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The Relationship Between Smoking Levels and VO_2 MAX in Students at the Indonesian Institute of the Arts Yogyakarta

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ABSTRACT

Introduction: As agents of change, university students require two supporting factors, namely physical fitness and academic performance. Students with low VO_2MAX values experience decreased learning outcomes and low levels of fitness, with one influencing factor being smoking habits. Smoking habits affect cardiovascular endurance due to the nicotine content in cigarettes, which can damage the lungs. This study aimed to investigate the relationship between smoking intensity and VO_2MAX among students. **Methods:** This correlation study employed an analytical observational method with a cross-sectional design. Purposive sampling was used to select 40 participants. The Cooper Test was used as the measurement tool. Data were analysed using the Spearman rank correlation. **Results:** The analysis of the relationship between smoking intensity and VO_2MAX using the Spearman rank test yielded a p-value of 0.01 ($p < 0.05$). This result shows a significant relationship between smoking intensity and VO_2MAX values. The correlation coefficient was -0.741, which indicates a strong statistical relationship between the variables. **Conclusion:** There is a relationship between smoking intensity and Maximum Oxygen Consumption (VO_2MAX) values among students.

***Keywords**: Degree of Smoking, Brinkman Index, VO_2MAX, Cooper Test, students*

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INTRODUCTION

Adult students are considered agents of change, whereby students must possess two supporting factors. These two factors are physical fitness and academic achievement. Physical fitness is an individual's ability to perform daily activities and work, as well as the habit of exerting the body without causing excessive fatigue and still having enough energy to continue performing subsequent activities (Ismail & Wahyudi, 2021).

Physical fitness greatly influences a person's learning activities, where physical fitness is influenced by, among other things, aerobic capacity or maximum oxygen uptake (VO_2MAX) (Fiyanti & Agustin, 2020). University students are part of early adulthood, a stage where they constantly seek acceptance within their peer group and are influenced to imitate the behaviours and actions of those around them, one of which is smoking (Budiman & Hamdan, 2021).

The habit of smoking affects cardiovascular endurance because the nicotine content in cigarettes can cause damage to the lungs. The effect of smoking on VO_2MAX is that the CO inhaled reduces the VO_2MAX value, which affects physical endurance. In addition, nicotine can increase energy expenditure and reduce appetite. This affects health and has an impact on a person's physical fitness (Fadli & Sutysna, 2017). Students with low VO_2MAX values will experience a decline in learning outcomes and low fitness levels, where one of the influencing factors is smoking (Ismail et al., 2021).

The prevalence of smokers aged 15 years and above worldwide, based on a report by the World Health Organisation (WHO), was more than 991 million people in 2020 (Mutia, 2021).Data from the WHO on the prevalence of smokers in Indonesia in 2019 shows that 19.2% of adolescents aged 13-15 years old and 16-19 years old as much

as 22.6% (Ministry of Health of the Republic of Indonesia et al., 2019). The province of DIY consists of four regencies and one city, namely Bantul Regency Bantul, Sleman Regency Sleman, Gunung Kidul Regency, Kulon Progo Regency, and Yogyakarta City. The highest cigarette consumption was found in Yogyakarta City at 47.0%, Bantul Regency at 47%, followed by Sleman Regency at 45.7%, and Kulon Progo Regency at 36.3% (Luji & Lubis, 2017).

METHODS

This is a correlational study using observational analytical methods with a cross-sectional design. The sampling technique used was purposive sampling with a sample size of 40 people. The measuring instruments used were the Cooper test for VO_2MAX and the Brinkman Index questionnaire to measure smoking levels.

The subjects selected were theatre students at the Indonesian Institute of the Arts in Yogyakarta. The population consisted of 68 people. Subjects were selected using purposive sampling with inclusion and exclusion criteria, with the sample size determined using the Slovin formula, resulting in 40 people who could be used as research subjects. The inclusion criteria were as follows: 1) The sample is willing to sign an Informed Consent form; 2) Active student; 3) Aged 19-25; 4) BMI: underweight, normal, overweight, obese, obesity 2; 5) Male and female; 6) Smokes daily; 7) Able to communicate effectively. Exclusion criteria include: 1) Did not attend the study; 2) Currently experiencing illness or injury such as fever and injury conditions that prevent running.

The study was conducted at the Indonesian Institute of the Arts Yogyakarta from 3 July 2023 to 4 July 2023.

RESULTS

After data collection, the results were obtained and analysed using:

Univariate Analysis

Univariate analysis is used to provide an overview of the characteristics of the variables studied. The sample in this study consisted of students majoring in theatre at the Indonesian Institute of the Arts in Yogyakarta.

