity.

Keywords: Smoking habit, hemoglobin level, VO$_2$max

1. Introduction

Smoking is the activity of smoking processed tobacco wrapped in white paper that is burned (Pradhana & Rochmania, 2018). In theory, the factor contributing to smoking habits is the development of nicotine addiction cigarettes by experiencing the beneficial effects of nicotine, namely for relaxation or calm, and reducing anxiety or tension (Fikriyah & Febrijanto, 2012). Smoking activity in Indonesia on average begins at the age of 15 years (Salsabila et al., 2022). At a young age in East Java, as many as 68.68% of smokers spend at least 1-5 cigarettes a day (Almaidah et al., 2021). Most smokers smoke at an interval of $\geq$ 60 minutes from waking up and cannot bear not to smoke in prohibited places (Salsabila et al., 2022).

The negative consequences of smoking, particularly on the respiratory organs (Rizqi & Rochmania, 2018). Smoking significantly reduces the function of the cardiorespiratory system by reducing the body's capacity to transport oxygen (de Borba et al., 2014). In addition, the main harmful substance that enters is carbon monoxide (CO) gas which worsens hemoglobin (Hb) and oxygen (O$_2$) levels (Putra et al., 2018), so smoking habits can reduce the quality of physical endurance (Febriadi & Andrijanto, 2021). However, little has been reported on the relationship between smoking habits and hemoglobin levels, and maximal oxygen volume.

Therefore, the purpose of this study is to examine the association between smoking behaviors and hemoglobin levels and maximal oxygen volume (VO$_2$max) in college students.

2. Material and Methods

This was a cross-sectional study with an analytic research approach. 14 students in total had an average age of 21.93 ± 1.38 years, with a normal body mass index of 21.53 ± 1.36 kg/m^2, and had an average smoking habit of 1881.07 ± 1907.01 cigarettes/year registered as research subjects. Data collection on smoking habits was carried out using an interview survey technique (Amelia et al., 2016), hemoglobin levels were measured using Easy Touch GCHb (Easy Touch, Hsinchu, Taiwan) with g/dL levels (Raharjo et al., 2021), and The multi-stage 20-m Shuttle Run Fitness Test was used to determine maximum oxygen volume (VO2max). (Puspodari et al., 2022). Data collection on smoking habits, hemoglobin levels, and VO$_2$max was carried out at one time. The Pearson product-moment correlation coefficient test with a significance threshold of 5% is used in the data analysis approach.

3. Results

The results of the study reported that the subjects had an average age of 21.93 ± 1.38 years, with a normal body mass index of 21.53 ± 1.36 kg/m$_2$. The subjects' average smoking habits were 1881.07 ± 1907.01 cigarettes/year, average hemoglobin 15.34 ± 1.23 g/dL, average VO$_2$max 28.14 ± 4.53 mL/kg/min, and more details can be seen in Table 1 below. Meanwhile, the results of the correlation analysis between smoking habits and hemoglobin levels and VO$_2$max show a negative correlation between the three which can be seen in Table 2.

Table 1. Characteristics of research subjects

Parameters	n	Minimum	Maximum	Mean	Std. Deviation
Age (yrs)	14	19.00	25.00	21.93	1.38
Height (m)	14	1.60	1.74	1.67	0.04
Weight (kg)	14	50.00	71.00	60.07	5.89
Body mass index (kg/m^2)	14	19.10	23.50	21.53	1.36
Smoking habits (cigarettes/year)	14	110.00	6570.00	1881.07	1907.01
Hemoglobin (g/dL)	14	12.20	17.00	15.34	1.23
VO$_2$max (mL/kg/min)	14	23.90	40.00	28.14	4.53

Table 2. The results of the correlation analysis of smoking habits with hemoglobin and VO$_2$max levels

Parameter	n	Smoking habits (Stems/yrs)	
		Pearson Correlation	Sig. (2-tailed)
Hemoglobin (g/dL)	14	-0.834[**]	0.000
VO$_2$max (mL/kg/min)	14	-0.669[**]	0.009

4. Discussion

The mean hemoglobin level of the 14 research subjects was 15.34 g/dL, with the lowest value being 12.20 g/dL and the highest value being 17.00 g/dL. The correlation analysis results revealed a negative association between smoking practices and hemoglobin levels (Table 2). This result is different from the

research report by Amelia et al. (2016) indicated that there was no link between the Brinkman Index and the degree of smoking and hemoglobin levels. Many other factors affect hemoglobin levels in the body, especially for smokers (Septiani, 2022). Smoking is known to be a major public health problem and is considered the leading cause of preventable death worldwide (Wang et al., 2023). Results by Vivek et al. (2023) confirmed that smoking tobacco has a strong relationship with iron deficiency anemia. Heavy metals and several persistent organic pollutants included in cigarettes can cause illnesses, such as cardiovascular disease (CVD), cancer, and chronic obstructive pulmonary disease (COPD) (Kim et al., 2023; Achanzar et al., 2001; Qin et al., 2009; Donaldson et al., 2010). However, it is well known that blood cells are produced in the bone marrow (Remley et al., 2023). The possible negative effects of smoking can have a direct impact on the quality of circulating blood cells. This might explain why there is a link between smoking behaviors and hemoglobin levels in this study. Therefore, future studies may compare smoking behaviors to bone marrow quality to identify the relationship between smoking habits and hemoglobin levels, yielding more precise results.

The findings revealed that there was a negative relationship between smoking habits and VO_2max capacity. That is, someone who has a smoking habit tends to have a lower VO_2max capacity compared to a non-smoker (Zuhdi & Yuliastrid, 2017). Mitochondrial respiration is an important component of cell metabolism (Smolina et al., 2023). Mitochondrial respiration can be represented by VO_2max capacity. VO2max measures an organism's ability to incorporate oxygen into metabolism to get energy (Rosado-Pérez & Mendoza-Núñez et al., 2018). According to the findings of this study, there is a negative relationship between smoking behaviors and obesity and VO_2max capacity. The possible mechanism linking smoking to a reduction in VO2max might be oxidative damage and inflammation caused by smoking. Smoking-induced oxidative stress and inflammation are linked to the pathological processes of several chronic respiratory disorders, including asthma, emphysema, chronic obstructive pulmonary disease, and cancer (Xue et al., 2023). According to Decker et al. (2023), cigarette smoke directly impairs the mitochondrial respiration of carbohydrate-derived substrates, which is the main mechanism underlying cigarette smoke-induced muscle dysfunction, resulting in adverse effects such as excess glucose conversion to fatty acids and lipotoxicity. It is well understood that mitochondria play a crucial role in the regulation of the inflammatory response (Marchi et al., 2023).

5. Conclusion

The study's findings demonstrate that there was a negative relationship between smoking habits and hemoglobin levels and VO_2max capacity. This shows that the higher the cigarette consumption, the lower the hemoglobin level and VO_2max capacity.

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