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Effects of dietary patterns, economic factors, and hemoglobin on physical fitness in adolescent students

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Abstract

Increased understanding of a balanced diet, the role of economic factors, and the importance of hemoglobin levels are essential for improving students' physical fitness. This research aims to determine the influence of food patterns, economic factors, and hemoglobin on students' physical fitness. The research method uses quantitative survey methods and path analysis. The sample involved 58 adolescent students selected through simple random sampling. Data collection included a closed questionnaire on diet and economic factors, BMI measurements based on age and gender norms, physical fitness tests using the Nusantara Student Fitness Test, and hemoglobin level assessments according to WHO standards. The data analysis employed normality and homogeneity tests, with t-tests to determine variable effects using SPSS 25. The results concluded that dietary patterns and economic factors significantly influence hemoglobin, with p-values of 0.041 and 0.028. The R Square value of 0.427 indicates that these factors explain 42.7% of hemoglobin variability. The variables of diet, economic factors, and hemoglobin were significant to physical fitness, with p-values of 0.044, 0.000, and 0.006, respectively. The R Square value of 0.724 indicates that these three variables can explain 72.4% of the variability in physical fitness. This study contributes to demonstrating the impacts of diet, economic factors, and hemoglobin on students' physical fitness. Path analysis clarifies the relationships between these variables, while comprehensive fitness assessments provide insights into hemoglobin's impact on performance.

Keywords: Food pattern, economic factors, hemoglobin, physical fitness.

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INTRODUCTION

Education is integral to human life, providing the foundation for individual progress (Lee & Lee, 2021; Sanova et al., 2022; Vilchez et al.,

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2021). This includes physical education, which plays an important role in developing students' potential and achieving optimal physical fitness (Bae, 2023; Blegur & Lumba, 2022). Physical education is not only about physical activity but also includes understanding health, diet, and other factors that affect physical fitness (De Bruijn et al., 2023; Makaracı et al., 2023). Physical education aims to create a healthy, fit, and high-achieving generation (Destriana et al., 2020). Research shows a correlation between physical fitness and hemoglobin levels in the body, which play an important role in health (Adriani & Fadilah, 2023). Therefore, physical education is integral to quality education services in schools. Hemoglobin is an oxygen-carrying protein in red blood cells (Matsuhira & Sakai, 2022). Its main function is to carry oxygen from the lungs to the rest of the body and transport carbon dioxide back to the lungs (Magor-Elliott et al., 2021). Hemoglobin levels can be an indicator of blood deficiency or anemia (Addo et al., 2021; Hoenemann et al., 2021). Hemoglobin is an oxygen-carrying metal protein containing iron in red blood cells in mammals and other animals. Hemoglobin in the blood carries oxygen from the lungs to all body tissues and brings carbon dioxide back from all cells to the lungs to be removed from the body. Myoglobin is an oxygen reservoir that receives, stores, and releases oxygen in muscle cells. Factors that affect hemoglobin levels involve the adequacy of iron in the body. The procedure for checking hemoglobin levels with the Easy Touch device involves steps such as washing hands, turning on the device, attaching the test strip, cleaning the fingertips, and following the instructions on the device screen (Whittaker et al., 2021).

Economic constraints can affect access to nutritious food, so the role of parents in creating an environment that supports healthy eating patterns is very important (Haria et al., 2023). Food pattern is human behavior in meeting nutritional needs (Kris-Etherton et al., 2021). A good diet consists of consuming healthy foods, regular eating habits, and drinking enough water (Yulita et al., 2022). In addition, this study also considers other factors such as the environment, physical activity, smoking

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habits, or consuming alcohol as external factors that can affect physical fitness. Food pattern components involve the type, frequency, and amount of food. A balanced food pattern is a daily food arrangement that meets the body's needs with appropriate nutrients, paying attention to food diversity, physical activity, hygiene, and weight monitoring (Verduci et al., 2021). The factors influencing eating patterns include economics, socio-culture, religion, education, environment, and eating habits (Marcone et al., 2020). Therefore, breakfast is also considered important in achieving a balanced food pattern and increasing productivity, especially for students.

BMI is a method of assessing nutritional status that compares body weight and height. Factors influencing BMI involve age, genetics, gender, food patterns, physical activity, and technological advances (Chatterjee et al., 2020; Hao et al., 2023). Modern eating patterns, especially fast food consumption, can increase the risk of obesity, while lack of physical activity or sedentary living habits can also cause weight gain (Fruh et al., 2021). Awareness of these factors is important for maintaining a balanced weight and healthy lifestyle. Socio-economic factors also play a key role in determining a person's or family's economic status, influencing access to education, health, and other facilities (Sanova et al., 2022).

Apart from that, the element of physical fitness, as an indicator of health, involves aspects of health and skills (Kadek et al., 2016; Zhamardiy et al., 2020). Factors influencing physical fitness involve physical activity, adequate food intake, and adequate rest. Awareness of physical fitness is important to support daily activities and overall health. So, there is a need for studies related to food patterns, body mass index, and economic factors on students' hemoglobin levels and physical fitness.

