

## The Relationship Between Body Mass Index and Muscle Strength in FK Unjani Students Class Of 2023

Apen Afgani Ridwan<sup>1</sup>, Hedi Hendrawan Rachmatdinata<sup>2</sup>, Ilham Faruq Saputra<sup>3</sup>

<sup>1</sup>Department of Physiology, Faculty of Medicine, General Achmad Yani University, Cimahi, Indonesia

<sup>2</sup>Department of Dermatology and Venereology, Faculty of Medicine, General Achmad Yani University, Cimahi, Indonesia. <sup>3</sup>Undergraduate Program in Medicine, Faculty of Medicine, General Achmad Yani University, Cimahi, Indonesia

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### Article Info

#### Keywords:

Body Mass Index (BMI),  
muscle strength,  
medical students,  
analytical observational

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### ABSTRACT

Body mass index (BMI) is an indicator of nutritional status that affects health and muscle strength. Obesity inhibits AMPK, which can reduce endurance and decrease muscle function, increasing the risk of disease. This study aims to determine the relationship between BMI and muscle strength in students at the Faculty of Medicine, Jenderal Achmad Yani University. This research used a cross-sectional analytical observational study method on pre-clinical students at the Faculty of Medicine, Jenderal Achmad Yani University Class of 2023. Samples were taken using inclusion and exclusion criteria, involving measurements of body mass index, grip strength, and jumps. Data analysis uses SPSS and complies with research ethics. The research results show that the majority of FK Unjani Class of 2023 students have a normal body mass index (BMI) (50%), which indicates good nutritional status. All respondents with overweight and obese BMI classes I and II showed standing long jump results below average (100%); only 7.1% of respondents with normal BMI reached the average category. Most respondents with normal BMI had normal hand strength (57.1%), as did those with class II obesity (83.3%). There was no significant relationship between BMI and muscle strength after being tested using the chi-square statistical test, with p-values of 0.629 and 0.792, respectively. This research is in line with previous studies that showed insignificance in the relationship between BMI and muscle strength. The majority of FK Unjani Class of 2023 students have normal BMI, normal muscle strength in handgrip strength, and low in standing long jump. There is no significant relationship between BMI and muscle strength.

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#### Corresponding Author:

Ilham Faruq Saputra  
Undergraduate Program in Medicine, Faculty of Medicine, General Achmad Yani University, Cimahi, Indonesia  
[saputrafaruq12@gmail.com](mailto:saputrafaruq12@gmail.com)

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### INTRODUCTION

Body Mass Index (BMI) is an anthropometric measure that classifies individuals based on height and weight, reflecting nutritional status and health risks. BMI is widely used in public health policy to assess obesity and related disease risk. Individuals with visceral obesity are at higher risk for various pathological conditions, including morbidity and mortality. BMI also serves as an indicator of fat mass and fat-free mass. In clinical practice, physicians use BMI to stratify

health risks, assist in screening for diabetes, hypercholesterolemia, and thyroid disorders, and provide counseling regarding diet and exercise.<sup>1-7</sup> Muscle strength is the ability of a muscle to generate maximum force against a load. Factors that influence it include muscle diameter, fiber type, contraction, blood supply, and nutritional status. Decreased muscle strength increases the risk of health problems.<sup>8-11</sup>

BMI affects muscle strength, including muscle strength and handgrip strength. Overweight and obesity impair muscle function through inflammation and insulin resistance. Muscle strength is commonly measured using a handgrip dynamometer and standing long jump. Evidence suggests that low muscle strength is negatively correlated with unhealthy weight gain, excess abdominal fat, and comorbid obesity.<sup>13-</sup>

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Several studies have shown inconsistencies in the relationship between Body Mass Index (BMI) and muscle strength. A UK cohort study found that handgrip strength increased with increasing BMI but decreased in individuals with central obesity. In overweight subjects, lower extremity muscle strength was lower compared to individuals with a normal BMI, while upper extremity muscle strength was higher. Conversely, individuals with a normal BMI had higher lower extremity muscle strength, but lower upper extremity muscle strength compared to overweight individuals. This phenomenon is caused by two types of muscle fibers in the body: slow-twitch (Type I/Red Muscle) and fast-twitch (Type IIa/White Muscle) fibers. Slow-twitch muscle fibers, which are more resistant to fatigue, are found primarily in the lower extremities to support the body. Conversely, fast-twitch muscle fibers are more prevalent in the upper extremities and fatigue more quickly. Obesity can inhibit the activation of Adenosine Monophosphate-activated Protein Kinase (AMPK), which influences calcium signaling in muscle activation mechanisms. Consequently, a shift from slow-twitch to fast-twitch muscle fibers occurs, which decreases muscle endurance and strength.<sup>20-24</sup>

