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THE EFFECT OF BODY FAT PERCENTAGE ON VO_2MAX IN FACULTY OF MEDICINE STUDENTS AT THE UNIVERSITY OF LAMPUNG

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Abstract

Changes in lifestyle and high levels of stress in early semester medical students have the potential to increase the risk of obesity which will have a direct effect on increasing the body fat percentage due to inadequate physical activity. The body fat percentage sufficiently affects maximal oxygen uptake (VO2max) during exercise. This study aims to determine the effect of body fats percentage on VO2max in medical students at the University of Lampung. This research is a correlative analytic research with a cross-sectional approach, using primary data obtained from a simple random sampling technique. A total of 39 male students from the Faculty of Medicine of Lampung University batch 2022 who met the inclusion and exclusion criteria were measured for BMI and the body fat percentage using a stepping scale, followed by the measurement of VO2max using the Balke Test method. The results of this study indicate that there is a significant relationship between the body fat percentage to VO2max with a correlation coefficient (r) -0.800, a significant significance value of p<0.000. The correlation formed is - 0.800 indicating a very strong negative correlation between variables, meaning that the higher the body fat percentage, the lower the VO2max values, and vice versa.

Keywords: *Fat body percentage, VO2max*

INTRODUCTION

Changes in lifestyle, diet, and homogeneous demanding activity accompanied by low physical activity and high stress levels at the beginning of the semester of medical student course schedules significantly increase the risk of obesity and body fat percentage [1]. In general, there is a close relationship between the percentage of body fat and the incidence of obesity. Fat mass is one of the constituent components of the body in addition to bone mass, muscle mass, and body water content. The combination of several factors such as genetics, diet, physical activity, stress factors, metabolism and individual hormones, sex, and age significantly affects the occurrence of obesity [2].

This also has an impact on VO2max, which is a measure of the maximum capacity of a person's body to use oxygen during exercise. The higher the percentage of body fat in a person, the lower the VO2max [3]. This is because body fat has a lower energy density than muscle; therefore, a person with a high percentage of body fat will have less muscle efficiency when using oxygen during exercise, resulting in a lower VO2max value.

Body fat percentage is the ratio of body fat to body composition [4]. Someone with the same height and weight will not have the same percentage of body fat, because the level of fat in the body is also affected by activities and daily diet. One study showed that athletes who tend to have a high percentage of body fat tend to have low VO_2max values compared to athletes who have ideal or normal body fat percentages who will have good VO_2max values [5]. So that the percentage of body fat sufficiently affects the amount of VO_2max [6].

Method

This study used a correlative analytic research method with a cross-sectional approach to determine the effect of body fat percentage on VO_2max in first-year students at the Faculty of Medicine, University of Lampung, class 2022. The population of this study was active male students at the University's Medical Faculty Lampung class in 2022. Through the sampling method, namely simple random sampling, 39 research subjects met the inclusion and exclusion criteria. Data collection was conducted at the Pahoman Stadium, Bandar Lampung, which has a flat, non-undulating, and non-slippery track structure with a track length of 435 meters. In an effort to protect the human rights and welfare of health research subjects, this study received ethical approval from the Health Research Ethics Commission of the Faculty of Medicine, University of Lampung (number 1396/UN26.18/PP.05.02.00/2023.

Before measuring body fat percentage and VO_2max values, data collection and informed consent were obtained from all research subjects. The primary data were obtained from direct measurements of body weight and height to obtain Body Mass Index (BMI) values. Body fat percentage was measured using a stepping scale and microtoise stature meter, while VO_2max measurements used the Balke test method, namely the research subjects ran from the start line for 15 minutes using a stopwatch, and then the distance each research subject successfully covered was recorded and entered into the Balke calculation formula. test, so that the VO_2max value was obtained in units (ml/kg/minute). After that, the data obtained were processed using SPSS software version 23.0 and analyzed using the Pearson test.

Results

The characteristics of the research subjects consisted of VO_2max, body mass index, and body fat percentage.

Table 1. Characteristics of Research Subjects

Subject Characteristic	Minimum	Maximum	Mean
Age (years)	18	20	18.31 ± 0.521
Body weight (kg)	42.2	121.3	71.249 ± 19.972
Body height (cm)	152.9	185.1	167.682 ± 6.223
BMI (kg/m^2)	16.6	43.2	25.177 ± 6.238

As shown in Table 1, the sample age ranged from 18 to 20 years. Based on body weight data, the lowest weight was 42.2 kg and the highest body weight was 121.3 kg. Meanwhile, the lowest height was 152.9 cm and the highest was 185.1 cm. The lowest Body Mass Index was 16.6 kg/m^2, the highest Body Mass Index was 43.2 kg/m^2, and the average BMI for all samples was 25.177 ± 6.238.

Table 2. Distribution of Body Mass Index Categories of Study Subjects

BMI	Number	%
Underweight	4	10.25
Normal	12	30.76
Overweight	4	10.25
Obesity	19	48.71

Data from Table 2 show that most of the samples had a body mass index in the obese category, namely 19 samples, followed by samples with a normal body mass index, namely 12 samples, 4 samples included in the thin or underweight category, and 4 samples included in the fat or overweight category.

Table 3. Univariate analysis of body fat percentage

Subject Characteristic	Minimum	Maximum	Median	Mean
Body fat percentage	5.0	38.1	19.600	19.218 ± 8.205

Based on Table 3 of 39 samples found the percentage of body fat with a minimum value of 5.0, a maximum value of 38.1, a median value of 19.600, and an average value of 19.218 with a minimum average value of 11.013 and a maximum average value of 27.423.

