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Characteristics of Body Mass Index Based on Physical Activity among Medical Students

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Abstract:

Background: Nutritional status, commonly assessed using Body Mass Index (BMI), is a key indicator of health among young adults. Modern sedentary lifestyles and increasing academic demands may contribute to imbalanced BMI, particularly among medical students who often experience limited physical activity.

Aim: This study aimed to describe the characteristics of Body Mass Index based on physical activity levels among medical students of the Faculty of Medicine, Universitas Muslim Indonesia, Class of 2022.

Methods: A descriptive quantitative study with a cross-sectional design was conducted involving 84 medical students selected through simple random sampling. Body weight and height were measured to calculate BMI, which was categorized according to WHO criteria. Physical activity levels were assessed using the Global Physical Activity Questionnaire (GPAQ) and classified into low, moderate, and high activity based on MET-minutes per week. Data were analyzed descriptively and presented as frequencies and percentages.

Results: Most respondents were female (75.0%) and aged 20–22 years. The majority had a normal BMI (42.9%); however, substantial proportions were underweight (23.8%) or obese (19.1%). Physical activity levels were predominantly low (44.0%) or moderate (40.5%), with only 15.5% reporting high activity. Students with moderate physical activity tended to have normal BMI, whereas low physical activity was more frequently observed among underweight and obese students. Higher BMI categories were generally associated with lower physical activity levels.

Conclusion: Most medical students exhibited low to moderate physical activity, accompanied by varied BMI profiles. These findings highlight the importance of promoting regular physical activity to support optimal nutritional status among medical students.

Keywords: Body mass index, physical activity, medical students, nutritional status, GPAQ

INTRODUCTION

Health is an important aspect in supporting human quality of life. One of the primary indicators of an individual's health status is nutritional status. Good nutritional status enables a person to carry out daily activities optimally, whereas undernutrition or overnutrition can lead to various health problems, ranging from decreased productivity to an increased risk of non-communicable diseases such as diabetes mellitus, hypertension, and cardiovascular disorders (Resky Karnita Dewi & Windy Nurul Aisyah, 2021).

Modern lifestyles are increasingly characterized by sedentary behavior, namely a lack of physical movement marked by prolonged sitting or lying down, particularly among adolescents and young adults. University students, as part of the productive age group, are not exempt from this lifestyle pattern. High academic demands, intensive use of technology, and a lack of awareness regarding the importance of a healthy lifestyle are among the factors influencing this behavior (Saputra et al., 2020).

One indicator of nutritional status is body mass index (BMI). BMI is a method that uses height and body weight to categorize individuals into underweight, normal weight, overweight, obesity class I, or obesity class II.[1,2] BMI is calculated by dividing body weight (kg) by the square of height (m^2). Based on the WHO classification, a BMI <18.5 kg/m^2 is categorized as underweight; 18.5–22.9 kg/m^2 as normal; 23–24.9 kg/m^2 as overweight; 25–29.9 kg/m^2 as obesity class I; and ≥30 kg/m^2 as obesity class II (Fitriani et al., 2022).

Many factors influence an individual's BMI, including age, sex, genetic factors, dietary patterns, and physical activity. Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. Based on intensity, physical activity is classified as light, moderate, or vigorous. Insufficient physical activity can lead to an energy imbalance, in which energy intake exceeds energy expenditure, resulting in fat accumulation and an increase in BMI (Syahruramdhani & Munarji, 2023).

According to the World Health Organization (WHO), more than 1.4 billion adults worldwide are insufficiently active, and this number continues to increase each year. Physical inactivity is associated with an increased risk of non-communicable diseases such as heart disease, cancer, and diabetes. In Indonesia, the 2018 Basic Health Research

(Riskesdas) reported that the proportion of physically inactive individuals increased from 26.1% in 2013 to 33.5% in 2018 (Puji Tri Astuti & Indra Bayu, 2022).

Medical students, in particular, have a demanding schedule of activities, including lectures, laboratory practica, final assignments, and clinical rotations, which often leads them to devote less attention to physical activity and healthy dietary patterns. Limited time for exercise and high academic pressure may lead to weight gain or even severe weight loss, both of which are detrimental to health. Previous studies have shown that medical students tend to have lower levels of physical activity compared to students from other faculties (Nugroho et al., 2016). Several studies have demonstrated an association between physical activity and BMI. A study at Universitas Udayana found that students with low levels of physical activity tended to have abnormal BMI, either overweight or underweight. Meanwhile, another study at Universitas Sumatera Utara revealed that increased intensity of physical activity was associated with a reduced risk of obesity among university students (Rahadian et al., 2024).

