ORIGINAL ARTICLE

Physical Therapy Journal of Indonesia (*PTJI*) 2023, Volume 4, Number 1: 50-54
E-ISSN : 2722-6034 ; P-ISSN : 2722-0125

The relationship between smoking dose with oxygen saturation and cardiorespiratory endurance on young adult men

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ABSTRACT

Background: Healthy lifestyle can reduce the risk of disease. One of the unhealthy lifestyle patterns is consuming cigarettes. Smoking can also reduce the affinity of oxygen for hemoglobin so that it can affect oxygen saturation levels in the blood. This study aimed to determine the relationship between smoking dose, oxygen saturation, and cardiorespiratory endurance in adult men.

Methods: The study design was a cross-sectional study with an adult male population in the Tampaksiring Village, Bali, Indonesia, in which they qualified for the inclusion and exclusion criteria. Adult men were selected by purposive sampling. It was obtained 52 samples. The measurement of smoking dose using the Brinkman index, the measurement of oxygen saturation using oximetry, and the measurement of cardiorespiratory endurance using the Harvard step test. Data were analyzed using computer software with the Spearman rank test to determine the relationship between smoking dose with oxygen saturation and cardiorespiratory endurance in adult men.

Results: The results showed that from 52 adult men were obtained by analysis result of the relationship between smoking dose and oxygen saturation where $p = 0.000$ ($p<0.05$) and the analysis result of the relationship between smoking dose and cardiorespiratory endurance with $p = 0.000$ ($p<0.05$).

Conclusion: There was a significant relationship between smoking dose with oxygen saturation and cardiorespiratory endurance in adult men in Tampaksiring Village, Bali, Indonesia.

Keywords: cardiorespiratory endurance, oxygen saturation, smoking dose, young adult men.

Cite this Article: Suadnyana, I.A.A., Negara, N.L.G.A.M., Wiraguna, I.W. 2023. The relationship between smoking dose with oxygen saturation and cardiorespiratory endurance on young adult men. *Physical Therapy Journal of Indonesia* 4(1): 50-54. DOI: 10.51559/ptji.v4i1.75

INTRODUCTION

A healthy lifestyle is essential for human beings' survival in terms of behavior, food, activities, and so on, leading to a healthier physical and spiritual life. A healthy lifestyle can reduce the risk of disease. One of the unhealthy lifestyle patterns is consuming cigarettes.

Cardiorespiratory endurance is the ability of the heart, lung, and blood vessel systems to function optimally in working and resting conditions to take in oxygen and channel it to active tissues so that it can be used in the body's metabolic processes.[1] Smoking can cause damage to the cardiorespiratory system, namely problems with the heart and lung system. Cigarette smoke that enters the body through the lungs contains carbon monoxide and nicotine and enters the blood, and is then flowed throughout the body, and this has an impact on the muscles becoming deprived of oxygen intake, which causes muscle work to be hampered so that the work of the heart will also be hindered because of blockage of blood vessels. It makes the heart pump harder, decreasing the heart's work power.[2]

The proportion of smokers in Indonesia in 2016 amounted to 28.8%, with the most active daily smokers at the age of 20-24 years of 27.3%, ages 25-29 years of 30.4%, ages 30-34 years of 32.2%, ages 35-39 years 32.20%.[3] Based on data from the Bali Provincial Health Office, the highest smoking prevalence is in Jembrana Regency, with a total of 22.56%, while the lowest is in Klungkung Regency, with a total of 13.54%, and for Gianyar Regency, the prevalence of smoking is 14.84%.[4]

Smoking is an act of burning and inhaling tobacco packaging in the form of cigarettes. The dose of smoking is divided into three categories: mild, moderate, and severe. The dose of smoking is the multiplication of the average number of cigarettes smoked multiplied by the number of years smoked; this is used to determine the dose of smoking - light, medium, and heavy. A person's smoking habit can be measured using the Brinkman index.[5]

Smoking can also affect cardiorespiratory endurance, an essential component in assessing a person's level of physical fitness. Cardiorespiratory endurance can be influenced by age, gender, body mass index, physical activity, nutritional

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Received : 2023-03-15
Accepted : 2023-04-24
Published : 2023-05-09

status, sports activities, and smoking habits.[6,7] Cardiorespiratory endurance can be assessed by measuring maximum oxygen consumption (VO2 max), the best single indicator that can be measured directly or indirectly. Cardiorespiratory endurance can be measured using the Harvard step test.[8]

Gianyar Regency ranks fourth in Bali, with a proportion of smokers of 11.0%.[4] Tampaksiring is one of the districts with a dense population. Of course, the large number of residents raises various kinds of problems, one of which is a large number of smokers. Based on the above, the researchers wanted to learn more about the relationship between smoking dose and oxygen saturation and cardiorespiratory endurance in adult males in Tampaksiring Village, Gianyar Regency, Bali, Indonesia.