This study explores the relationship between BMI and muscle strength in medical students, who have different activity patterns. As the first study of students from the Class of 2023 at the Faculty of Medicine, Jenderal Achmad Yani University, this study aims to fill data gaps and address discrepancies in previous findings.

## MATERIALS AND METHODS

### Research Design

This study is an observational analytical study with a cross-sectional design, where data collection was conducted at a single point in time.

### Population and Sample

The population in this study was preclinical students of the Faculty of Medicine, Jenderal Achmad Yani University, Class of 2023. The sample size was determined using the Lameshow formula, using  $Z\alpha = 1.96$  and  $Z\beta = 0.84$ . With population proportions of  $P1 = 0.257$  and  $P2 = 0.16$ , the calculation yielded  $n = 25.6$ , rounded up to a minimum of 26 samples. Sampling in this study was conducted using consecutive sampling.

## Tools and Materials

### BMI

1. Weight Scale
2. Microtoise
3. Calculator

### Handgrip Strength

1. Handgrip Dynamometer

## Research Procedures

1. Research Preparation: Identify subjects according to inclusion criteria, explain the purpose and procedures of the study, including BMI and muscle strength measurements, and obtain informed consent before the procedure is performed.
2. Weight Examination Procedure: The individual removes personal belongings, stands on the scale, the examiner accurately records the weight, and then measures the results.
3. Height Examination Procedure: The individual removes items other than clothing, stands upright facing forward, and the examiner measures height with a microtoise from the top of the head to the toes, then records the results.
4. Handgrip Dynamometer Examination Procedure: Ensure the dynamometer is functioning and is the right size for the hand. The subject sits or stands comfortably, arms at their sides with elbows at a 90-degree angle. Wrists are neutral. The subject grips the hand for a maximum of 3-5 seconds. Record the measurement results.
5. Standing Long Jump Examination Procedure: Stand on the starting line with your feet parallel. Swing your arms and jump powerfully forward. Land with your feet parallel and your knees bent. Measure the distance from the starting line to the landing point and record the result.

## Data Analysis

Data were analyzed using SPSS with univariate frequency distribution and bivariate chi-square testing for the relationship between BMI, handgrip dynamometer, and standing long jump. Results are presented in tables and analysis descriptions.

## RESULT AND DISCUSSION

### Analysis Univariate

#### Index Overview Body Mass Index (BMI)

**Table 1.** Distribution BMI Frequency of Unjani Medical Faculty Students Class of 2023

BMI	Amount	Percentage
Underweight	0	0
Normal	14	50
Overweight	3	10.7
Obesity class I	5	17.9
Class II Obesity	6	21.4
Total	28	100

The study results showed that 50% of Unjani Medical Faculty students in the Class of 2023 had a normal BMI, while the other 50% were divided into class I (17.4%) and class II (21.4%) obesity, with no underweight category. BMI is used as an indicator of nutritional status and body composition, reflecting the proportion of fat and muscle. Thus, half of the respondents had good nutritional status, while the rest were poor. This data provides an overview of the distribution of students' nutritional status, which can have implications for their health and fitness.

### Power Image Muscle

**Table 2.** Distribution Frequency Strength Muscle Unjani Medical Faculty Students

Strength muscle	Total (N=28)	Percentage (%)
Handgrip Strength		
Weak	9	32.1
Normal	19	67.9
Strong	0	0
Standing Long Jump		
Above average	0	0
Average	1	3.6
Below average	27	96.4

The study results showed that 7.9% of Unjani Medical Faculty students in the Class of 2023 had normal handgrip strength, while 96.4% demonstrated below-average standing long jump strength. Sixty-seven percent had normal right handgrip strength, 32.1% had weak right handgrip strength, and none were classified as strong. The majority of students had normal handgrip muscle strength, but overall showed weakness in the standing long jump, reflecting low lower body muscle strength.

