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Submission date: 05-Aug-2023 09:21AM (UTC+0700)
Submission ID: 2141510446
File name: 4_OK.pdf (590.23K)
Word count: 5420
Character count: 31265

Edu Sportivo
Indonesian Journal of Physical Education
e-ISSN 2745-942X
Journal Homepage: https://journal.uir.ac.id/index.php/SPORTIVO

Exploring the relationship between body mass index and physical fitness: Implications from a comprehensive study in a secondary school setting

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Received: 05 May 2023; Accepted 17 July 2023; Published 05 August 2023

OPEN ACCESS

ABSTRACT

Assessing the physical fitness and body mass index (BMI) of students is crucial for understanding their overall health and well-being. This study aims to investigate the relationship between students' nutritional status, as measured by BMI, and their level of physical fitness. Physical and anthropometric tests were conducted to collect data on height, weight, and relevant physical indicators, which were used to calculate BMI. The data were analysed using percentage analysis to determine the frequency and percentage of students in different BMI categories and levels of physical fitness. However, it is important to note that this study had limitations, including a sample restricted to students from a single school, which might limit generalizability to the larger student population. Additionally, the study focused solely on the relationship between nutritional status (assessed through BMI) and physical fitness without considering other potential factors that might influence students' fitness levels. Future research should aim to expand the sample size to include a more diverse student population and investigate additional factors that might impact students' physical fitness levels. This study's findings contributed to the existing literature by providing valuable insights into the interplay between students' nutritional status, BMI, and their level of physical fitness.

Keywords: Body mass index; physical fitness; nutritional status; physical education

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https://doi.org/10.25299/es:ijope.2023.vol4(2).12775

How to Cite: Aliriad, H., S, A., Fahrudi, A., Apriyanto, R., & Da'I, M. (2023). Exploring the relationship between body mass index and physical fitness: Implications from a comprehensive study in a secondary school setting. *Edu Sportivo: Indonesian Journal of Physical Education*, *4*(2), 136-147. https://doi.org/10.25299/es:ijope.2023.vol4(2).12775

Authors' Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

INTRODUCTION

Physical fitness plays a vital role in maintaining an individual's health and overall well-being. It encompasses various aspects such as physical strength, endurance, flexibility, and other components of body fitness (Santika et al., 2020). Achieving and maintaining physical fitness are essential for enjoying a high quality of life and optimal functioning in daily activities. Additionally, physical fitness has been linked to numerous health benefits, including an improved cardiovascular system, reduced risk of chronic diseases, increased muscle strength, and enhanced mental well-being (Thorburn, 2018). To maintain good health, physical activity (PA) and a balanced diet are crucial factors (Arikan & Revan, 2019). Engaging in regular physical activity and adopting a nutritious

diet contribute to the development and maintenance of physical fitness, ultimately promoting overall well-being and optimal health.

Consequently, physical education, sports, and health are recognised as mandatory subjects at different levels of education, ranging from elementary to junior high and vocational high school. Physical education programmes play a significant role in promoting and maintaining students' health throughout their school years (Bowen, 2023). It is an integral part of the curriculum at all education levels, emphasising the importance of physical well-being and providing opportunities for students to engage in various physical activities (Sarlis & Tjortjis, 2020). Moreover, these educational initiatives contribute to the establishment of age and gender-specific health standards, taking into account variations in the impact of physical fitness on children and adolescents based on their age and sex (Chou et al., 2022; Gill & Hung, 2014; Zhang, 2021). By addressing the physical fitness needs of students, physical education programmes aim to develop well-rounded individuals by enhancing their physical capabilities, intelligence, morality, and social intelligence (Peng et al., 2023).

In this context, the importance of measuring body mass index (BMI) becomes evident. Body mass index (BMI) is an important factor that can affect the level of cardiovascular fitness (Andrastea et al., 2018). BMI is calculated by dividing body weight in kilogrammes by the square of height in metres. It is widely used as a method to estimate whether a person is overweight or experiencing health problems, serving as an indicator of body fat levels for most individuals. Additionally, BMI is a relatively easy, inexpensive, and non-invasive measurement tool. However, it has certain limitations, as it does not provide information about body fat distribution or muscle mass (Smetanina et al., 2015). Despite these limitations, BMI serves as a valuable initial assessment in evaluating individuals' weight status and potential health risks.