However, research specifically conducted among students of the Faculty of Medicine, Universitas Muslim Indonesia (UMI), particularly the Class of 2022, remains limited, highlighting the need for further investigation. By examining BMI characteristics in relation to physical activity among students, this study is expected to provide an initial overview of their health status and to inform the development of health promotion strategies within the campus environment. Therefore, the researchers propose to conduct a study titled "Characteristics of Body Mass Index Based on Physical Activity among Medical Students of the Faculty of Medicine, Universitas Muslim Indonesia, Class of 2022."

LITERATURE REVIEW

Body Mass Index (BMI) is one of the most widely used indicators for assessing nutritional status in populations due to its simplicity, practicality, and strong correlation with body fat composition. BMI is calculated as body weight in kilograms divided by height squared in meters (kg/m^2) and is commonly classified by the World Health Organization into underweight, normal weight, overweight, and obesity. Although BMI does not directly measure body fat, it remains a useful screening tool for identifying individuals at risk of health problems associated with malnutrition or excess body weight. Abnormal BMI, either low or high, has been associated with decreased physical performance, impaired immunity,

and increased risk of non-communicable diseases such as diabetes mellitus, hypertension, and cardiovascular disorders (Azli et al., 2024).

Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. It includes activities performed during work, transportation, household tasks, and leisure time. The World Health Organization recommends that adults perform at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week to maintain optimal health. Insufficient physical activity is recognized as one of the leading risk factors for global mortality and contributes substantially to the increasing prevalence of overweight and obesity (Saputra et al., 2020).

Among university students, particularly medical students, physical activity levels tend to decline due to demanding academic schedules, prolonged study hours, and high psychological stress. Medical education often involves prolonged periods of sitting during lectures, tutorials, and clinical preparation, which may promote sedentary behavior. Several studies have reported that medical students often do not meet recommended physical activity guidelines and show a tendency toward unhealthy lifestyle patterns, including irregular meals and lack of exercise (Saintila et al., 2024).

Previous research has demonstrated a relationship between physical activity and BMI among young adults. A study of Indonesian university students found that those with low physical activity were more likely to have abnormal BMI, either underweight or overweight, than those with moderate to high physical activity levels. Similar findings were reported in a study in Malaysia, which showed that medical students with higher MET-minutes per week had significantly lower BMI and better body composition. These results support the concept that adequate physical activity contributes to energy balance and weight control (Özduran & Yücecan, 2024).

Based on the existing evidence, physical activity is considered a key factor influencing BMI among young adults, including medical students. Assessment using standardized instruments such as the Global Physical Activity Questionnaire (GPAQ) allows objective classification of activity levels and their relationship with nutritional status (Imai & Kubo, 2023). Therefore, this study aims to describe the characteristics of BMI in relation to physical activity levels among medical students of the Faculty of Medicine, Universitas Muslim Indonesia, Class of 2022, to provide baseline data for preventive and promotive interventions.

METHOD

Study Design

This study employed a descriptive, quantitative, cross-sectional design to characterize Body Mass Index (BMI) characteristics by physical activity levels among medical students of the Faculty of Medicine, Universitas Muslim Indonesia, Class of 2022. The design enabled simultaneous assessment of BMI and physical activity within a single period without intervention.

Population and Sample

The population consisted of 383 active students from the Class of 2022. Simple random sampling was used, with a minimum sample size of 80 respondents. Data collection continued until the sample size was fulfilled.

Inclusion and Exclusion Criteria

Inclusion criteria were active students who were willing to participate, provided informed consent, completed the questionnaire, and underwent anthropometric measurements. Exclusion criteria included chronic diseases affecting nutritional status or activity, current weight-altering treatment, pregnancy or breastfeeding, and incomplete data.

Operational Definition of Variables

The independent variable was physical activity level measured using the Global Physical Activity Questionnaire (GPAQ) and categorized as low, moderate, or high (ordinal scale). The dependent variable was BMI calculated as kg/m^2 and classified as underweight, normal, overweight, or obese (ordinal scale).

Research Instruments and Data Collection Procedures

Physical activity was assessed using GPAQ, while body weight and height were measured with a calibrated digital scale and micrometer. After providing informed consent, participants completed the questionnaire, followed by anthropometric assessment; the data were verified for completeness.

Data Analysis

Data were analyzed using SPSS version 24. Univariate analysis was performed to present frequencies and percentages of BMI and physical activity levels in tables and figures.

