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Correlation Between Body Mass Index and Cardiovascular Fitness in Medical Student

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Abstrak

Pendahuluan: Kebugaran kardiovaskular merupakan salah satu komponen yang dapat menilai kebugaran fisik yang berhubungan dengan kesehatan. Adanya korelasi yang kuat antara indeks massa tubuh (IMT) dengan kebugaran kardoivaskular menjadikan IMT sebagai salah satu faktor yang dapat memengaruhi kebugaran kardiovaskular. **Tujuan penelitian:** Untuk menilai korelasi antara IMT dengan kebugaran kardiovaskular mahasiswa Fakultas Kedokteran Universitas Baiturrahmah. **Metode:** Penelitian dilakukan di Laboratorium Fisiologi Fakultas Kedokteran Universitas Baiturrahmah. Pada penelitian ini dilakukan penilaian terhadap IMT setiap subjek dan kebugaran kardiovaskular dengan menggunakan *Harvard Step Test*. Analisis data dilakukan menggunakan analisis korelasi *Spearman rho.* **Hasil:** Dari 50 subjek yang mengikuti penelitian ini didapatkan rata-rata IMT adalah 23.66±0.67 kg/m^2 dengan sekitar 68% (34) subjek termasuk dalam kelompok IMT normal. Penelitian ini menemukan bahwa 34% (17) subjek memiliki tingkat kebugaran kardiovaskular yang baik (*good*) dengan rata-rata nilai kebugaran kardiobvaskular adalah 75.48±2.17. Hasil analisis menunjukkan adanya korelasi negatif yang signifikan antara BMI dengan kebugaran kardiovaskular ($r = -0.436$, $p<0.05$). Hal ini menunjukkan bahwa semakin tinggi nilai IMT maka tingkat kebugaran kardiovaskular akan semakin rendah. **Kesimpulan:** Hasil penelitian ini menunjukkan adanya korelasi negatif yang signifikan antara IMT dengan kebugaran kardiovaskular mahasiswa Fakultas Kedokteran Universitas Baiturrahmah.

Kata kunci -- *Harvard step test,* Indeks massa tubuh, Kebugaran kardiovaskular

Abstract

Introduction: *Cardiovascular fitness is one of the components that can be used to evaluate health-related physical fitness. Body mass index (BMI) is a factor that can influence cardiovascular fitness. This is due to the strong correlation between BMI and cardiovascular fitness.* ***Aims:*** *To assess the correlation between BMI and cardiovascular fitness among medical students at Universitas Baiturrahmah.* ***Method:*** *The research was conducted at the Physiology Laboratory, Faculty of Medicine, Universitas Baiturrahmah. We assessed each subjects's BMI and evaluated their cardiovascular fitness using the Harvard Step Test. The data were processed using Spearman rho correlation analysis.* ***Results:*** *Among the 50 subjects who participated in this study the mean BMI was 23.66±0.67 kg/m^2, with approximately 68% (34) of subjects categorized in the normal BMI group. Out of the total number of subjects, around 34% (17) subjects had good cardiovascular fitness, with a mean value around 75.48±2.17. The results showed a significant correlation between BMI and cardiovascular*

fitness (r = -0.436, p<0.05), indicating that a higher BMI is related to lower levels of cardiovascular fitness. ***Conclusion:*** *The results of this study indicate a significant negative correlation between BMI and cardiovascular fitness among medical students at Universitas Baiturrahmah.*

Keywords -- *Body mass index, Cardiovascular fitness, Harvard step test*

I. INTRODUCTION

The Body Mass Index (BMI) is a simple method for monitoring an individual's nutritional status. It is interpreted by classifying body weight as underweight, normal, overweight, or obese.[1] An increased BMI can be a major cause of various chronic diseases that contribute to higher mortality rates, including type 2 diabetes, sleep disorders, hypertension, cardiovascular diseases, hyperlipidemia, metabolic syndrome, chronic kidney disease, liver disorders, osteoarthritis, cancers, and depression.[2] To calculate the BMI, divide the weight in kilograms by the square of the height in meters (BMI = weight (kg) / height $(m)^2$.[3]

Increased body mass index (BMI) also affects physical activity capacity, as it can lead to decreased cardiovascular fitness.[3] Physical activity involves body movement resulting from increased energy expenditure, allowing skeletal muscles to contract effectively.[4,5]
Physical fitness is defined as an individual's ability to perform daily activities maximally without causing fatigue, ensuring that the body always has energy reserves for subsequent tasks.[3] There are several ways to assess an individual's physical fitness, one of which is through the measurement of the Body Endurance Index using the Harvard Step Test method. The Harvard Step Test evaluates cardiovascular fitness by having the person ascend and descend a step of specific bench (47 cm for males and 40 cm for females) at a set pace for 5 minutes. During the test, the pulse rate is recorded during the first, second, and third 30-second intervals. A higher Body Endurance Index value indicates better overall physical fitness.[6]

This study was conducted to determine correlation between Body Mass Index with cardiovascular fitness in medical Student of Universitas Baiturrahmah.