Physical fitness is typically measured in relation to body weight, with an increase in body fat leading to a decrease in fitness level (Muñoz-Vera et al., 2017). Body composition, which encompasses factors such as height, weight, and fat thickness, is essential to understanding physical fitness. The standard BMI calculation, using weight in kilogrammes divided by height in metres squared, can be employed to assess individuals' overweight levels (Fares et al., 2022). An imbalance between energy intake and expenditure contributes to an increase in BMI, resulting in the accumulation of excess energy in the form of fat and potentially leading to obesity or a higher BMI (Nafilah & Fitranti, 2014). Higher BMI values are associated with an increased risk of various diseases (Laurienti et al., 2023).

Nevertheless, it is important to recognise that evaluating body composition goes beyond mere weight measurement. Body composition provides insights into the ratio of fat mass, bone mass, body fluids, organs, and muscle tissue. On average, individuals possess essential fat levels ranging from 3% to 12% and non-essential fat levels of 10% to 22% in men and 20% to 32% in women. Assessing body composition enables the identification of disease risks and the evaluation of nutritional status (Mohamadshahi et al., 2014). By considering these factors, a more comprehensive understanding of physical fitness and its relationship with BMI can be attained.

Physical fitness plays a crucial role in the overall well-being of students (Aliriad et al., 2023; Kusnandar et al., 2019). However, there are notable challenges concerning the physical fitness levels of students. One significant obstacle is the limited engagement in movement activities, as indicated by the low participation in sports and extracurricular programs (Darti, 2018; Nofianti, 2018). Currently, students only have opportunities for movement during physical education lessons and weekly fitness exercises. This situation highlights the need to improve physical fitness within the school environment

in order to enhance the learning process and promote healthy lifestyles among students (Beauty et al., 2020; Fikri, 2017). It is essential to address these challenges and provides students with more opportunities for physical activity to ensure their holistic development and academic success.

It has been observed that students with higher levels of physical fitness generally perform better in their academic activities, whereas those with lower levels may encounter difficulties in coping with the academic workload (Kamaruddin, 2018; Sepriadi et al., 2018). Previous research has consistently shown a positive association between students' physical fitness and their academic performance. For instance, students with higher levels of physical fitness tend to achieve better exam results and demonstrate higher levels of concentration during the learning process (Abduh et al., 2020). Additionally, engaging in physical activities, such as sports and physical educations, has been found to enhance students' cognitive abilities, including problem-solving skills, memory retention, and attention span (Fitrianto & Habibie, 2023; Setiawan et al., 2020). Therefore, it is crucial to address the challenges faced by students regarding their physical fitness in order to support an optimal learning environment.

Body mass index (BMI) is widely used to assess the relationship between an individual's weight and height (Amenya et al., 2021; Chen, 2017; Zhu et al., 2017). Previous studies have demonstrated a correlation between students' physical fitness and their academic performance. However, there is still a need for further research to investigate the specific relationship between BMI and physical fitness among students. Despite the existing research, there is a lack of studies focusing on this relationship in the context of the school environment. This study aims to fill this gap in the literature and provide a deeper understanding of how BMI relates to physical fitness.

Addressing students' physical fitness levels is crucial, particularly in the school environment. Limited engagement in movement activities, such as low participation in sports and extracurricular programmes, poses a significant challenge. This situation highlights the importance of exploring the relationship between BMI and physical fitness to enhance the learning process and promote healthy lifestyles among students. The findings of this study contribute to enhancing our understanding of the factors influencing students' physical fitness and inform the development of targeted interventions to promote their overall health and well-being.

The novelty of this research lies in its focus on investigating the specific relationship between BMI and physical fitness among students. By examining this relationship, the study aims to provide new insights into the factors influencing students' physical fitness levels and their implications for academic performance. This research contributes to the existing body of knowledge on the influence of BMI on students' physical fitness, with a particular emphasis on the school environment. The main objective of this study is to explore the relationship between students' BMI and their level of physical fitness. By measuring BMI using standard formulas and assessing physical fitness through validated tests and evaluations, this research aims to provide a comprehensive understanding of how BMI influences students' physical fitness. The findings of this study are expected to provide valuable information for designing intervention programmes aimed at improving students' physical fitness levels and maintaining their health.