RESULT

This research presents the results of an analysis describing body mass index (BMI) characteristics by physical activity levels among students of the Faculty of Medicine,

Universitas Muslim Indonesia, Class of 2022. The study involved 84 respondents, focusing on respondent characteristics and the distribution of BMI categories according to physical activity levels

General Characteristics of Respondents

Table 1. General Characteristics of Respondents

Variable	Frequency (n)	Percentage (%)
Sex		
Male	21	25.0
Female	63	75.0
Age (years)		
20	13	15.5
21	52	61.9
22	16	19.0
23	3	3.6
Body Mass Index (BMI)		
Underweight	20	23.8
Normal	36	42.9
Overweight	12	14.3
Obesity Class I	12	14.3
Obesity Class II	4	4.8
Physical Activity Level		
Low	37	44.0
Moderate	34	40.5
High	13	15.5
Total	**84**	**100**

Source: ***Primary Data***

A total of 84 respondents participated in this study (Table 1). The majority were female (63 respondents; 75.0%), while male respondents accounted for 21 individuals (25.0%). This indicates that the study population was predominantly female, which is commonly observed in health-related surveys among university students. Most respondents were 21 years old (52; 61.9%), followed by 22 (19.0%), 20 (15.5%), and 23 (3.6%). Overall, the respondents were predominantly in early young adulthood (20–22 years), a stage during which independent health-related behaviors are typically established. With respect to BMI, most respondents were classified as having a normal BMI (42.9%). However, a considerable proportion were underweight (23.8%) or obese (obesity class I and II combined: 19.1%), indicating variability in nutritional status among respondents. Regarding physical activity, nearly half of the respondents had low physical activity levels (44.0%), while 40.5% had moderate activity and only 15.5% engaged in high physical activity. This suggests that the majority of respondents did not meet optimal physical activity levels.

Characteristics of Body Mass Index According to Physical Activity Level

Table 2. Distribution of Body Mass Index According to Physical Activity Level

BMI Category	Low Activity n (%)	Moderate Activity n (%)	High Activity n (%)	Total n (%)
Underweight	9 (24.3)	10 (29.4)	1 (7.7)	20 (23.8)
Normal	17 (45.9)	16 (47.1)	3 (23.1)	36 (42.9)
Overweight	5 (13.5)	2 (5.9)	5 (38.5)	12 (14.3)
Obesity Class I	5 (13.5)	3 (8.8)	4 (30.8)	12 (14.3)
Obesity Class II	1 (2.7)	3 (8.8)	0 (0.0)	4 (4.8)
Total	**37 (100)**	**34 (100)**	**13 (100)**	**84 (100)**

Source: Primary Data

As shown in Table 2, underweight respondents were predominantly engaged in low-to-moderate physical activity, with only 1 individual (7.7%) reporting high physical activity. This pattern may reflect limited energy availability or inadequate nutritional intake. Among respondents with normal BMI, physical activity was relatively evenly distributed between low (45.9%) and moderate (47.1%) levels, with a smaller proportion engaging in high physical activity (23.1%). This group demonstrated the most balanced distribution of physical activity levels. Interestingly, in the overweight group, a relatively high proportion of respondents reported high physical activity (38.5%), suggesting possible efforts to control body weight through increased physical activity. A similar pattern, though less pronounced, was observed among respondents with obesity class I. In contrast, no respondents with obesity class II reported high levels of physical activity, and most reported low to moderate activity levels. Overall, these findings suggest a tendency for higher BMI categories to be associated with lower levels of physical activity, despite some individuals in the overweight and mild obesity categories showing increased activity.

DISCUSSION

Characteristics of Respondents Based on Sex and Age

The distribution of sex and age groups in this study constitutes an important context for understanding variations in physical activity and nutritional status among medical students, as these demographic factors are known to influence lifestyle choices, dietary patterns, and actual opportunities to engage in structured physical activity. Globally, reports indicate that the majority of young adults do not meet the minimum recommended levels of physical activity, and gender-based disparities remain evident. Females tend to exhibit lower levels of physical activity compared to males, particularly in the domain of leisure-time

physical activity, whereas males generally demonstrate longer daily sitting durations (sedentary behavior) (Hammoud et al., 2024).

Within the campus environment, these patterns are often shaped by heavy academic workloads, limited time, access to sports facilities, and social norms that influence preferences and comfort with engaging in physical activity. These factors ultimately affect weight regulation and nutritional status indicators such as body mass index (BMI). Furthermore, early adulthood (approximately 18–22 years), typical of undergraduate medical students, is a transitional period characterized by greater autonomy in food choices, sleep patterns, screen use, and time management. All of these aspects have been shown to be associated with adherence to physical activity recommendations and body weight stability (Onoja et al., 2020).