Based on Table 1, it can be seen that the characteristics of the respondents in this study were 23 males (57.5%) and 17 females (42.5%). Gender was a factor that influenced the categorisation of VO_2MAX values. The respondents in this study who were 19 years old numbered 13 (32.5%), 20 years old (22 respondents, 55.0%), and 21 years old (5 respondents, 12.5%).

Table 1. Analysis of Respondent Characteristics

Characteristics	Details	Frequency	Percentage (%)	Mean	Std Dev
Type Gender	Male	23	57.5%	1.43	.501
	Female	17	42.5%	1.43	.501
Age	19 years	13	32.5%	19.80	.648
	20 years	22	55.0%	19.80	.648
	21 years	5	12.5%	19.80	.648
BMI	Under weight	4	10.0%	2.60	.982
	Normal	17	42.5%	2.60	.982
	Over weight	11	27.5	2.60	.982
	Obesity1	7	17.5%	2.60	.982
	Obesity2	1	2.5	2.60	.982
Physical activity	Never	14	35.0%	1.90	.810
	Once a week	17	42.5%	1.90	.810
	2 times a week	8	20.0%	1.90	.810
	3 times a week	1	2.5%	1.90	.810
Smoking level	Mild	13	32.5%	1.90	.588
	Moderate	24	60.0%	1.90	.588
	Weight	3	7.5%	1.90	.588
VO2MAX	Very Poor	14	35.0%	2.03	.947
	Poor	14	35.0%	2.03	.947
	Fair	9	22.5%	2.03	.947
	Good	3	7.5%	2.03	.947

Respondents with an underweight BMI were 4 (10.0%), with a value of Normal BMI was 17 (42.5%), 11 respondents (27.5%) had overweight BMI, 7 respondents (17.5%) had obesity BMI 1, and 1 respondent (2.5%) had obesity BMI 2. Respondents with no physical activity at all numbered 14 (35.0%), physical activity once a week numbered 17 (42.5%), respondents with physical activity twice a week: 8 (20.0%), and respondents with physical activity three times a week: 1 (2.5%). Respondents with a light smoking level numbered 13 (32.5%), respondents with a moderate smoking level numbered 24 (60.0%), and respondents with a heavy smoking level numbered 3 (7.5%).

Respondents with a very poor VO_2MAX score numbered 14 (35.0%), respondents with a poor VO_2MAX score numbered 14 (35.0%), respondents with a fair VO_2MAX score numbered 9 (22.5%), and respondents with a good VO_2MAX score numbered 3 (7.5%). Respondents with a light smoking level numbered 13 (32.5%), moderate

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level numbered 24 (60.0%), and heavy level numbered 3 (7.5%).

Bivariate Analysis

Bivariate analysis was conducted to determine the relationship between the two variables, namely the dependent and independent variables. For data analysis, the Spearman test was used with SPSS, which is used to measure the closeness of the relationship between two variables.

Table 2. Analysis of the Relationship between Smoking Status and VO_2MAX

Spearman's rho	**Degree Smoking**	Correlation Coefficient	1.000	-0.741
		Sig. (tailed) 2	-	0.01
		N	40	40
	VO_2MAX	Correlation Coefficient	-0.741	1.000
		Sig. 2 (tailed)	.000	
		N	40	40

Based on Table 2, the results of the analysis of the relationship between smoking degree and VO_2MAX using the Spearman test show a p-value of 0.01 ($p<0.05$), which means that there is a significant relationship between smoking degree and VO_2MAX value. The correlation coefficient value is -0.741, with a statistically strong variable relationship category.The correlation coefficient value is negative, which means that the relationship between the two variables is not in the same direction or is opposite. This means that if the independent variable increases, the dependent variable decreases, or vice versa. Thus, it can be interpreted that if one variable increases, the other variable decreases. From the results of the study and data analysis, it was found that the higher the degree of smoking, the lower the VO_2MAX value.

DISCUSSION

Students require good physical fitness as it is one of the supporting elements in carrying out all activities. In conducting academic activities, good physical fitness is needed so that the learning process and activities during lectures can be carried out to the fullest, where physical fitness is influenced by, among other things, maximum oxygen volume (VO_2MAX). If VO_2MAX is good, physical fitness will also be good.

According to Max et al. (2016), males tend to have higher VO_2MAX values greater maximum compared to women with a range that is 15-30% greater. This is in line with Millah's (2020) research, which states that gender affects VO_2MAX values and categorisation in men and women, with men having higher VO_2MAX values than women. This difference in VO_2MAX values is generally due to changes in body composition and differences in haemoglobin content in the body.