### Bivariate Analysis

**Table 3.** Relationship between Body Mass Index and Handgrip Strength in Unjani Medical Faculty Students, Class of 2023

BMI	Strength Hand Muscles	Strength Hand Muscles	Total (N / %)	p-value
	Weak (N / %)	Normal (N / %)		
Underweight	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.629
Normal	6 (42.9%)	8 (57.1%)	14 (100.0%)	
Overweight / Obesitas I	1 (33.3%)	2 (66.7%)	3 (100.0%)	
Obesitas II	1 (16.7%)	5 (83.3%)	6 (100.0%)	
Total	9 (32.1%)	19 (67.9%)	28 (100.0%)	

Based on Table 3, the majority of Unjani Medical Faculty students of Class of 2023 with normal BMI have normal handgrip strength (57.1%), while 42.9% have weak handgrip strength.

In the class II obesity group, 83.3% have normal handgrip strength, and 20% have weak handgrip strength. The proportion of students with weak handgrip strength is higher in those with normal BMI. There are no measurements in the underweight category because there were no respondents. The chi-square test showed a p-value of 0.629, which means there is no significant relationship between BMI and handgrip strength ( $p < 0.05$ ), indicating that other factors may influence hand muscle strength.

**Table 4.** Relationship between body mass index and standing long jump muscle strength in Unjani Medical Faculty students, Class of 2023

IMT	Leg Muscle Strength Below Average (N / %)	Leg Muscle Strength Average (N / %)	Total (N / %)	p-value
Underweight	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Normal	13 (92.9%)	1 (7.1%)	14 (100.0%)	
Overweight / Obesitas I	5 (100.0%)	0 (0.0%)	5 (100.0%)	0.792
Obesitas II	6 (100.0%)	0 (0.0%)	6 (100.0%)	
Total	27 (96.4%)	1 (3.6%)	28 (100.0%)	

Based on Table 4.4, the majority of respondents across various BMI categories demonstrated below-average standing long jump results. The overweight group (100%) and obesity classes I and II (100%) all fell into this category. In the normal BMI group, only 7.1% had average results, while 92.9% were below average. No measurements were taken for the underweight category due to the lack of respondents. The chi-square test showed a p-value of 0.792, indicating no significant relationship between BMI and standing long jump results among the 2023 Faculty of Medicine, Unjani, students ( $p < 0.05$ ).

Based on Tables 4.3 and 4.4, there was no relationship between body mass index (BMI) and muscle strength (handgrip strength and standing long jump) among the 2023 Faculty of Medicine, Unjani, students, with the chi-square test showing  $p > 0.05$ . Several factors that may have influenced these results include: (1) BMI only measures the relationship between weight and height without specifying the proportion of muscle and fat; (2) Different physical activities in each student can affect muscle strength in varying ways; (3) genetic factors, diet, and lifestyle also influence muscle development and function; and (4) the small sample size limits the validity of the results.

These results align with research by Diyan Ayu Pertiwi (2021) at the Faculty of Medicine, Jenderal Soedirman University, which found no significant relationship between BMI and handgrip strength ( $p = 0.260$ ). A similar finding was also found in Setiowati's (2014) study of basketball athletes in Semarang ( $p = 0.894$ ). However, these results differ from research by Kadek Intan Murti Dewi (2020) at the Faculty of Medicine, University of Mataram, which showed a significant relationship ( $p < 0.05$ ), and research by AlAsadi (2018) on medical students in Iraq, which found similar results ( $p = 0.000$ ).

## CONCLUSION

The Body Mass Index (BMI) of the Faculty of Medicine, Unjani, Intake of 2023 students is within the normal criteria, with categories other than Normal including Overweight, Obesity I, and Obesity II. The muscle strength of the Faculty of Medicine, Unjani, Intake of 2023 students in the handgrip strength test is within the normal criteria, and in the standing long jump test, it is within the low criteria. There is no relationship between body mass index and muscle strength (handgrip strength and standing long jump) among the Faculty of Medicine, Unjani, Intake of 2023 students.

## ACKNOWLEDGEMENTS

The author would like to thank all professionals who assisted in the research and preparation of this paper, including the Chair and Staff of the Physiology Laboratory, Faculty of Medicine, General Achmad Yani University.

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