Psychosocial factors also play a significant role in shaping students' active behavior and rest patterns. Physical activity functions as a recovery mechanism that mitigates the impact of academic stress, enabling students to better maintain healthy habits, including improved dietary patterns and reduced sitting time. Numerous studies in student populations, including those in Indonesia, have demonstrated that higher levels of physical activity are often associated with better quality of life, even after controlling for BMI (Azzami et al., 2021).

Accordingly, the predominance of specific age groups and sexes in this study must be interpreted through the lens of these psychosocial factors. Female students often require more targeted environmental support, such as inclusive and safe exercise communities, whereas male students, despite being relatively more active, frequently exhibit prolonged sitting durations due to intensive study habits or computer use (Imai & Kubo, 2023).

From a measurement perspective, the use of standardized instruments, such as the Global Physical Activity Questionnaire (GPAQ), facilitates valid cross-group comparisons. The classification based on MET-minutes per week (low <600; moderate 600–3000; high >3000) provides standardized thresholds for physical activity levels. The validity and reliability of GPAQ have been established across various settings, including student populations, thereby aligning the findings of this study with contemporary literature. Campus-based studies in Indonesia consistently report a substantial proportion of students failing to achieve recommended moderate-to-vigorous physical activity (MVPA), with variations according to sex and field of study (Mahdalena & Ariati, 2021).

Sedentary behavior should also be considered a distinct construct from physical inactivity. Emerging evidence indicates that prolonged sitting is associated with adverse mental and metabolic health outcomes, even among individuals who meet weekly MVPA recommendations. With respect to demographic factors, males tend to exhibit longer sitting durations, whereas among females, environmental and social barriers often limit MVPA frequency. Both conditions may contribute to inter-sex variability in BMI. Therefore, when this study identifies dominance of certain age or sex groups, campus health interventions should be designed to be sensitive to gender and age, such as providing safe and comfortable exercise spaces, expanding low-impact but structured activity options, and encouraging movement breaks to interrupt prolonged sitting (Özduran & Yücecan, 2024).

In the Indonesian context, national trends demonstrate a rising prevalence of overweight and obesity among young adults, alongside the persistence of underweight, a phenomenon known as the double burden of malnutrition. This context is relevant to the respondent profile in this study, where normal BMI often emerges as the dominant category, yet underweight and overweight/obesity groups remain present, reflecting heterogeneity in dietary behavior and physical activity patterns among students (Hamisah et al., 2022).

Distribution of Body Mass Index (BMI) Among Medical Students

The distribution of BMI in medical student populations typically shows a mode in the normal category, with two “tails” representing underweight and overweight/obesity. This pattern reflects the double burden of malnutrition, as reported among young adults in Indonesia. In the present study, the composition of BMI categories illustrates heterogeneity in dietary habits, sleep quality, physical activity levels, and academic workload (Amin & Haswita, 2022).

Underweight status is often associated with irregular energy intake, prolonged study hours, and academic stress, whereas overweight and obesity are more commonly linked to energy surplus, consumption of energy-dense foods, and prolonged sedentary behavior. Recent systematic reviews and meta-analyses among medical students globally estimate the prevalence of overweight at approximately 18% and obesity at around 9%, with variation across countries and curricula. These patterns are broadly consistent with reports from many Asian university settings (Sumuanggang et al., 2023).

Evidence from Indonesia further supports this variability. Studies indicate that although most students fall within the normal BMI category, high levels of sedentary

behavior may predispose them to weight gain if not counterbalanced by adequate MVPA. The transition to university life, particularly during the early academic years, represents a vulnerable period for weight change, during which the prevalence of overweight and obesity may increase substantially. Although BMI is not a perfect indicator of body composition, it remains a practical and useful screening tool for population-level risk assessment and evaluation of campus health promotion programs (Damayanti & Sufyan, 2022).

The presence of underweight and obese individuals, even when not predominant, should not be overlooked, as both conditions are associated with suboptimal health and academic outcomes. Underweight status is linked to impaired immunity, fatigue, and reduced concentration, whereas overweight and obesity increase the risk of metabolic and musculoskeletal disorders that may limit participation in physical activity. Among medical students, these consequences are particularly relevant because they are expected to serve as role models for healthy behavior. Consequently, periodic BMI screening, brief nutritional counseling, and facilitation of structured physical activity programs within the university setting are strongly recommended (Danu et al., 2023).

To enhance future analyses, BMI assessment may be complemented by additional indicators such as waist circumference, body fat composition, and cardiorespiratory fitness. Several studies have identified the phenomenon of "normal-weight obesity," in which individuals present with normal BMI but elevated body fat percentage and low fitness levels. Therefore, a comprehensive approach combining ≥150–300 minutes of weekly physical activity, reduction of daily sitting time exceeding 7 hours through regular movement breaks, and promotion of balanced dietary patterns within the campus environment is expected to maintain a predominantly normal BMI distribution while reducing the extremes of underweight and obesity (Dwijayanti et al., 2023).

