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The Influence of Hemoglobin and Motivation on Students' Physical Fitness

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ABSTRACT

This study aims to analyze the effect of hemoglobin levels and motivation on students' physical fitness. This study used a quantitative approach with a correlational design and involved 60 students as respondents who were randomly selected through random sampling *techniques. The variables studied consisted of hemoglobin levels measured with a hemoglobinometer, motivation levels measured using a questionnaire with a Likert scale, and physical fitness measured through physical tests which included running 1,600 meters, push-ups, and sit-ups. The results of bivariate analysis showed a significant relationship between hemoglobin levels and students' physical fitness (p = 0.003). In addition, the study also showed a significant relationship between motivation and students' physical fitness (p = 0.001). Students with high motivation had better physical fitness, with most being in the good (18.3%) and moderate (16.7%) categories. The results of this study confirmed that sufficient hemoglobin and high motivation play an important role in supporting students' physical fitness. This study provides important insights into the factors that influence students' physical fitness in an educational setting.*

Keywords: *Hemoglobin Levels, Motivation, Physical Fitness*

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INTRODUCTION

Education is an important pillar in the development and progress of a nation. According to Care & Care (2017), the achievement of national education goals that include improving the quality of life and educating the nation's life can be realized with the shared responsibility of various parties, including students, parents, teachers, government, and higher education institutions. Each individual in the education system has a mutually supportive role, especially in terms of realizing holistic educational goals, which are not only limited to the mastery of academic knowledge, but also to the physical and mental development of students.

Physical Education, as an integral part of the education curriculum, aims to develop students' knowledge of physical movements in sports and the health factors that influence them. According to Sutrisno & Fitria (2016), physical education not only teaches skills in performing physical activities, but also provides an understanding of the importance of maintaining health and physical fitness on an ongoing basis. With structured physical education, students are expected to have a high awareness of the importance of exercise, physical fitness, and a healthy lifestyle.

Physical fitness is a fundamental indicator of health status and functional capacity, especially among students who are in a critical period of growth and development. One of the physiological factors influencing physical fitness is hemoglobin (Hb) level in the blood. Hemoglobin plays a crucial role in oxygen transport from the lungs to body tissues, which is essential for aerobic metabolism and endurance during physical activity. Studies have demonstrated a significant relationship between hemoglobin levels and physical fitness, where adequate hemoglobin supports better oxygen delivery, thus enhancing physical performance and endurance (Sepriadi et al., 2020; Lisnawati et al., 2021). Regular exercise can increase hemoglobin levels, which in turn improves cardiovascular endurance and overall fitness (Agus, 2018).

In addition to physiological factors, psychological components such as motivation are critical determinants of physical fitness. Motivation influences the willingness and consistency of students to engage in physical activity, which affects their fitness levels. High motivation encourages regular exercise participation, leading to improved physical fitness outcomes (Notoatmodjo, 2012). Therefore, understanding the combined influence of hemoglobin levels and motivation on students' physical fitness is essential for developing comprehensive health promotion strategies in educational settings.

This study aims to examine how hemoglobin concentration and motivation jointly affect the physical fitness of students, providing insights to optimize interventions for enhancing student health and performance.

Furthermore, physical education plays a role in shaping students' character through physical activities that involve teamwork, discipline and mental resilience. Pratama & Sari (2018) emphasized that physical education can increase students' motivation to be more active in exercise and keep their bodies healthy. This is important because good physical fitness will have a direct effect on students' physical and mental health, which in turn can affect their academic performance.

The importance of physical education is also emphasized by Putra (2019), who revealed that with quality physical education, students can gain knowledge about healthy lifestyles and fitness that are not only useful during school, but can also be applied in their daily lives in the future. Therefore, every educational institution must be able to organize physical education with an approach that suits the needs and characteristics of students, so that the goals of national education in educating the nation's life can be achieved comprehensively.

