Association of Body Mass Index (BMI) and Body Fat Percentage in Sports Science Students

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Abstract

Body Mass Index (BMI) is widely used as a simple indicator of nutritional status, but it has limitations because it cannot differentiate between muscle mass and fat mass. This limitation often leads to misclassification, particularly among athletes or physically active individuals. To provide a more accurate depiction of body composition, body fat percentage measurements are required. This study aimed to examine the relationship between BMI and body fat percentage among Sports Science students at Ngudi Waluyo University in 2026, thereby evaluating the effectiveness of BMI as an indicator of nutritional status in this population. A quantitative observational design with a cross-sectional approach was employed, involving 46 students (39 males and 7 females). BMI was calculated from body weight and height, while body fat percentage was determined using skinfold thickness measurements at seven anatomical sites based on the Jackson & Pollock method, with conversion to body fat percentage using Siri's equation. Data were analyzed using Pearson's correlation test to assess the strength and significance of the relationship between BMI and body fat percentage. The results revealed variations in BMI categories ranging from underweight, normal, to overweight. Students with higher BMI generally exhibited greater body fat percentages, while those with normal or underweight BMI showed moderate to low body fat percentages. For example, Ulva Lutviyah (BMI 29.6) had a body fat percentage of 21.9%, whereas Indah Karunia Telaumbanua (BMI 20.4) had 12.6%, and Romanus Ficerman Gulo (BMI 18.8) had approximately 7%. Pearson's correlation analysis yielded $r = 0.82$ with $p < 0.05$, indicating a strong and statistically significant positive relationship between BMI and body fat percentage. However, certain cases highlighted BMI's limitations, such as overweight students with relatively low body fat due to higher muscle mass. In conclusion, BMI can serve as an initial indicator of nutritional status, but it should be complemented with body fat percentage measurements to provide a more accurate evaluation. These findings emphasize the importance of combining BMI and skinfold assessments in monitoring student health and fitness, while future studies should consider larger samples and additional variables such as dietary patterns, physical activity, and muscle mass.

Introduction

Body Mass Index (BMI) has long been used as a simple indicator to assess nutritional status and population health. BMI is calculated using the formula: body weight (kg) divided by height squared (m^2). Although practical, BMI has limitations because it cannot distinguish between muscle mass and fat mass, often resulting in bias among individuals with high muscle mass (WHO, 2020). In contrast, the measurement of body fat percentage provides a more detailed picture of body composition and is considered more accurate in assessing health risks (Heyward & Wagner, 2004).

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BMI cannot identify an individual's body composition (Wiranata & Inayah, 2020). This limitation may affect the outcomes of initial screening in detecting nutritional status (Dong et al., 2025). Individuals such as athletes or physically active persons, who tend to have a higher proportion of muscle compared to body fat, may present with elevated BMI values, and vice versa (Walsh et al., 2018). Nutritional status categories based on BMI include underweight, normal, overweight, and obesity (Ministry of Health, 2023).

Students of Sports Science represent an interesting group to study because they engage in relatively high levels of physical activity and maintain lifestyles that differ from students in other academic programs. Regular physical activity can influence body composition, making it important to determine whether their BMI aligns with body fat percentage. Understanding the relationship between BMI and body fat percentage enables educational institutions to provide more appropriate recommendations regarding training patterns, nutrition, and healthy lifestyles for students.

This study was conducted to examine the relationship between BMI and body fat percentage among Sports Science students at Ngudi Waluyo University. The findings are expected to provide insights into the effectiveness of BMI as an indicator of nutritional status in this population, while also emphasizing the importance of body fat measurement as a complementary tool in health and fitness assessment.

Methods

This study employed a quantitative observational design with a cross-sectional approach, in which data were collected at a single point in time to assess the relationship between Body Mass Index (BMI) and body fat percentage. The research sample consisted of 46 students from Ngudi Waluyo University in 2026, comprising 39 males and 7 females. BMI measurement was conducted by recording body weight using a digital scale and measuring height with a stadiometer. BMI values were then calculated using the formula:

$$\text{BMI} = \frac{\text{Body Weight (kg)}}{\text{Heigth (m)}^2}$$

The results were categorized according to the World Health Organization (WHO) standards. Meanwhile, body fat percentage was obtained using the skinfold method with calipers. Measurement sites included the chest, abdomen, triceps, subscapula, suprailiac, midaxillary, and thigh. The skinfold values from these sites were processed to estimate body fat percentage based on standard formulas widely applied in fitness research. Skinfold measurements at multiple body sites were conducted using the Jackson & Pollock method. The sum of skinfold thicknesses was then entered into the equation to estimate Body Density (BD). The collected data were analyzed using Pearson's correlation test to examine the relationship between BMI and body fat percentage. The correlation coefficient (r) was used to determine the direction and strength of the relationship, while the significance value (p-value) was applied to assess the statistical relevance of the findings.

Results and Discussion

Measurements of 46 Sports Science students at Ngudi Waluyo University in 2026 (39 males and 7 females) revealed variations in Body Mass Index (BMI) across categories ranging from underweight, normal, to overweight. These differences reflect diverse nutritional status among the students. Using the Jackson & Pollock skinfold method and conversion with Siri's equation, a clear relationship was observed between BMI and body fat percentage.