METHOD

This study applies a cross-sectional and analytical approach to investigate (Mathew et al., 2021). The relationship between variables X and Y in SMP Muhammadiyah 4 Balen. In this effort, the sample consisted of 73 students who were selected as research

participants. Various tests have been conducted as data collection instruments, including evaluation of students 'nutritional status, measurement of body mass index (BMI), and measurement of students' physical fitness level.

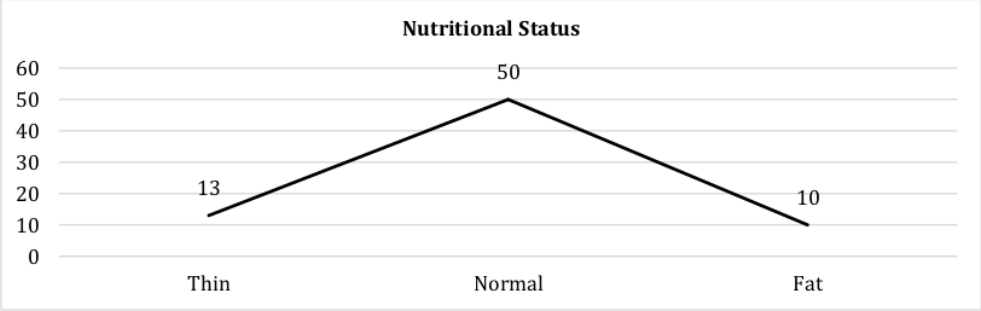
The cross-sectional approach allows us to collect data at one specific point in time (Almutairi et al., 2018; Carl et al., 2022) , so that we can get an idea of the relationship between the variables X and Y at the same time. In this case, the variables X and Y represent the concepts to be studied, and this study aims to understand how the relationship between the two is identified in the environment of SMP Muhammadiyah 4 Balen. By integrating analytical methods, the study not only records the data but also analyzes it carefully. More in-depth analysis may involve the use of statistical techniques to identify and evaluate potential relationships between variables X and Y, as well as examine other factors that might influence those relationships.

RESULTS AND DISCUSSION

The study subjects were asked to conduct anthropometric and Indonesian physical fitness tests. This anthropometric test measures a student's height and weight; this test was used to determine the student's body mass index value and then determine the student's nutritional status. After conducting tests on 73 students, the following results were obtained:

Table 3. Anthropometric Test Result

Nutritional Status	Number of Students
Thin	13
Normal	50
Fat	10
Total	**73**

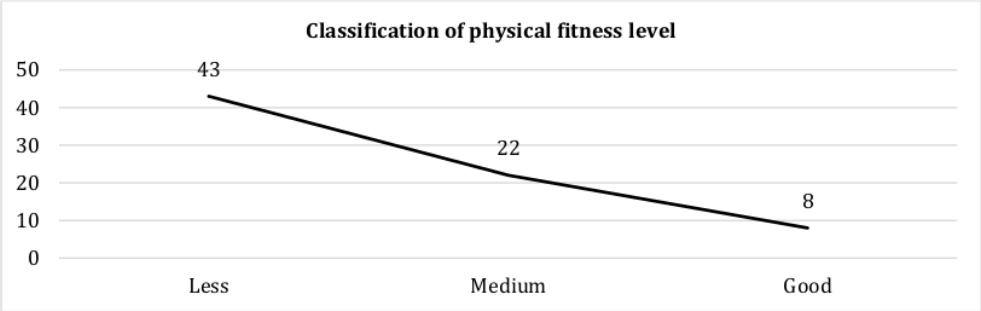


Graph 1. Anthropometric Test Result

The table data showed the results of fifteen thin students, 50 students with normal nutritional status, and ten fat students. The Indonesian physical fitness test consisted of 4 tests: the 20-meter MFT test, the excellent jumping test, the 60-second sitting bed test and the 60-second Push-Up test. The following were the results of the Indonesian physical fitness test that was carried out on the subjects of 73 students.

