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Relationship between Physical Activity Level and Body Mass Index among Active Students

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Abstract. *Physical activity significantly impacts adolescent health, typically correlating with a normal Body Mass Index (BMI). This study aims to determine the relationship between physical activity levels and BMI among students. A cross-sectional study was conducted on 23 students at the FIKK UNM laboratory. Physical activity was assessed using the International Physical Activity Questionnaire-Short Form (IPAQ-SF), while BMI was calculated from digital scale and stadiometer measurements. Due to the small sample size, bivariate analysis was performed using the Fisher's Exact Test. Results showed that most students engaged in heavy physical activity (47.8%) and had a normal BMI (47.8%). However, no significant relationship was found between physical activity levels and BMI ($p > 0.05$). Despite the lack of correlation, these findings support Sustainable Development Goal (SDG) Target 3.4, emphasizing the importance of monitoring young adults' physical activity and BMI as an early preventative measure to reduce premature mortality from non-communicable diseases (NCDs).*

Keywords: *Physical Activity; Body Mass Index; Student; Individual Activity; Body Weight*

1. Introduction

Technological developments have a positive impact on human life. Activities of human that was previously difficult becomes faster and easier, so it does not require additional energy to complete the work. Such as the use of elevators or escalator stairs in large buildings, the existence of online motorcycle taxis which make it easier for people to meet their daily needs, the use of TV remotes in households. But this convenience becomes an ongoing problem if it is carried out without realizing the resulting impact. Humans will become lazy and tend to be less physically active (Jayadilaga, Putra, et al., 2023). A body that is less active will affect physical fitness levels.

Physical activity helps to get or keep fit (Burton et al., 2020). The higher the physical activity, the higher the amount of energy required. If energy levels are inadequate, fat reserves will be broken down into energy. Living an active life will support increasing muscle mass and reducing fat mass thereby improving long-term health (Jayadilaga, Handayani, et al., 2023).

Many teenagers spend time playing with gadgets and 80% of teenagers are not physically active. Lack of physical activity will have an impact on health level (Handayani & Jayadilaga, 2024). Worldwide, physical activity is decreasing and obesity rates are increasing among teenagers (Karchynskaya et al., 2022). Low physical activity contributes to obesity in adolescents. Obesity causes health problems (Lobstein & Jackson-Leach, 2016). Moreover, 18% of teenagers in the world are overweight and obese (Azzopardi et al., 2019). Physical

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inactivity among teenagers can contribute to health problems, including mental health disorders, heart attacks, strokes diabetes (van Sluijs et al., 2021).

The rising prevalence of metabolic disorders and obesity among the youth has positioned physical activity as a critical pillar of public health. For adolescents and young adults, maintaining an active lifestyle is widely regarded as the primary defense against an elevated Body Mass Index (BMI) and associated cardiovascular risks. The results of research showed that the prevalence of obesity in children and adolescents has increased globally in the last 5 decades (Jebeile et al., 2022). Risk factors for obesity can occur in 6 periods of life, namely preconception, prenatal, infancy, pre-school, elementary school, and adolescence (Nogueira-de-Almeida et al., 2024). Based on the problems described, the study aims to analyze the relationship between physical activity and body mass index in adolescents.

Understanding this relationship is vital for refining health assessment protocols in academic settings. If high activity levels do not consistently correlate with lower BMI, it suggests that other factors—such as nutritional habits, genetic predispositions, or the "fat-but-fit" phenomenon—may play a more dominant role. Efforts to increase physical activity and control BMI in adolescents are directly aligned with the global agenda of Sustainable Development Goals (SDGs), particularly SDG Target 3.4, which aims to reduce premature mortality from non-communicable diseases (NCDs) by one-third by 2030. Low physical activity and BMI imbalances are primary risk factors for the emergence of degenerative NCDs such as type 2 diabetes and hypertension (Nystoriak & Bhatnagar, 2018).

The novelty of this research lies in its specific focus on sports science students who already maintain high levels of physical activity. While the inverse relationship between exercise and BMI is well-documented in the general public, this study explores whether that same pattern applies to individuals accustomed to routines with high metabolic equivalents (METs).