Table 1. Female Students – BMI and Body Fat Percentage

BMI Category	Student Name	BMI	Body Fat (%)	Description
Obesity 1	Ulva Lutviyah	29.6	21.9	Exhibited relatively high body fat percentage.
Overweight	Jerni Mawati Zebua	25.2	16.2	Exhibited relatively high body fat percentage.
Normal	Indah Karunia Telaumbanua	20.4	12.6	Showed moderate body fat percentage.

Table 2. Male Students – BMI and Body Fat Percentage

BMI Category	Student Name	BMI	Body Fat (%)	Description
Overweight	Arif Faoita Waruwu	29.4	8.3	Exhibited relatively high body fat percentage.
Normal	Ahmad Saiful Ersa Fathoni	20.8	5.4	Showed moderate body fat percentage.
Underweight	Romanus Ficerman Gulo	18.8	7.0	Demonstrated low body fat percentage.

Students with higher BMI generally exhibited greater body fat percentages. For instance, Ulva Lutviyah (BMI 29.6) had a body fat percentage of 21.9%, while Indah Karunia Telaumbanua (BMI 20.4) showed 12.6%, and Romanus Ficerman Gulo (BMI 18.8) had approximately 7%. This consistent pattern indicates that the higher the BMI, the higher the body fat percentage. Pearson's correlation analysis confirmed this relationship with $r = 0.82$ and $p < 0.05$, signifying a strong and statistically significant positive correlation.

However, the findings also highlight the limitations of BMI as a sole indicator of nutritional status. For example, Arif Faoita Waruwu (BMI 29.4) was categorized as overweight, yet his body fat percentage was only 8.3%, which is relatively low. This discrepancy suggests that BMI cannot distinguish between muscle mass and fat mass, potentially leading to misclassification in individuals with high muscle mass, such as athletes.

Overall, overweight students tended to have relatively high body fat percentages, normal BMI students showed moderate levels, and underweight students demonstrated low body fat percentages. These results reinforce the importance of complementing BMI with direct body composition assessments. Skinfold measurements using the Jackson & Pollock method, followed by Siri's equation, provide a more accurate depiction of body composition and should be used alongside BMI to evaluate the nutritional and fitness status of Sports Science students.

In sports science students, the relationship between BMI and body fat percentage tends to be lower than in the general population. This is due to the characteristics of sports students who have higher muscle mass as a result of regular physical activity and training. Individuals with high muscle mass can have a BMI categorized as overweight, even though their body fat percentage is still within the normal range. Therefore, BMI does not always accurately reflect adiposity status in physically active populations.

This finding aligns with research by Mayasari et al. (2025), who reported that in sports science students, BMI had a high positive correlation with body weight and visceral fat, but only a low positive correlation with body fat percentage. This study concluded that BMI is less sensitive for detecting obesity in physically active individuals with a body composition dominated by fat-free mass.

Furthermore, research on Padjadjaran University students found a strong correlation between BMI and body fat percentage, with $r = 0.853$ in males and $r = 0.834$ in females. These results indicate that BMI can still be used as an initial screening tool for nutritional status, but its interpretation needs to be combined with body composition measurements, such as body fat percentage, to obtain a more accurate picture of nutritional status. The difference in the relationship between BMI and body fat percentage in sports students is also influenced by gender. Female students generally have a higher body fat percentage than male students due to hormonal and physiological differences. Conversely, male students tend to have greater muscle mass, allowing their BMI to increase without a significant increase in body fat percentage.

These research results also reinforce the concept that body composition measurements are a better indicator than BMI in assessing health risks in active individuals. Body fat percentage provides information about fat distribution, which is associated with the risk of metabolic diseases, such as obesity, type 2 diabetes mellitus, and cardiovascular disease. Therefore, evaluating the nutritional status of sports science students should not rely solely on BMI, but should also consider measuring body fat percentage using methods such as Bioelectrical Impedance Analysis (BIA) or other body composition methods.

Overall, the study results indicate a significant relationship between BMI and body fat percentage in sports science students. However, due to the relatively high muscle mass of sports students, BMI has limitations in distinguishing between fat and muscle mass. Therefore, using BMI as a sole indicator of nutritional status in sports science students requires caution and should be combined with body composition measurements to obtain more comprehensive and accurate results.

Conclusion and Suggestions

This study demonstrated variations in the Body Mass Index (BMI) of Sports Science students at Ngudi Waluyo University in 2026, ranging from underweight, normal, to overweight categories. The analysis revealed that students with higher BMI tended to have greater body fat percentages, whereas those with normal or underweight BMI showed lower body fat percentages. Pearson's correlation analysis yielded $r = 0.82$ with $p < 0.05$, indicating a strong and statistically significant positive relationship between BMI and body fat percentage. These findings confirm that BMI can serve as an initial indicator of nutritional status; however, it cannot be used as the sole reference since BMI does not distinguish between muscle mass and fat mass. Therefore, skinfold measurements using the Jackson & Pollock method, subsequently converted with Siri's equation, are essential to complement BMI data.

In light of these results, students are encouraged to maintain their BMI within the normal range through balanced nutrition and regular physical activity, as a higher BMI is associated with increased body fat percentage. Educational institutions should also conduct routine monitoring of students' nutritional and fitness status using both BMI and skinfold

measurements, which can serve as a foundation for designing effective training and health programs. Future research would benefit from larger sample sizes and the inclusion of additional variables such as physical activity levels, dietary patterns, and muscle mass, to provide a more comprehensive understanding of body composition among university students.

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