METHODS

This research is an analytic observational study with a cross-sectional design. The sampling technique used in this research is non-probability sampling with purposive sampling. The research was conducted from May to June 2022. The participants met the inclusion criteria: male aged 20-40 years, active smokers for at least two years, can read and write (communicate well), and willing to volunteer as a research sample from the beginning to the end of the study by signing informed consent. Meanwhile, the exclusion criteria were not currently treated for infectious diseases and psychiatric disorders. The sample size was 52 participants.

In the cross-sectional approach, data concerning the independent variable and the dependent variable are collected at one time and at the same time. Data on a smoking dose, oxygen saturation, and cardiorespiratory endurance were carried out at the same time, meaning that each study subject was collected once using oximetry and the Harvard step test to measure the level of freshness or physical fitness, has a validity value of 0.883 and a reliability level of.[9] Data were analyzed using SPSS version 25 computer software with the Spearman rank test to determine the relationship between smoking dose with oxygen saturation and cardiorespiratory endurance in adult men.

RESULTS

Based on Table 1, the distribution of data based on age with an age range of 20-25 years, totaling 17 people (32.7%), an age range of 26-30 years, totaling 16 people (30.8%), an age range of 31-35 total 9 people (17.3%) and the age range of 36-40 amounted to 10 people (19.2%). Distribution of data based on work as employees totaling 10 people (19.2%), working as builders demolishing 17 people (32.7%), working as craftsmen totaling 18 people (34.6%), and as nurses 7 people (13.5%) with a total sample of 52 people (100%).

Based on table 2 shows that respondents with mild smoking dose with SpO2 levels of 95%, namely 1 respondent (1.92%), respondents with mild smoking dose with SpO2 levels of 96%, namely 9 respondents (17.31%), respondents with smoking dose mild smoking with a SpO2 level of 97%, namely 8 respondents (15.4%), respondents with a mild dose of smoking with a level of SpO2 of 98%, namely 13 respondents (25%) and respondents with a mild dose of smoking with a level of SpO2 of 99%, namely 14 respondents (26, 9%). Then respondents with moderate smoking dose with SpO2 levels of 95%, namely 5 respondents (9.62%), and respondents with moderate smoking dose with SpO2 levels of 96%, namely 2 respondents (3.85%).

Table 2 also shows that the p-value is 0.000 ($p < 0.05$), which means a significant relationship exists between the dose of smoking and oxygen saturation in adult men. Then in the table, the correlation value (r) is -0.910, which means that the relationship between smoking dose and oxygen saturation has a powerful correlation level with a negative direction.

Based on table 3 shows that respondents with mild smoking dose had excellent cardiovascular endurance, namely 3 respondents (5.78%), respondents with mild smoking dose with good cardiovascular endurance, namely 41 respondents (78.8%), and respondents with mild smoking dose with sufficient cardiovascular endurance, namely 1 respondent (1.92%). Then respondents with moderate smoking dose with good cardiovascular endurance 7 respondents (13.5%).

Table 3 below also shows that the p-value is 0.000 ($p < 0.05$), which means a significant relationship exists between the dose of smoking and cardiovascular endurance. Then in the table, the correlation value (r) is -0.892, which means that the level of relationship between smoking dose and cardiorespiratory endurance has an extreme correlation level in a negative direction.

DISCUSSION

This study's results align with the results of research conducted by Makawekes (2016) that out of 60 respondents who smoked, 96% were in the age range of 20-23 years.[10] The mild smoking dose category often occurs in the age range of 17-25 years with the number of cigarettes smoked per day ± 10 cigarettes.[11] Working activity while smoking has become a culture in Indonesia, per the 2018 Riskesdas report and the global tobacco survey,

which states that working people smoke more than non-working people.[3]

All respondents were in normal oxygen saturation conditions ranging from 95-100%. This study shows that the heavier the dose of smoking, the less oxygen saturation will decrease. Smoking affects blood oxygen saturation levels. Carbon monoxide content in cigarettes is one of the causes of changes in oxygen saturation. Someone who does not smoke has a higher oxygen saturation than smokers.[12]

The results of this study are also supported by previous research conducted by Sudaryanto (2017) on 90 smoker respondents with a p-value <0.05, which means there is a significant relationship between smoking and oxygen saturation.[13] The dose of smoking affects the value of oxygen saturation because one cigarette that is burned will emit around 4,000 chemicals, including nicotine, carbon monoxide gas, nitrogen oxides, hydrogen cyanide, ammonia, acrolein, benzene, and ethanol.[14]

Carbon monoxide binds to hemoglobin 200 times more strongly than oxygen. The carbon monoxide and hemoglobin bond, which is more potent than oxygen, will decrease oxygen availability in the tissues. With this bond, more HbCO will be formed than HbO2, reducing the blood's ability to distribute oxygen, especially in organs with the most oxygen needs. Besides this, it also causes an increase in red blood cell mass, explained as a response to tissues that lack oxygen supply as a result of exposure to carbon monoxide (CO), which reduces the affinity of oxygen for hemoglobin and affects oxygen saturation levels in the blood.[14]

The higher the intensity of smoking in one day multiplied by the number of years smoking will affect the value of oxygen saturation levels.[11] The amount and duration of smoking determine the dose of smoking in a person, which will affect the level of oxygen saturation in the blood.