In Indonesia, students' physical fitness is becoming an increasingly pressing issue, especially with the development of modern lifestyles that tend to be more sedentary. This lifestyle change causes students to spend more time in front of screens, whether it's studying, playing games, or using social media, which results in less time for physical activity. According to the 2018 Basic Health Research (Riskesdas), more than 30% of children and adolescents in Indonesia lack the recommended physical activity, with the majority of them spending more than 3 hours a day on activities that do not involve physical activity (Ministry of Health of the Republic of Indonesia, 2018). This phenomenon has contributed to an increase in the prevalence of obesity among students, which is one of the main factors in the decline of their physical fitness.

In addition, another factor that also affects students' physical fitness is the level of hemoglobin in the blood. Low hemoglobin, a condition known as anemia, can lead to a decrease in the body's capacity to carry oxygen to all tissues, which in turn hinders physical performance and worsens students' endurance (Anwar & Syafruddin, 2020). Students with low hemoglobin levels tend to experience fatigue more quickly, even when performing light physical activities. This further worsens their physical fitness condition, making them unable to participate in sports activities that can improve their overall physical condition.

However, in addition to physical factors such as hemoglobin, motivation also plays an important role in maintaining students' physical fitness. Intrinsic motivation, which comes from within the student, as well as extrinsic motivation, which comes from external factors such as the support of parents, teachers, or friends, largely determines the extent to which students participate in sports or other physical activities. Research shows that students who have high motivation, either due to health awareness or encouragement from the surrounding environment, are more likely to engage in physical activities that support their fitness (Yuliana & Dewi, 2019).

Given the importance of these two factors-hemoglobin and motivation-this study aims to explore their influence on students' physical fitness in Indonesia. It is hoped that the findings from this study will provide a clearer picture of how hemoglobin levels and motivation interact to influence students' physical fitness, and provide a basis for designing intervention programs that can help improve the physical health and quality of life of Indonesia's youth.

METHODS

This study used a quantitative approach with a correlational design to determine the effect of hemoglobin and motivation on students' physical fitness. The sample used consisted of 60 students who were randomly selected through *random sampling* technique. The independent variables in this study were hemoglobin levels measured using a hemoglobinometer and motivation measured through a questionnaire with a Likert scale. While the dependent variable is physical fitness, which is measured through physical tests such as the 12-minute run test, sit-ups, and push-ups. Data collection is done by taking blood samples to measure hemoglobin, administering questionnaires to measure motivation, and conducting physical fitness tests in the field. The data obtained will be analyzed using the normality test to check data distribution, Pearson correlation test to determine the relationship between variables, and multiple linear regression test to determine the simultaneous effect of hemoglobin and motivation on physical fitness. This study also pays attention to ethical aspects, by obtaining written consent from students and parents and maintaining the confidentiality of the data obtained. This study has limitations, namely only involving students from one school, so the results cannot be generalized to a wider population without further research.

Table 1. Definition

No.	Variables	Variable Type	Indicator	Measurement Scale
1	**Hemoglobin (X_1)**	**Independent**	Blood hemoglobin level (g/dL)	**Ratio**
2	**Motivation (X_2)**	**Independent**	Interests in sports Personal goals Social support	**Ordinal**
3	**Physical Fitness (Y)**	**Dependent**	-Cardiorespiratory endurance Muscle strength Flexibility	**Ratio**

RESULTS

1. Hemoglobin Check Result (X_1) Student

Table 1. Frequency data of students' hemoglobin examination results

Hb Category	Value Range (g/dL)	Number of respondents	Percentage
Low	< 12.0	10	16.7 %
Normal	12.0 - 15.0	44	73.3 %
High	>15.0	6	10.0 %
Total		60	100.0 %

Based on data on hemoglobin levels from 60 respondents, it can be seen that most students - 44 people or 73.3% - have hemoglobin levels in the normal range (12.0-15.0 g/dL). A total of 10 respondents (16.7%) fell into the low hemoglobin category (<12.0 g/dL). On the other hand, 6 respondents (10.0%) recorded high hemoglobin levels (>15.0 g/dL).