Table 4. Physical Fitness Test Results

Classification of physical fitness level	Number of Students
Less	43
Medium	22
Good	8
Total	73

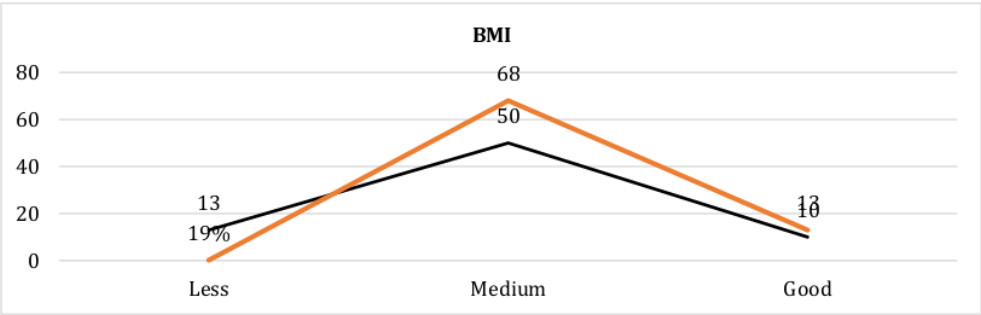


Graph 2. Physical Fitness Test Results

Table 5. Body Mass Index

BMI	Total	Percentage
Skinny	13	19%
Normal	50	68%
Fat	10	13%
Total	**73**	**100%**

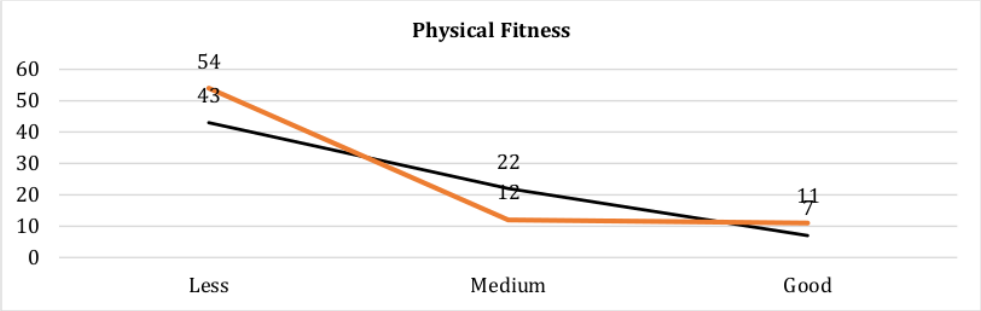
Table 5 showed that of the 73 students who were sampled in the study, 13 students or 19%, had thin nutritional status, 50 students or 68% of students, had normal nutritional status, and ten students or 13% of students had obese dietary status.



Graph 3. Body Mass Index

Table 6. Physical Fitness Level

Physical Fitness	Total	Percentage
Less	43	54%
Medium	22	12%
Good	8	11%
Total	**73**	**100%**



Graph 4. Physical Fitness Level

In this study, two key tables were analyzed to explore the relationship between nutritional status and physical fitness among students. Table 4 provides an overview of the students' nutritional status, while Table 5 presents their physical fitness levels. Table 4 reveals that out of the total number of students (73), 19% were classified as underweight, 68% had a normal nutritional status, and 13% were categorized as obese. This data highlights the distribution of nutritional status among the students sampled in the study. Moving on to Table 5, which focuses on physical fitness levels, it can be observed that among the 73 students, 54% had lower physical fitness levels, 12% had moderate levels, and 7% demonstrated good levels of physical fitness. This table provides valuable insights into the distribution of physical fitness levels within the study sample.

Analyzing both tables together allow us to draw conclusions regarding the correlation between nutritional status and physical fitness levels among students. Students with an underweight BMI tended to have lower levels of physical fitness, while those with a good BMI showed higher levels of physical fitness. Specifically, among the students with an underweight BMI, 68% had low physical fitness, 19% had moderate fitness, and 13% had good fitness. For students with a normal BMI, 28% had low physical fitness, 36% had moderate fitness, and 36% had good fitness. Among students with a good BMI, 10% had low physical fitness, 60% had moderate fitness, and 30% had good fitness levels.