Table 4. Distribution of VO_2max categories based on body fat percentage

Body fat percentage	VO_2max					
	Very low		Low		Average	
	N	%	N	%	N	%
Normal	8	20.51	14	35.89	6	15.38
Obesity	10	25.64	1	2.56	0	0

Table 4 shows that most of the subjects with normal body fat percentage had low category VO_2max values, namely 14 subjects, followed by 8 subjects who had very low VO_2max values, and 6 subjects who had fairly good VO_2max values. While the 10 subjects who were included in the obese category had very low VO_2max values, only one sample had low VO_2max and none had a fairly good VO_2max value.

Table 5. Data normality test

	Shapiro-wilk		
	Statistic	df	Sig.
VO_2max	0.965	39	0.254
Body fat percentage	0.974	39	0.491

Table 5 shows the results of the normality of the data using the Shapiro-Wilk test with a value of Sig. > 0.05, namely the sig value. The VO_2max was 0.254, and the body fat percentage was 0.491. Thus, it can be concluded that the VO_2max data and body fat percentage are normally distributed.

Table 6. An overview of the relationship between body fat percentage and VO_2max using the Pearson correlation test

		VO_2max	Body fat percentage
VO_2max	Pearson correlation	1	-0.800
	Sig. (2-tailed)		0.000
	N	39	39
Body fat percentage	Pearson correlation	-0.800	1
	Sig. (2-tailed)	0.000	
	N	39	39

Based on Table 6, the results obtained using the Pearson correlation test had a correlation coefficient (r) of -0.800 with a significance value of <0.000. The significance value was set at p <0.005. This value indicates a significant relationship between body fat percentage and VO_2max. The correlation formed, namely -0.800, indicates a very strong negative correlation between variables, meaning that the higher the percentage of body fat, the lower the VO_2max value, and vice versa.

Discussion

One of the aspects that must be fulfilled before conducting a statistical test is the data normality test. Normally distributed data produces valid data to avoid biased or inaccurate results. This study used the Shapiro-Wilk normality test. The data were normally distributed if the Sig. both groups > 0.05. Therefore, it can be concluded that the data in this study were normally distributed.

Based on the statistical tests listed in Table 6, the value of $p < 0.05$, that is, $p < 0.000$. This proves that there is a strong correlation between VO_2max and the percentage of body fat among medical students at the University of Lampung, class of 2022. The correlation coefficient of the results of the study was -0.800, which means that there was a very strong negative relationship between the percentage of body fat and VO_2max. This can be interpreted as the higher the body fat percentage, the lower the VO_2max value.

The results of this study are in line with research conducted by Anjali et al. [5] concerning the relationship between VO_2max and body fat percentage in female athletes, which showed statistically higher VO_2max values in female athletes who regularly exercised in their two-year career than in non-athletes. This study also demonstrated a negative correlation between VO_2max and body fat percentage. Another study reported that VO_2max was statistically higher in trained subjects who performed endurance exercise at least 3 times a week for 3 months than in subjects who had never performed aerobic exercise in the 3 months before the test [7]. Similar results also show a statistically significant negative correlation between

VO_2max and body fat percentage in trained subjects such as studies conducted by Pibris et al. [8], Huldani et al. [3], Susilo [9], and Sharma et al. [12]. Research conducted by Mondal [11] showed a very strong negative correlation between body fat percentage and VO_2max (r=-0.75) in 60 healthy adolescents aged 18-25 years. Subjects with a high body fat percentage had low aerobic capacity compared to subjects with a low body fat percentage.

There was a more significant correlation coefficient between body fat percentage and VO_2max than between BMI and VO_2max. This shows that fat percentage is a better parameter than BMI for predicting an individual's cardiorespiratory function [11]. A high percentage of body fat greatly affects cardiorespiratory ability, particularly during activities, which directly reduces the VO_2max value. The higher the percentage of body fat, the lower is the cardiac output and oxygen absorption in the muscles. This is related to the amount of fat tissue, which results in peripheral resistance and constriction of blood vessels by fat, thereby affecting cellular oxygen uptake [10].

Inadequate physical activity has an impact on increasing body fat percentage and decreasing muscle mass [12]. This relates to entry-level medical students who have sedentary activities and higher levels of stress due to adjustments in study habits that tend to spend most of their time sitting and completing their assignments. A total of 19 subjects in the study were included in the obese BMI category. Subcutaneous and visceral fat deposition can limit lung expansion during inspiration, thus narrowing the airway. Meanwhile, during activities, muscles require oxygen as a basic material for the ATP formation which is mostly obtained from aerobic respiration. A high percentage of body fat requires more ATP for adequate muscles contraction. With less oxygen supply but increased ATP demand, muscles perform anaerobic respiration through glycolysis process in order to meet ATP needs. Instead, anaerobic glycolysis produces a product in the form of lactic acid which causes pain and muscle fatigue [13].
An individual is advised to engage in moderate activity or regular physical exercise for at least 150 minutes per week. Regular exercise can help reduce body fat percentage and increase VO_2max values, and indirectly help reduce the risk of disease in individuals [14].

Conclusion
There is a relationship between body fat percentage and VO_2max in first-year students of the Faculty of Medicine, University of Lampung, class of 2022.

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