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Body Mass Index and Agility Among Physiotherapy Undergraduate Students: A Cross-Sectional Study

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Abstract

Introduction: Restrictions on daily activities to curb the spread of COVID-19 have disrupted regular routines, leading to reduced physical activity. This reduction in activity may affect adolescents' nutritional status and overall health, often resulting in increased body weight, directly influencing body mass index (BMI). Elevated BMI can, in turn, impact agility. This study aimed to investigate the relationship between BMI and agility among physiotherapy undergraduate students at the Faculty of Medicine, Udayana University.

Methods: An analytical observational cross-sectional study was conducted involving 47 participants selected using purposive sampling. BMI was calculated based on measured height and weight. Agility was assessed using the T-test. Data analysis was performed using the Spearman rho non-parametric correlation test.

Results: The analysis revealed a significant inverse relationship between BMI and agility among the participants ($r = -0.530$, $p < 0.05$).

Conclusion: There is a strong, significant, and negative correlation between BMI and agility in physiotherapy undergraduate students at Udayana University. Higher BMI is associated with lower agility levels.

Keywords: Body mass index, agility, physical fitness, university students, cross-sectional study

Introduction

Activity restrictions implemented to control the spread of COVID-19 have disrupted daily routines for many individuals. People tend to engage in lower levels of physical activity as most of their time is spent at home performing sedentary activities such as watching television, lying down, sitting, playing video games, and using mobile devices. Reduced physical activity decreases energy expenditure, which can negatively affect an individual's nutritional status. A study by Rukmana found that male adolescents exhibited lower physical activity levels compared to female adolescents during the COVID-19 pandemic in Medan city. Specifically, 59.6% of adolescents did not engage in sufficient physical activity, and 23% were classified as overweight or obese during the pandemic.[1]

Nutritional status can be categorized by measuring body mass index (BMI). BMI provides an indication of an individual's nutritional intake by comparing body weight relative to height. Adequate nutritional intake results in a normal BMI, excessive intake leads to overweight or obesity, and insufficient intake results in underweight.[2] BMI is commonly used to assess body composition by classifying weight relative to height into several categories. Adolescents whose social activities are highly restricted, particularly those attending online classes, are likely to experience an increase in BMI during the COVID-19 pandemic. Elevated BMI affects both nutritional status and physical fitness, including agility. Individuals classified as overweight or obese experience an increase in fat mass accompanied by a reduction in muscle mass.[3]

Muscle mass reduction negatively impacts agility, as decreased muscle mass results in weaker and slower muscle contractions, reducing movement efficiency. Additionally, higher BMI increases the mechanical load on the body, slowing overall movement. Slower body movements directly affect agility, which is closely related to movement speed. Elevated BMI also alters the center of gravity (COG), affecting balance, and poor balance can further compromise agility. Thakur reported a significant relationship between BMI and agility ($p = 0.000$) in a study examining the association of obesity with agility and speed among kabaddi athletes. The study measured height, weight, BMI, speed, agility, and analyzed correlations among these variables. Participants had an average BMI of 21.576 (classified as normal) and an average agility score of 10.849, with most demonstrating good or average agility.[4]

Previous research has predominantly focused on athletes or individuals with high physical activity levels. This study aims to investigate agility in individuals with moderate activity levels, represented by university students. Specifically, this research examines whether BMI is associated with agility in physiotherapy undergraduate students.

Participants were aged 18–24 years, a period during which social restrictions, particularly online learning during the COVID-19 pandemic, may have led to reduced physical activity. Consequently, students may experience weight gain, which could negatively affect agility. Physiotherapy students were selected as the study population because they are expected to maintain good physical fitness for their future professional practice. Reduced agility can serve as an indicator of declining physical fitness in students.

This study aimed to determine the relationship between BMI and agility among physiotherapy undergraduate students at the Faculty of Medicine, Udayana University. The hypothesis was that BMI is significantly associated with agility in this population.

Methods

This study employed an analytical observational design using a cross-sectional approach. Data collection was conducted in May 2023 and involved the entire population of physiotherapy undergraduate students at the Faculty of Medicine, Udayana University. Purposive sampling was applied based on specific inclusion and exclusion criteria.

The **inclusion criteria** were: students enrolled in the physiotherapy program at Udayana University, aged 18–24 years, and in good health. The exclusion criteria included a history of ankle injuries such as sprains or strains within the last three months that could affect agility, post-operative lower limb fractures within the past two years, and obesity with waist circumference exceeding 90 cm for males or 80 cm for females. A total of 47 participants were included in this study.

The independent variable was BMI, the dependent variable was agility, and the control variable was age. Controlling for age allowed the study to include participants at late adolescence to early adulthood, a period in which agility typically increases only minimally.

BMI was calculated using the formula: body weight (kg) divided by height squared (m^2), expressed in kg/m^2.[5] Body weight was measured using a digital scale, and height was measured using a stadiometer. The calculated BMI values were then categorized into four groups: underweight (<18.4), normal (18.5–25.0), overweight (25.1–27.0), and obese (>27.0).[2]

Agility was assessed using the T-test, with results recorded in seconds. Agility scores were classified into four categories: excellent (<9.5 s for males, <10.5 s for females), good (9.5–10.5 s for males, 10.5–11.5 s for females), average (10.5–11.5 s for males, 11.5–12.5 s for females), and poor (>11.5 s for males, >12.5 s for females).[6]

Both univariate and bivariate analyses were performed. Univariate analysis described the characteristics of the sample, including BMI, agility, and gender. Bivariate analysis was conducted to examine the correlation between BMI and agility using the non-parametric Spearman rho test.