These results align with research conducted by Rahmawati on adolescents in Serang, Banten, in 2009, showing a relationship between cigarette consumption and fitness.[16] Another study by Budiasih in 2011 showed a relationship between smoking behavior and physical fitness, which measured the level of cardiorespiratory endurance as measured by the Harvard step test.[17]

Substances contained in cigarettes such as carbon monoxide (CO) found in cigarettes can also cause impaired cardiorespiratory endurance because CO's ability to bind to hemoglobin is stronger than oxygen, so it can cause hemoglobin desaturation in the blood and directly reduce oxygen supply to tissues throughout the body, including to muscles. Heart. Carbon monoxide replaces oxygen in hemoglobin and interferes with the release of oxygen. Thus, carbon monoxide reduces the capacity for physical exercise.[18]

Individuals with a higher dose of smoking cause a decrease in cardiorespiratory endurance. This was proven in a study conducted by Erawati in 2014 in Riau, which found less cardiorespiratory

Table 1. Characteristics of respondents based on age and occupation.

Characteristic	Category	Frequency	Percentage (%)
Age	20-25 years	17	32,7
	26-30 years	16	30,8
	31-35 years	9	17,3
	36-40 years	10	19,2
Occupation	Employees	10	19,2
	Builder	17	32,7
	Craftsmen	18	34,6
	Nurse	7	13,5

Table 2. Result of Spearman rank test of dose of smoking and oxygen saturation.

Dose of smoking	SpO2										Total		Spearman rank correlation test value	
	95		96		97		98		99					
	n	%	n	%	n	%	n	%	n	%	n	%	*p*-value	*r*
Mild	1	1.9	9	17.3	8	15.4	13	25	14	26.9	45	86.5	0.000	-0.91
Moderate	5	9.6	2	3.9	0	0	0	0	0	0	7	13.5		

n, number of participants; *r*, Spearmen correlation value.

Table 3. Result of Spearman rank test results in dose of smoking and cardiovascular endurance.

Dose of smoking	Cardiovascular Endurance						Total		Spearman rank correlation test value	
	Excellent		Good		Average					
	n	%	n	%	n	%	n	%	*p*-value	*r*
Mild	3	5.8	41	78.8	1	1.9	45	86.5	0.000	-0.892
Moderate	0	0	0	0	7	13.5	7	13.5		

n, number of participants; *r*, Spearmen correlation value.

endurance in individuals who smoked by measuring cardiorespiratory endurance, namely the Harvard step test.[19] Cardiorespiratory endurance is an essential indicator of obtaining information about the performance of the respiratory organs and the heart in humans.[20] Thus, this can be a reference used as a critical component of how someone can determine their level of fitness, namely cardiorespiratory endurance.

Cardiorespiratory endurance is also known as aerobic capacity. In the laboratory, the most objective measurement is made by calculating the VO2 max. A person's cardiorespiratory endurance is closely related to the state or ability of the heart (circulatory system) and lungs (respiratory system) to function optimally when carrying out daily activities for quite a long time without experiencing significant fatigue.[20]

Individuals who do not smoke have cardiorespiratory endurance of 7.2% less than smokers. The resting pulse rate of individuals who smoke is higher, and the maximum pulse rate is lower than individuals who do not smoke.[19,21] In other words, the higher the resting pulse rate, both the heart and lungs of a smoker will result from heavier work for these organs to pump blood throughout the body so that the individual will tire quickly, affecting cardiorespiratory endurance.

CONCLUSION

Based on the research and discussion results, it can be concluded that there was a relationship between the dose of smoking and oxygen saturation levels and cardiorespiratory endurance in adult men in Tampaksiring Village, Bali, Indonesia.

CONFLICT OF INTEREST

This research has no conflict of interest.

LIMITATION

Unable to control the number of cigarettes smoked each day.

ETHICAL CONSIDERATION

This study included informed consent. This study received approval from the ethical committee of Universitas Bali Internasional.

FUNDING

No funding for this study.

AUTHOR CONTRIBUTIONS

IAAS compiled the study design, data collection, and data analysis and drafted the manuscript; IAAS, NLGAMN, and IWW participated in the literature search, drafting, and revising of the manuscript. All authors have read and approved the final version of the manuscript.

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