II. METHODS

This research was conducted using an analytical method and a cross-sectional study design. The aim of this study is to determine the correlation between BMI and cardiovascular fitness among the students of the Faculty of Medicine at Universitas Baiturrahmah. The Protocol and Informed Consent Form were reviewed and approved by the Health Research Ethics Committe, Faculty of Medicine, Universitas Baiturrahmah.

A total of fifty male students from the Faculty of Medicine at Universitas Baiturrahmah aged 18 to 22 years were enrolled in the study after duly consenting and signing the Informed Consent Form. The following were excluded: unexpected incidents occurred during the cardiovascular fitness test, such as shortness of breath, current or a history of heart and lung diseases, blood pressure and pulse screening results before the study, and current or a history of consuming heart and lung medications.

Each participant will undergo an examination of their weight, height, and BMI and categorized according to the categories shown in Table 1.[5,7] Then, the participants will be asked to perform the Harvard Step Test in order to evaluate their cardiovascular fitness. The Harvard Step Test is the most commonly used step test method, utilizing a bench and a metronome set at 180 or 300 seconds. The test is conducted for a maximum duration of 5 minutes, or it could be changed depending on the participant's ability to maintain the same rhythm as the metronome set at 120 beats per minute, while stepping up and down the bench. When the participant becomes fatigued or their step rhythm becomes inconsistent, the

test is immediately stopped, and the time recorded is noted.

TABLE 1. BODY MASS INDEKS CLASSIFICATION ACCORDING TO WHO[5,7]

Categories	BMI (kg/m^2)
Underweight	<18.5
Normal	18.5 – 24.9
Overweight	25.0 – 29.9
Obesity Class 1	30.0 – 39.9
Obesity Class 2	35.0 – 39.9
Obesity Class 3	>40.0

After completing the Harvard Step Test, participants can rest for one minute. Then, the radial artery pulse rate is measured during the first, second, and third minutes, each measured for 30 seconds. Additionally, the duration that the participant is able to perform the Harvard Step Test is recorded. Based on the collected data, cardiovascular fitness is calculated and categorized according to the categories shown in Table 2.[8]

TABLE 2. CARDIOVASCULAR FITNESS CATEGORIES[8]

Cardiovascular Fitness Index	Categories
>90	Excellent
80-90	Good
65-79	Average
50-64	Low Average
<50	Poor

Data analysis was conducted using univariate and bivariate analysis. Univariate analysis was used to describe or depict the independent and dependent variables. The independent variable is BMI, while the dependent variable is cardiovascular fitness. Bivariate analysis was used to determine whether there is a significant relationship between the independent variable (BMI) and the dependent variable (cardiovascular fitness). This bivariate analysis utilized the Pearson correlation analysis if the data distribution was normal or the Spearman rho correlation analysis if the data distribution was not normal.

III. RESULTS

A. STUDY POPULATION

Fifty healthy male students from the Faculty of Medicine at Universitas Baiturrahmah were enrolled in the study. All fifty participants completed the. Mean age was 20.86 ± 0.76 years, mean BMI was 23.66 ± 0.67 kg/m^{2,} and mean cardiovascular fitness was 75.48±2.17 (Table 3).

TABLE 3. CHARACTERISTICS OF THE PARTICIPANTS

Variables	Mean ± SD
Age (years)	20.86 ± 0.76
BMI (kg/m^2)	23.66 ± 0.67
Cardiovascular Fitness	75.48±2.17

B. BODY MASS INDEKS (BMI) AND CARDIOVASCULAR FITNESS

According to the results presented in Table 4, the majority of participants, specifically 34 individuals (68%), have a normal BMI. In terms of cardiovascular fitness, 17 participants (34%) are in the good category, while the remaining participants are distributed among the very good, fair, bad, and very poor categories.