2. Methods

The sample in this research consisted of 23 students. This sample size was not determined through an a priori statistical power analysis but was constrained by practical factors, specifically the limited availability of active students who met the inclusion criteria during the designated cross-sectional data collection period. The instrument used to collect the data of physical activity level was the International Physical Activity Questionnaire-Short Form (IPAQ-SF). To minimize potential self-reporting bias inherent in this instrument, all participants received standardized instructions and verbal clarifications from trained data collectors prior to filling out the questionnaire, ensuring they accurately estimated their weekly physical exertion. Body Mass Index (BMI) was determined through weight and height measurements using calibrated digital scales and a stadiometer. Data were analyzed univariately and bivariately using SPSS 22. While the Chi-Square test was initially planned for bivariate analysis, the Fisher Exact Test was ultimately utilized due to the small sample size (N=23) and the presence of expected cell frequencies below five. Statistical significance was set at a level of 0.05.

3. Results and Discussion

3.1. Results

Physical activity was assessed based on the respondent's habits which were measured using seven question points. The scores for categories of three levels of physical activity are

activities accumulated under 600 MET-minutes/week for light physical activity, accumulated at least 600 MET-minutes/week for moderate physical activity and accumulated at least 1500 MET-minutes/week for heavy physical activity. Table 1 shows the category of phisical activity among adolescent.

Table 1. Category of phisical activity

Physical activity level	Frequency	Percentage (%)
Light	2	8.7
Moderate	10	43.5
Heavy	11	47.8
Total	23	100.0

Table 1 shows that the majority of adolescents have accumulated physical activity of at least 1500 MET-minutes/week. This result indicates that most of the students experienced a heavy physical activity. Meanwhile, BMI measurements are carried out from body weight and height data. BMI is a measure used to assess a person's weight status based on their weight and height, and this categorization of BMI status is important for determining the health risks associated with weight.

Table 2. Category of Body Mass Index

BMI	Frequency	Percentage (%)
Underweight	6	26.1
Normal	11	47.8
Overweight	5	21.7
Obese	1	4.3
Total	23	100.0

Table 2 shows that most of the student have a normal body mass index (47.8%). Furthermore, to identify the relationship between the two variables, a correlation test was carried out. However, the results of the analysis showed that there was no relationship between physical activity and BMI status. This can happen because the research subjects are small and the categories of each variable vary greatly (more than two categories).

Table 3. Cross Tabulation of BMI and Physical Activity

BMI	Physical activity level			Total	Fisher's exact
	Light	Moderate	Heavy		
Underweight	1 (16,7%)	1 (16,7%)	4 (66,7%)	6 (100%)	
Normal	1 (9,1%)	7 (63.6%)	3 (27.3%)	11 (100%)	P= 0,478
Overweight	0 (0%)	2 (40%)	3 (60%)	5 (100%)	
Obese	0 (0%)	0 (0%)	1 (100%)	1 (100%)	
Total	2 (8.7%)	10 (43.5%)	11 (47.8%)	23 (100%)	

Table 3 shows data on physical activity which varies for each BMI status. The majority of BMI status categories have heavy physical activity, namely teenagers with underweight, normal or obese BMI. This result explains that there is no relationship between BMI status and adolescents' physical activity categories, or vice versa. Table 3 presents the cross-tabulation between BMI status and physical activity levels. Although heavy physical activity was prevalent across almost all BMI categories—including 66.7% of underweight students and 60% of overweight students—the bivariate analysis revealed no significant relationship between the two variables p = 0,487.

The absence of a statistical correlation ($p > 0.05$) indicates that in this specific group of active students, BMI status is independent of physical activity intensity. This lack of significance is attributed to the high homogeneity of the sample (where 91.3% of students were already in the moderate-to-heavy activity range) and the limited sample size, which reduces the statistical power to detect a correlation.

3.2 Discussion

The results showed that there was no relationship between physical activity and BMI status. This results support by previous studies that found no relationship between physical activity and body mass index status in students (Candrawati, 2011). The same result also explain that no significant relationship between physical activity and BMI (Nurkhopipah et al., 2018). Research shows no significant relationship between physical activity and the incidence of obesity based on body mass index.