Results

The study subjects were active physiotherapy undergraduate students at the Faculty of Medicine, Udayana University. Following the application of inclusion and exclusion criteria, a total of 47 participants were enrolled. Bivariate analysis described the characteristics of the subjects, including gender, BMI, agility, BMI by gender, and agility by gender.

Table 1. Subject Characteristics

Variable	Frequency (n)	Percentage (%)
BMI		
Underweight	10	21.3
Normal	25	53.2
Overweight	6	12.8
Obese	6	12.8
Agility		
Poor	18	38.3
Average	25	53.2
Good	4	8.5
Gender		
Male	24	51.1
Female	23	48.9

As shown in Table 1, among the 47 participants, 24 (51.1%) were male and 23 (48.9%) were female. The majority of participants had a normal BMI (25 participants, 53.2%), while 6 participants (12.8%) were classified as obese. Based on the T-test agility results, 18 participants (38.3%) fell into the poor agility category, whereas most participants (25 participants, 53.2%) were classified as having average agility.

Table 2. Relationship Between Body Mass Index and Agility

Variable	Correlation	P-value
Body Mass Index	-0.530	0.000
Agility		

As shown in Table 2, the Spearman rho correlation analysis revealed a significant relationship between BMI and agility ($p = 0.000$, $p < 0.05$). The correlation coefficient was -0.530, indicating a strong inverse relationship. This negative correlation implies that as BMI increases, agility decreases.

Discussion

Subject Characteristics

A total of 47 physiotherapy undergraduate students participated in this study, comprising 23 females (48.9%) and 24 males (51.1%). Of the participants, 10 (21.3%) were classified as underweight, 25 (53.2%) had a normal BMI, 6 (12.8%) were overweight, and 6 (12.8%) were obese. Although most participants had a normal BMI, a substantial proportion were classified as overweight or obese. Male participants exhibited a higher incidence of overweight and obesity compared to females, with all obese participants being male and four of six overweight participants being male. These findings align with Budiman's study, which reported that overweight and obesity were more prevalent in males than females, potentially due to faster growth in muscle, bone, and fat mass in males, which increases the likelihood of excess body weight.[7]

Regarding agility, 18 participants (38.3%) were classified as poor, 25 participants (53.2%) as average, and 4 participants (8.5%) as good. These results indicate that most participants demonstrated average or poor agility. This observation is consistent with Hidayat's findings, which reported that individuals aged 16–23 years measured with the T-test predominantly fell into the average agility category (46.7%). At this age range, agility has not yet increased significantly, resulting in standard or average performance.[8]

Relationship Between Body Mass Index and Agility

Spearman rho correlation analysis indicated a significant relationship between BMI and agility among physiotherapy undergraduate students at the Faculty of Medicine, Udayana University ($p = 0.000$, $p < 0.05$). The correlation coefficient was -0.530, indicating a strong inverse relationship. This negative correlation suggests that higher BMI is associated with lower agility, with the strength of the relationship classified as strong (r between 0.51–0.75).

An increased BMI affects agility because overweight and obese categories impose higher mechanical loads on the body, hindering movement.[4] Excessive fat can also impair blood flow to muscles, reducing oxygen and nutrient delivery necessary for muscle contraction and agility.[8] Additionally, weight-related reductions in balance may decrease agility, as agility requires rapid changes in direction without losing balance.[9]

These findings are supported by Dhapola and Verma, who reported a significant correlation between BMI and agility in university athletes using the 4×10 meter shuttle run test ($r = 0.546$, $p = 0.000$).[10] Similarly, Mustofa et al. found that agility among medical students was influenced by BMI, with T-test results yielding $p = 0.02$ and $r = -0.45$.[11]

Conversely, Mubarani (2017) reported no statistically significant association between BMI and agility (Fisher's exact test, $p = 0.640$), indicating that overweight categories did not influence agility in that population.[12]

High BMI correlates with increased body mass, which can reduce physical performance and muscle strength, thereby impairing agility.[8] Individuals with higher BMI experience shifts in the center of gravity (COG) due to fat accumulation, anterior pelvic tilt, and lumbar hyperextension. These postural changes displace the COG forward, affecting balance, which in turn compromises agility, as balance is a critical component of agile movement.[4,10]

Maintaining a normal BMI ensures adequate energy intake and minimizes biomechanical and balance constraints, supporting optimal agility.[9]

Limitations of this study include the inability to ensure that participants performed movements with maximal effort and the slightly slippery testing surface, which may have caused hesitation during agility tasks. Future research should ensure proper supervision and clear instructions, and select testing locations with surfaces that facilitate safe and confident movement.

Overall, higher BMI is associated with lower agility among physiotherapy undergraduate students. However, these findings are specific to this population and may not be generalizable to students from other programs or universities, or to other age groups. Additionally, agility is influenced by multiple factors, including physical fitness, muscle strength, flexibility, and training, which should be considered when interpreting these results.

Conclusion

The findings of this study indicate a significant inverse relationship between BMI and agility among physiotherapy undergraduate students at the Faculty of Medicine, Udayana University. Higher BMI is associated with reduced agility. Maintaining a normal BMI is recommended to preserve agility, reflecting adequate nutritional intake and overall physical fitness.

Author Contribution

I Wayan Budi Wicaksana: Conceptualization, methodology, data collection, data analysis, and manuscript drafting.
Made Widnyana: Supervision, guidance on research design, and critical review of the manuscript.

I Gusti Ayu Artini: Supervision, validation, and manuscript editing.

I Wayan Gede Sutadarma: Supervision, methodological consultation, and final manuscript review.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was not required as the study involved only non-invasive procedures (blood pressure measurement and questionnaire surveys) and posed minimal risk to participants. Informed consent was obtained from all participants prior to their inclusion in the study, and confidentiality was strictly maintained.

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