TABLE 4. DISTRIBUTION OF PARTICIPANT'S BMI AND CARDIOVASCULAR FITNESS

Categories	Frequency (n)	Persen (%)
Body Mass Index		
Underweight	3	6
Normal	34	68
Overweight	9	18
Obesity Class 1	0	0
Obesity Class 2	4	8
Obesity Class 3	0	0
Cardiovascular Fitness		
Excellent	10	20
Good	17	34
Average	9	18
Low Average	11	22
Poor	3	6

C. Correlation Between Body Mass Indeks (BMI) and Cardiovascular Fitness

In this study, we found a moderate negative correlation between BMI and cardiovascular fitness (r = -0.436, p<0.05) (Figure 1). This finding suggests that an individual's cardiovascular fitness will decline as their BMI increases.

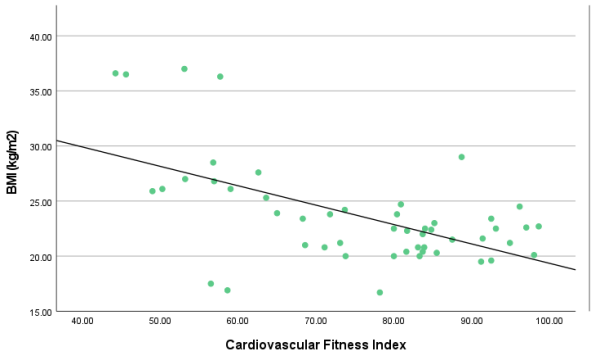

Figure 1. Correlation between BMI and Cardiovascular Fitness

IV. Discussion

From the fifty subjects involved in this study, the majority were found to have normal BMI, around 34 participants (68%). The rest consisted of 3 participants (6%) classified as underweight, 9 participants (18%) as overweight, and 4 participants (8%) with obesity class 2. This study aligns with the research by Juliyanty et al. (2022), which found that 45 students from the Faculty of Medicine and Health Sciences, Universitas Warmadewa (62.5%) were classified as having a normal BMI.[9]

An imbalance in body weight, either excessive or insufficient can be associated with increased health risks. Variations in weight can be influenced by various factors such as genetics, dietary patterns, physical activity, and lifestyle. Imbalanced nutrition intake can lead to a decrease in individual quality of life. Excessive energy intake without sufficient energy expenditure can lead to overweight, as the excess energy intake is stored as fat, thereby causing weight gain.[10–12] Unhealthy behaviours, such as a sedentary lifestyle, can contribute to weight gain. A sedentary lifestyle refers to a lack of physical activity, with the most common body positions being laying down or sitting, excluding sleep.[6]

It is common knowledge that modern students heavily depend on technology, allowing them to access everything without requiring much physical activity. According to a study by Wenni et al. in 2023, lifestyle changes due to the transition from school to university learning methods can be associated with increased sedentary behaviour and decreased physical activity. These changes can ultimately impact cardiovascular fitness.[12]

In this study, cardiovascular fitness was primarily categorized as good in 34% of the participants (17 participants), very good in 20% (10 participants), average in 18% (9 participants), low average in 22% (11 participants), and poor in 6% (3 participants). The quality of an individual's cardiovascular fitness can be assessed based on the duration of their activities. Regular physical activity can have a more positive impact on fitness. If an individual is capable of participating in leisure activities even after completing their everyday activities, it can be inferred that their cardiovascular fitness is within a satisfactory range.[13]

In this study, we found a moderate negative correlation between BMI and cardiovascular fitness (r = -0.436, p<0.05) (Figure 1). The findings of this study are consistent with the research by Andrastea et al. (2018), which showed a significant relationship between BMI and cardiovascular fitness levels among female medical students at Universitas Udayana.[14] Handoko et al. (2021), on the other hand, found a weak correlation between BMI and physical fitness index among medical students at Universitas Jember.[6]

It can be concluded that there is an inverse relationship between an individual's BMI and their cardiovascular fitness. Therefore, individuals with overweight and obesity require more energy to move and support their body compared to those with a normal BMI. As a result, they are more likely to experience fatigue more easily.[3] Individuals with an underweight BMI may also experience inadequate physical fitness due to the body's ability to convert eaten proteins, lipids, and carbs into energy sources. Inadequate energy intake results in a decline in the energy production process, which in turn causes increasing fatigue and diminished capacity for physical activity. Individuals with an underweight BMI may experience reduced cardiovascular fitness.[15,16]

V. CONCLUSIONS

The results of this study indicate a significant negative correlation between BMI and cardiovascular fitness among medical students at Universitas Baiturrahmah. Individuals with high BMI have an increase in adipose tissue, which can negatively influence heart function. This, in turn, leads to a decrease in cardiac output and a reduction in the delivery of oxygenated blood to the skeletal muscle that are involved in physical activity.

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