Cardiovascular endurance increases in intensity from the age of 12 until it reaches its maximum at the age of 20-30. This endurance will decrease over time and with age. According to Noordia (2015), VO_2MAX will gradually decline after the age of 25. According to Ani (2012) in Gantarialdha (2021), age reduces a person's physical fitness level by about 8-10% every ten years for people who are inactive in their daily activities or do not like to exercise.

Body mass is a way to monitor a person's nutritional status in relation to underweight, overweight or obesity. Excess weight can increase the risk of degenerative diseases. According to Gantarialdha (2021), if a person's BMI falls into the overweight to obese category, there will be an increase in body fat. This increase in body fat will disrupt or reduce the physiological function of the heart due to thickening of the ventricular walls, resulting in a decrease in cardiac output, which causes less blood to be pumped and therefore less oxygen to circulate in the muscles.

High BMI values cause a decrease in VO_2MAX levels. As BMI increases, VO_2MAX decreases. The VO_2MAX values for underweight and obese individuals will adjust according to their physical capabilities and activity levels (Rusmini & Ma'rifah, 2017). High levels of activity do not guarantee a good VO_2MAX value; rather, physical activities such as sports or exercise that are beneficial to the body are required

Individuals with light activity levels have a 10 times lower risk of cardiorespiratory fitness compared to those with moderate and high activity levels (Munir et al., 2022). Physical activities can include jogging, cycling, leisurely walking, or other sports. The frequency of exercise, typically performed 1–3 times a week, 3–4 times a week, 4–

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5 times a week, or daily over the course of a week, can increase VO_2MAX values towards their maximum (Rahman et al., 2020).

The statistical conclusion based on the Spearman test yielded a result of p=0.01. If the Sig. (2–Tailed) p<0.05, it can be said that there is a significant relationship between smoking level and VO_2MAX. Based on the correlation coefficient test, the result was r=-0.741, which means there is a strong relationship. The negative value indicates that there is a negative or inverse relationship between smoking degree and VO_2MAX, meaning that the higher the smoking degree, the lower the VO_2MAX value, or conversely, the lower the smoking degree, the higher the VO_2MAX value.

This is because the level of VO_2MAX is influenced by several factors, namely smoking status, age, physical activity, BMI, and gender. Low and high BMI can reduce VO_2MAX, while high or frequent physical activity will increase VO_2MAX.From the data collected, the highest VO_2MAX value was found in males at 46.3 ml/kg/minute, with a BMI of 18.7 kg/m²and a smoking level of 1/light, with physical activity twice a week. The lowest VO_2MAX value in males was 17.7 ml/kg/min, with an IMT of 20.2 kg/m²and a smoking level of heavy/3, with physical activity once a week.

The highest VO_2MAX value in women was 35.2 ml/kg/minute, with a BMI of 16.7 kg/m² 2 and a smoking level of 1/light and physical activity 2 times a week. The lowest VO_2MAX value in women was 17.3 ml/kg/min, with a BMI of 25.3 kg/m²and moderate smoking (2)and no physical activity. A higher smoking level reduces a person's VO_2MAX value.

According to Delfa (2020), cardiorespiratory endurance is an important indicator used to obtain information about the performance of the respiratory and cardiac organs in humans, where cardiorespiratory endurance is also referred to as aerobic capacity, which is measured by calculating the VO_2MAX value.From the data collected, the VO_2MAX value was obtained. This aligns with Zuhdi's (2017) research, which states that the higher the smoking habit, the lower the VO_2MAX level, and vice versa.

CONCLUSION

Based on the objectives, results, and discussion, the following conclusions were drawn:

There is a relationship between smoking levels and maximum oxygen uptake (VO_2MAX) values among students at the Indonesian Institute of the Arts in Yogyakarta, based on a p-value of 0.01 (<0.05). The correlation coefficient test result of r=-0.741 indicates a strong and negative relationship, showing that the higher the smoking level, the lower the VO_2MAX value.

Research Limitations

The researcher could not control the respondents' daily physical activity and could not accurately monitor the number of cigarettes consumed by respondents in a day.

Recommendations

Based on the conclusions of the research results, the following recommendations are made for future research:

1. For Future Researchers

   It is necessary to monitor or verify the daily physical activity of respondents, which may influence VO_2MAX values. Ensure that the injury or illness history of respondents is accurately documented.
2. For Physiotherapists

   It is hoped that this can be used as a reference or plan for intervention and education in cases related to cardiorespiratory health.
3. For Students

   For students, the results of this study can be used as an illustration or reference for things that can support achievement and as education to learn about the dangers of smoking and the importance of cardiorespiratory health.

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