METHOD

This research method uses a quantitative approach with survey methods, measurement techniques, and path analysis to analyze the relationship between variables (Sugiyono, 2018). Path analysis examines the causal influence between independent and dependent variables, either directly or indirectly. The path analysis model used involves four variables,

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namely diet (X1), economic factors (X2), hemoglobin (X3) as an intervening variable, and physical fitness (Y).

The study population involved all teenage students from the Madrasah Tsanawiyah Negeri (MTsN) 2 Muara Bungo school, with a sample involved from this study of 58 seventh-grade students selected using simple random sampling. This research method uses a quantitative approach with survey methods, measurement techniques, and path analysis to analyze the relationship between variables (Sugiyono, 2018). Path analysis is used to test the causal influence between independent and dependent variables, both directly and indirectly. The path analysis model used involves four variables, namely diet (X1), economic factors (X2), hemoglobin (X3) as an intervening variable, and physical fitness (Y). The analysis examined the direct and indirect effects of independent variables on the dependent variable. In this case, the t-test and F-test were used to determine the significance of the path coefficient.

Data collection instruments were a closed questionnaire on diet and economic factors that had been prepared based on feasibility tests by relevant parties and had been tested, measurement of BMI based on age and gender norms, physical fitness tests using the Nusantara Student Fitness Test, and measurement of hemoglobin levels with limits according to WHO standards. Physical fitness tests using the Indonesian student fitness test include carrying out tests: (1) *V sit reach test*, (2) *sit up* 60 seconds, (3) *squat thrust* 30 seconds, (4) PACER *test*. The test results were tabulated by adjusting the physical fitness test norms according to the research subjects' age and gender. Data analysis techniques include normality tests, regression significance, linearity tests, and path analyses to test the research hypothesis. The results of path analysis form a hypothetical model that is tested for significance to find causal relationships between variables. With a quantitative approach and path analysis method, this study sought to explore the influence of diet, economic factors, and hemoglobin levels on the physical fitness of MTsN 2 Muara Bungo students. Path analysis helps reveal the pattern of variable

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relationships and their significance in the context of this study. The analysis was carried out by examining the direct and indirect effects of independent variables on the dependent variable. In this case, the t-test and F-test were used to determine the significance of the path coefficient.

RESULT

The results of this research are presented in the form of a description of the data processing results by taking research results. The study involved a research sample of 58 Madrasah Tsanawiyah Negeri (MTsN) 2 Muara Bungo school class VII adolescent students.

Table 1. Normality test results

P_{Value}	α	Conclusion
0,072	0,05	Normal

The results of the Kolmogorov-Smirnov test in SPSS 25 show a P value (0.072) > 0.05, indicating a normal distribution. In conclusion, all data groups in this study come from normal populations.

Table 2. Linearity test results

Variable	P_{Value}	F_{count}	α	Information
Foot pattern and physical fitness	0,265	1,264	0,05	Linear
Economic factors and physical fitness	0,447	1,005		
Hemoglobin and physical fitness	0,992	0,402		

Based on the results of the linearity test, there is a linear relationship between food patterns (sig. 0.265), economic factors (sig. 0.447), and hemoglobin (sig. 0.992). However, the significance is above 0.05, indicating a tendency for a linear relationship with physical fitness. The F_{count} value also supports this assumption, with relatively low values (0.843, 1.005, and 0.405). So, there is a linear relationship between food pattern variables, economic factors, and hemoglobin on physical fitness.

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Table 3. Homogeneity test results

Variable	P Value	Value α	Information
Foot pattern and physical fitness	0,615	0,05	Homogenous
Economic factors and physical fitness	0,281		
Hemoglobin and physical fitness	0,506		

The results of the homogeneity of variance test on food patterns (sig. 0.615), economic factors (sig. 0.281), and hemoglobin (sig. 0.506) suggest that these three variables come from populations with relatively homogeneous variances. A p-value greater than 0.05 indicates that the assumption of homogeneity of variance is met, supporting the validity of the data analysis.

Table 4. Hypothesis test results

Model	Variable	R Square	Koef	*Sig.*	*P-Value*	Information
Structure 1	foot petrn, hemoglobin (p_{31})	0.427	0.262	0,041	0,05	Significant
	Economic factors, hemoglobin (p_{32})		0.283	0,028		
Structure 2	foot petrn, physical fitness (p_{y1})	0,724	-0.206	0,044		
	economic factors, physical fitness (p_{y2})		0.762	0,000		
	hemoglobin, physical fitness (p_{y3})		-0.299	0,006		

In testing substructure hypothesis 1, regression analysis shows that food pattern (x_1) and economic factors (x_2) have a significant influence on hemoglobin (x_3), with p values of 0.041 and 0.028, respectively. The R Square value of 0.427 indicates that food patterns and economic factors can explain 42.7% of hemoglobin variability. In the context of substructure 2, the variables food pattern (x_1), economic factors (x_2), and hemoglobin (x_3) are significant on physical fitness (y), with p values of 0.044, 0.000, and 0.006, respectively. The R Square value of 0.724 indicates that these three variables can explain 72.4% of the variability in physical fitness. These results provide sufficient statistical evidence to reject the null hypothesis, indicating a significant influence of the predictor variables on the response variables in both substructures.