2. Interview results Motivation (X_2) Students

Table 2. Interview results of Motivation (X_2) Students

Motivation Category	Score	Number of respondents	Percentage
Low	< 60	8	13.3 %
Medium	60-79	30	50.0 %
High	≥ 80	22	36.7 %
Total		60	100.0 %

A total of 8 respondents (13.3%) were in the low motivation category (score < 60). This group shows a lack of drive to actively participate in fitness activities, A total of 30 respondents (50.0%) were in the moderate motivation category (score 60-79). This indicates that half of the students have sufficient motivation, but still not optimal to achieve peak physical fitness. Meanwhile, 22 respondents (36.7%) were classified as high motivation (score ≥ 80). Students in this category already show a strong internal drive to exercise and maintain physical fitness.

3. Students' Physical Fitness Examination Results

Table 3. Students' Physical Fitness Examination Results

Fitness Category	Score	Number of Respondents	Percentage
Less	< 50	12	20.0 %
Medium	50 - 74	33	55.0 %
Good	>75	15	25.0 %
Total		60	100.0 %

Based on physical fitness data from 60 respondents, it appears that the majority of students 33 people or 55.0% - are in the moderate category (index score 50-74). A total of 15 respondents (25.0%) were in the good category (index score ≥ 75). Meanwhile, 12 respondents (20.0%) were recorded as having poor physical fitness (index score < 50).

Bivariate Analysis

1. The Relationship of Hemoglobin to Students' Physical Fitness

Table 4. Relationship between Hemoglobin and Students' Physical Fitness

Hemoglobin	Physical Fitness						Total	
	Less		Medium		Good			
	n	%	n	%	n	%	n	%
Low	6	10.0 %	4	6.7 %	0	0.0 %	10	16.7 %
Normal	5	8.3 %	25	41.7 %	14	23.3 %	44	73.3 %
High	1	1.7 %	4	6.7 %	1	1.7 %	6	10.0 %
Total	12	20 %	33	55.0 %	15	25.0 %	60	100.0 %

Based on the results of bivariate analysis in Table 4, it can be seen that there is a relationship between hemoglobin levels and students' physical fitness. Students with low hemoglobin levels mostly had poor (10.0%) and moderate (6.7%) physical fitness, while no students with low hemoglobin had good physical fitness (0.0%). In contrast, students with normal hemoglobin levels showed a better distribution of physical fitness, with 8.3% in the deficient category, 41.7% in the moderate category, and 23.3% in the good category. This indicates that most students with normal hemoglobin levels have moderate to good physical fitness levels. Meanwhile, students with high hemoglobin levels consisted of 1.7% with poor fitness, 6.7% with moderate fitness, and 1.7% with good fitness. Overall, out of a total of 60 students studied, 20.0% had poor physical fitness, 55.0% had moderate fitness, and 25.0% had good fitness. Based on the chi-square statistical test, a *p-value* of 0.003 was obtained, indicating that there is a significant relationship between hemoglobin levels and students' physical fitness levels ($p < 0.05$).

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2. The Relationship of Motivation to Physical Fitness

Table 5. Relationship between Motivation and Students' Physical Fitness

Motivation	Physical Fitness						Total		*P-value*
	Less		Medium		Good				
	n	%	N	%	n	%	n	%	
Low	5	8.3 %	3	5.0 %	0	0.0 %	8	13.3 %	
Normal	6	10.0 %	20	33.3 %	4	6.7 %	30	50.0 %	
High	1	1.7 %	10	16.7 %	11	18.3 %	22	36.7 %	**0.001**
Total	12	20 %	33	55.0 %	15	25.0 %	12	**100.0 %**	

Based on the results of bivariate analysis in Table 5, it can be seen that there is a relationship between motivation level and students' physical fitness. Students with low motivation mostly had poor (8.3%) and moderate (5.0%) physical fitness, and none were in the good fitness category (0.0%). Meanwhile, students with normal motivation showed a more even distribution of physical fitness, namely 10.0% less, 33.3% moderate, and 6.7% good. Students with high motivation were mostly in the good (18.3%) and moderate (16.7%) physical fitness categories, and only 1.7% had poor physical fitness. Overall, out of a total of 60 students studied, 20.0% had poor physical fitness, 55.0% moderate, and 25.0% good. Based on the chi-square statistical test, a *p-value* of 0.001 was obtained, which indicates that there is a significant relationship between the level of motivation and students' physical fitness ($p < 0.05$).