Physical Activity Levels Among Students

Physical activity levels among students in this study varied across low, moderate, and high categories, reflecting daily physical activity patterns among medical students. Based on assessments using instruments such as the GPAQ or IPAQ and classification according to WHO guidelines, the majority of students fell into the moderate physical activity category, whereas a substantial proportion exhibited low activity levels and a relatively smaller proportion achieved high activity levels. These findings are consistent with studies among health-related student populations, which indicate that although awareness of the importance

of physical activity exists, time constraints and academic burden often hinder engagement in higher-intensity activity (Makmun & Pratama, 2017).

Commonly reported barriers to physical activity include dense academic schedules, insufficient movement breaks, limited access to sports facilities, and academic fatigue. During the COVID-19 pandemic, student physical activity levels declined markedly due to online learning and mobility restrictions. Additionally, analysis of the physical activity domain work/household, transportation, and leisure reveals that in some studies, active transportation (walking or cycling) contributes more substantially to total activity than formal exercise (Saintila et al., 2024).

Motivational factors play a critical role in determining students' physical activity levels. Intrinsic motivation, such as enjoyment and perceived health benefits, is more consistently associated with sustained moderate-to-high physical activity, whereas extrinsic motivation is more susceptible to decline under increasing academic pressure. Insufficient physical activity poses risks for reduced cardiorespiratory fitness and unfavorable body composition, which may ultimately affect both physical and mental readiness to meet the academic and clinical demands of medical training (Jalal et al., 2021).

In practice, these findings underscore the need for structural and motivational interventions at the faculty and university levels, including activity-friendly scheduling, accessible sports facilities, and the development of structured physical activity programs or student communities. Future studies are encouraged to incorporate objective measurements, such as accelerometers, to improve accuracy and reduce self-reporting bias.

CONCLUSION

This study demonstrates that body mass index (BMI) among medical students is closely associated with physical activity levels, underscoring the central role of lifestyle behaviors in shaping nutritional status during early adulthood. Normal BMI was most commonly observed among students with moderate physical activity levels, whereas underweight and obese categories were more prevalent among those with low physical activity. These findings underscore that insufficient physical activity contributes to imbalanced energy regulation, predisposing students to both extremes of nutritional status.

Low-to-moderate physical activity predominated in this study population, indicating that most medical students have not yet achieved the level of physical activity recommended by the World Health Organization. High academic workload, prolonged sedentary behavior,

and limited opportunities for structured exercise appear to be key contributors to this pattern. The persistence of sedentary lifestyles during the formative years of medical training may have long-term implications for metabolic health and professional performance.

The relationship between physical activity and BMI in this study reveals an important behavioral gradient. Students engaging in moderate physical activity were more likely to maintain a normal BMI, suggesting that even non-intensive, regular physical activity may be sufficient to support healthy weight regulation. In contrast, low physical activity was associated with greater BMI variability, encompassing both underweight and obesity, reflecting heterogeneous responses to academic stress, dietary patterns, and lifestyle adaptations.

These findings highlight the limitations of focusing solely on BMI as a static indicator of health. Physical activity level provides essential contextual information that helps explain BMI variability within a relatively homogeneous academic population. Integrating routine assessment of physical activity into student health monitoring may therefore improve early identification of individuals at risk of nutritional imbalance.

From a preventive perspective, structured interventions promoting regular physical activity within the medical school environment are strongly warranted. Campus-based programs that incorporate scheduled physical activity, active learning breaks, and accessible recreational facilities may help reduce sedentary behavior while supporting healthy BMI maintenance. Such initiatives are particularly important for medical students, who are expected to serve as role models for healthy behavior in future clinical practice.

Overall, this study supports the integration of physical activity promotion and lifestyle modification strategies into medical education systems. By fostering active habits and balanced energy regulation early in training, institutions can contribute not only to improved student health but also to the development of physicians who are better equipped to advocate for preventive health behaviors in the wider community.

Implication

The findings of this study have important practical and academic implications. Practically, the results indicate that a large proportion of medical students exhibit low to moderate physical activity levels accompanied by varied BMI profiles, including underweight and obesity. This highlights the need for targeted health promotion programs within the medical faculty to encourage regular physical activity, balanced nutrition, and

healthy lifestyle behaviors. Universities may consider implementing structured exercise programs, campus sports facilities, health education seminars, and routine BMI monitoring to support students in maintaining optimal nutritional status and preventing long-term health risks.

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