Different results suggest that there is a fairly strong relationship between physical activity and BMI in students (Ariani & AF, 2017). The results found that there was a significant relationship between physical activity and BMI in high school students (Suyasmi et al., 2018). In addition, study found a strong relationship between physical activity levels and BMI in junior high school students (Daniati et al., 2020) and suggests that there is a relationship between physical activity and BMI in students (Indahsari & Mahali, 2019).

The results of the study found that one sample had a body weight in the obese category but with a heavy activity level. Different results were stated by (Rafiq et al., 2022) physical activity has an influence on reducing weight and cholesterol levels in people with obesity. Physical activity can have a good influence on the body, namely improving the body's metabolism, improving quality of life, increasing self-efficacy and increasing cardiorespiratory fitness. Result showed that physical activity and food intake influence weight loss by only 0.3%, while 99.7% is influenced by other factors (Emilia & Cilmiyati, 2020).

Physical activity data that varied for each BMI status was found in this study. Study showed that subjects who did light physical activity tended to be three times more likely to have fat IT compared to subjects who did moderate and heavy physical activity (Nurkhopipah et al., 2017). There was a tendency for subjects who had light activity to have a higher BMI and body fat composition or be obese (Suryana & Fitri, 2017).

The lack of a significant correlation observed in this study aligns with several recent findings suggesting that BMI is a multifaceted metric influenced by factors beyond just caloric expenditure. One primary explanation is the "compensation effect." Individuals engaging in heavy physical activity often experience increased appetite, leading to a higher caloric intake that offsets the energy expended during exercise (Sun et al., 2022). The study showed that there is a relationship between the frequency of fast food consumption and the nutritional

status of adolescents (Nisa et al., 2021). It was suggested that there was a relationship between diet, media exposure and heredity on student overweight (Ishak et al., 2019). There is a significant and meaningful relationship between eating patterns and the incidence of excess weight in adolescents.

The diversity of physical activity levels across all BMI categories—as seen in Table 3 suggests that student lifestyle choices are highly individualized. For instance, underweight students may engage in heavy activity due to high metabolism or sports involvement, while obese students may be active but unable to reduce BMI due to dietary habits or genetic predispositions.

A study by Guthold et al. (2020) notes that global physical activity trends among adolescents are highly variable and that environmental factors, such as school facilities and socio-economic status, play a larger role in BMI than activity levels alone. The small sample size and the multi-categorical nature of the variables in this study likely reduced the statistical power to detect a subtle relationship, a common limitation in localized pilot studies (Nystoriak & Bhatnagar, 2018).

Several limitations may need to be considered in interpreting the results of this study. Measurement of physical activity was carried out using the IPAQ-SF questionnaire instrument. Although steps were taken to minimize self-reporting bias—such as providing standardized instructions—the reliance on self-reported data means that recall bias or overestimation of physical activity cannot be entirely eliminated. Furthermore, a significant limitation of this study is that BMI solely measures total body mass and does not distinguish between fat mass and fat-free mass (muscle). Students classified as "overweight" or "obese" who engage in heavy physical activity may possess higher muscle hypertrophy, which weighs more than fat but is metabolically healthier. In this study, supplementary measures to differentiate body composition—such as waist circumference, skinfold thickness, or body fat percentage measurements—were not utilized due to resource constraints.

Conclusions

Based on our findings, physical activity levels do not significantly correlate with Body Mass Index (BMI) in this group of active students. This suggests that for people who exercise heavily, BMI alone might not be the best indicator of health, likely due to factors such as greater muscle mass or compensatory eating habits. To overcome the limitations of the current study, we highly recommend that future research uses larger sample sizes and objective physical activity trackers instead of relying purely on questionnaires. Incorporating comprehensive body composition analyses will also be key to validating these results. Ultimately, although no statistical relationship was found in this specific group, continuously monitoring adolescent activity and nutrition remains essential for achieving Sustainable Development Goal (SDG) Target 3.4 and preventing non-communicable diseases (NCDs).

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Conflicts of Interest

The authors declare no conflict of interest.

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