This study aligns with previous research, including studies by Santiworakul et al. (2022) and Wattanapisit et al. (2016), which also found a positive relationship between nutritional status and physical fitness in adolescents and college students. These students with better nutritional status demonstrated higher levels of cardiorespiratory endurance, muscle strength, and flexibility, as evidenced by studies conducted by Almutairi et al. (2018), Alshamri, (2020), Khalaf et al. (2013). The results underscore the importance of comprehensive approaches that address both nutritional status and physical fitness in promoting the overall health and well-being of students. By implementing interventions that encourage healthy eating habits and regular exercise, schools and parents can support students in achieving optimal physical fitness levels and fostering lifelong wellness habits.

Based on these findings, it is crucial to raise awareness about the significance of balanced nutrition and regular exercise among students and adolescents (Rizqi & Udin, 2018; Zuhdy et al., 2015). Integrating school health programmes with physical education and exercise has been shown to effectively improve student health and fitness (Mustafa & Dwiyogo, 2020; Pambudi et al., 2019). Furthermore, involving parents and implementing targeted intervention programmes are crucial to supporting students

with poor nutritional status or low physical fitness (Soraya et al., 2017; Yunitasari et al., 2019). To obtain more comprehensive and reliable results, future studies should include larger and more diverse samples from different students and adolescent populations (Wulandari & Jariono, 2022; Yulianingsih, 2019). This approach facilitateed appropriate follow-up actions to enhance the health, physical fitness, and academic abilities of students.

The results of this study also have important implications for education and management in the field of Education. Previous studies have emphasised the role of physical activities in supporting students' health and fitness during learning activities (Aliriad, 2023). Therefore, this study confirms that incorporating varied sports activities appropriate for students' fitness levels into the school curriculum is essential (Adi et al., 2023; Lin & Yang, 2015). By promoting an active and engaging learning environment, schools can effectively enhance students physical fitness and overall well-being. This underscores the importance of a holistic approach to education that integrates physical health and fitness alongside academic development (Lorenza & Sihabudin, 2022; Mustafa, 2022).

Furthermore, this study provides valuable implications for parents to monitor their children's diet and physical activity. Preventing obesity in children is a crucial step toward ensuring their future health and physical fitness. Parents can refer to the results of this study as a guide to provide support and guidance for their children's healthy lifestyles. However, it is important to note that the study's results are based on a specific sample of students and may not represent the entire population. Therefore, conducting more extensive studies with larger samples and variations in the student population is necessary to obtain more generalized and reliable results. Future research can also explore additional factors that influence the relationship between nutritional status and physical fitness among students, while considering their impact on academic performance.

As a follow-up to the findings of this study, it is crucial to increase awareness and understanding of the importance of balanced nutrition and regular exercise within the educational context. The education system should integrate a healthy lifestyle as an integral part of the curriculum, incorporating nutrition and physical fitness education. Additionally, implementing specially designed intervention programs can help students with poor nutritional status or low physical fitness to achieve better health and improve their academic abilities. These efforts contributed significantly to promoting the health, fitness, and academic performance of students in the educational environment.

CONCLUSION

This study provides valuable insights into the relationship between students' nutritional status, BMI, and their level of physical fitness. By assessing BMI and conducting physical tests, the study reveals patterns in this association, highlighting the importance of considering both factors in promoting students' overall well-being. The findings contribute to the existing literature by enhancing our understanding of the interplay between nutritional status and physical fitness among students.

The implications of this study extend to various stakeholders, including educators, parents, and policymakers. Educators can utilize these findings to develop comprehensive health and physical education programmes that prioritize balanced nutrition and regular exercise to improve students' physical fitness. Parents can also benefit from the study's insights by raising awareness of the significance of healthy diets and encouraging their children to engage in physical activities. Furthermore, policymakers can incorporate these findings into educational policies to promote

healthier lifestyles and enhance the physical fitness of students at a broader level.

By emphasising the relationship between nutritional status, BMI, and physical fitness, this study contributes to the advancement of knowledge in the field of students' health and well-being. It highlights the need for a holistic approach to students' wellness and underscores the importance of considering multiple factors in promoting their physical fitness. Ultimately, the insights gained from this study can pave the way for more targeted interventions and initiatives aimed at enhancing the health and fitness of students in educational settings.

ACKNOWLEDGEMENTS

We gratefully thank all respondent.

CONFLICTS OF INTERESTS

The authors declare that they have no competition.

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