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DISCUSSION

Overall, this study provides an important contribution to understanding the factors that affect the physical fitness of teenage students from the Madrasah Tsanawiyah Negeri (MTsN) 2 Muara Bungo school. The implications can be used to develop intervention programs to improve students' diet, economic conditions, and hemoglobin levels, thereby supporting their physical fitness improvement. This study also touches on the element of physical fitness, this element is influenced by internal factors such as genetics, age, and gender, as well as external factors such as physical activity and the environment (Fatmawati et al., 2021). Therefore, this study also highlights the importance of understanding these factors to improve physical fitness. Then, the discussion regarding the socio-economic level of parents is also considered because it can affect the facilities provided to students, including physical fitness development. This is in line with research conducted by (Satriwan Chan, 2021) that socio-economic levels can affect children's knowledge, food intake, and health, which then have an impact on students' physical fitness and learning achievement at school.

This research program aims to improve physical fitness through physical exercise and implementing a healthy diet. Before the program is implemented, an initial test is conducted to assess each research object's initial state of physical fitness. This test includes hemoglobin examination, pulse measurement, and determination of exercise zones based on pulse rate. After that, a healthy exercise and diet program is implemented, and a final test is conducted to evaluate the development of physical fitness. The focus of this study is the importance of a balanced diet, paying attention to cleanliness, and maintaining endurance and physical fitness.

A good diet consists of consuming healthy foods, regular eating habits, and drinking enough water (Yulita et al., 2022). In addition, this study also considers other factors such as the environment, physical activity, smoking habits, or consuming alcohol as external factors that can affect physical fitness. According to Budiono and Rivai (2021), healthy

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living behavior in the elderly can affect physical health and quality of life. Therefore, aspects of physical fitness are related to diet, physical exercise, and overall quality of life.

This study also touches on the element of physical fitness, which is influenced by internal factors such as genetics, age, and gender, as well as external factors such as physical activity and the environment (Fatmawati et al., 2021). Therefore, this study also highlights the importance of understanding these factors to improve physical fitness. Then, the discussion regarding the socio-economic level of parents is also considered because it can affect the facilities provided to students, including physical fitness development. This is in line with research conducted by (Satriwan Chan, 2021) that socio-economic levels can affect children's knowledge, food intake, and health, which then have an impact on students' physical fitness and learning achievement at school. The importance of nutritious food intake and nutritional balance in physical fitness development is also highlighted. The family's economic condition can affect the fulfillment of students' food and nutritional needs, so it can impact the level of physical fitness. This is in line with previous research conducted by Sukendro et al. (2022), which found that the family environment is also a factor that influences the level of physical fitness, both physically and socio-economically. Together, these factors influence the measurement of a person's physical fitness level. Environmental factors, lifestyle, and physical exercise need to be considered to achieve optimal physical fitness levels. Furthermore, this study highlights the role of hemoglobin in physical fitness.

Therefore, this study discusses the importance of understanding hemoglobin levels and how certain factors can influence them. Therefore, this study proposes preventive efforts in the form of nutritional education through video media to increase students' knowledge about anemia and the importance of maintaining hemoglobin levels. This preventive approach is expected to reduce the impact of anemia on adolescents, including health problems, low academic achievement, and the risk of

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complications during pregnancy. With increased knowledge and understanding of nutritional aspects and physical fitness, it is hoped that adolescents can take preventive steps to maintain their health and improve their physical fitness.

CONCLUSION

In conclusion, this study revealed a significant relationship between diet, economic factors, hemoglobin, and physical fitness of students at MTsN 2 Muara Bungo. The results of the path test showed that diet had a significant direct effect on physical fitness, thus confirming the importance of nutritional aspects in shaping students' fitness levels. Furthermore, economic factors were also shown to have a significant direct impact on students' physical fitness. This shows that economic aspects in the family can affect diet and students' fitness levels. Therefore, collaboration between schools and families in improving understanding of balanced nutrition and physical activity is becoming increasingly crucial.

In addition, the results of the path test showed that hemoglobin played an important role in mediating the relationship between diet and economic factors with physical fitness. Adequate hemoglobin levels are key to supporting students' physical performance and well-being. Therefore, efforts to improve understanding of the importance of nutrient intake and implementing healthy eating patterns need to be strengthened. Overall, these findings provide a strong foundation to support the importance of nutrition education, promotion of healthy eating patterns, and accessibility to nutritious foods in educational contexts. Joint efforts between schools, families, and communities can form an academically intelligent generation with optimal physical fitness, maintaining a balance between cognitive and physical aspects of student development.

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