DISCUSSION

1. The Relationship of Hemoglobin to Physical Fitness

Based on the results of bivariate analysis in Table 4, there is a significant relationship between hemoglobin levels and students' physical fitness level ($p = 0.003$). Students with normal hemoglobin levels showed a better distribution of physical fitness, mostly in the moderate (41.7%) and good (23.3%) categories, while no students with low hemoglobin had good fitness. Physiologically, adequate hemoglobin levels will increase the blood's ability to transport oxygen throughout the body, especially to muscle tissues that are active during physical activity, thus supporting aerobic metabolism and increasing physical fitness capacity.

These results are in line with the research of Santosa and Maulidiyah (2020) which showed a significant positive relationship between hemoglobin levels and the level of physical fitness of high school students, where normal hemoglobin levels support the achievement of better physical fitness. Similar research by Dewi et al. (2021) also supports these findings, showing that adolescent athletes with higher hemoglobin levels have better VO_2max performance, which is an important indicator in assessing physical fitness. This was reinforced by Arifin and Sari (2022), who found that

increased hemoglobin levels were significantly positively correlated with physical endurance and heart-lung work efficiency in students.

However, these results differ from the findings of Hidayat and Ramadhan (2019) who found no significant relationship between hemoglobin levels and physical fitness in university students, and mentioned that other factors such as exercise habits, nutritional intake, and rest patterns have a more dominant role. This difference may be due to variations in respondent characteristics, age range, and differences in routine physical activity between the populations studied.

2. The Relationship between Motivation and Physical Fitness

Based on the results of the bivariate analysis in Table 5, it was found that there was a significant relationship between motivation level and students' physical fitness ($p = 0.001$). Students with high motivation showed a better level of physical fitness, where most were in the good (18.3%) and moderate (16.7%) categories, while only 1.7% had poor fitness. In contrast, students with low motivation tended to have low levels of physical fitness as well, with 8.3% being in the poor category and none reaching the good fitness category. These results suggest that motivation has an important role in encouraging students to be more physically active and maintain their fitness. Highly motivated individuals tend to have clear goals, discipline in undergoing exercise, and are better able to overcome fatigue or obstacles in exercise.

This finding is in line with research from Wibowo and Ramdani (2021) which shows that intrinsic motivation has a strong positive correlation with the physical fitness of secondary school students. They found that students with high learning motivation were more diligent in participating in physical activities, both in the school environment and outside of school. Similarly, the study by Nurhayati et al. (2020) also showed that motivation is one of the important predictors in improving students' aerobic capacity, where students with high motivation are more consistent in following fitness programs. Another study by Setiawan and Lestari (2022) also emphasized that motivation fostered by the school environment, PJOK teachers, and the role of family significantly increased student involvement in routine sports.

However, these results are not in line with research by Anwar and Hidayah (2019), who concluded that motivation does not have a significant influence on students' physical fitness. They suggested that fitness levels are more influenced by diet, health conditions, and rest duration than motivation. This discrepancy could be caused by differences in age groups, respondents' backgrounds, and educational settings between school students and university students. Thus, although motivation is not the only factor, the results of this study confirm that the role of motivation remains significant in shaping an active lifestyle that supports students' physical fitness.

CONCLUSIONS

Based on the results of the study, it can be concluded that there is a significant relationship between hemoglobin and motivation with students' physical fitness. Students with normal to high hemoglobin levels tend to have better physical fitness levels compared to students with low hemoglobin levels. This suggests that hemoglobin as an important component in the transportation of oxygen has an important role in supporting physical performance and fitness.

In addition, motivation was also shown to be significantly related to students' physical fitness. Students with high motivation generally have physical fitness in the good category, while students with low motivation tend to have poor fitness. This finding indicates that motivation plays an important role in encouraging students to actively move, exercise, and maintain their physical fitness.

Thus, both hemoglobin and motivation are two important factors that jointly influence students' physical fitness level. As a follow-up to these findings, it is recommended that schools and educators pay attention to students' health aspects, especially hemoglobin levels through regular health checks, and build a learning environment that is able to foster students' motivation to lead a healthy and active lifestyle. In addition, sports activities and education on the importance of maintaining physical fitness need to be integrated consistently in the education curriculum and extracurricular programs.

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