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Physical Fitness and Learning Concentration in Adolescents: A Cross-Sectional Study

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Abstract

Introduction: Physical fitness is essential in supporting students' cognitive functions, including learning concentration. Sedentary behavior and insufficient physical activity may lead to decreased fitness levels, higher risk of metabolic disorders, and impaired focus. This study aimed to examine the association between physical fitness and learning concentration in adolescents.

Methods: A quantitative cross-sectional study was conducted at Muhammadiyah 2 Gamping Junior High School in May 2024. The study population consisted of 309 students, from which a sample of 76 students was randomly selected. Inclusion criteria included being an active student, free from severe health conditions, and willing to participate. Physical fitness was measured using the Six-Minute Walk Test (6MWT), while learning concentration was assessed using the Grid Concentration Test. Data analysis was performed using Spearman's correlation test.

Results: The mean 6MWT distance was 360.58 meters, and the mean concentration score was 9.61 points. Spearman's correlation test showed a strong and statistically significant relationship between physical fitness and learning concentration ($r = 0.763$; $p < 0.05$).

Conclusion: Physical fitness is significantly associated with learning concentration among adolescents. Higher physical fitness levels are linked to better concentration. These findings emphasize the importance of promoting physical activity in schools to improve both health and academic performance.

Keywords

Physical fitness, learning, adolescents, Six-Minute Walk Test, attention

Introduction

Physical fitness is a key indicator in assessing an individual's overall health, particularly in relation to their ability to perform daily activities without excessive fatigue. It also reflects the body's ability to adapt its physiological functions to environmental conditions and physical tasks involving cognitive engagement.[1,2]

An individual's level of fitness can either improve or decline depending on the extent of physical activity performed. Regular and structured physical activity stimulates physiological adaptations such as increased blood volume, enhanced myocardial contractility, greater ventricular elasticity, and the formation of new blood vessels (angiogenesis), all of which contribute to improved cardiac output.[3] Conversely, unhealthy lifestyle habits such as insufficient physical activity, poor dietary patterns, and excessive use of electronic devices can decrease physical fitness and increase the risk of overweight and obesity.[4]

According to the Sport Development Index (SDI), approximately 80% of the Indonesian population falls into the poor physical fitness category. Among individuals aged 10–15 years, only 6.79% are categorized as having good fitness, while 77.12% are classified as poor or very poor.[5] The World Health Organization (WHO) recommends that children and adolescents aged 5–17 years engage in at least 60 minutes of physical activity per day, including aerobic exercises and muscle- and bone-strengthening activities at least three times per week, to enhance cardiovascular fitness and reduce sedentary behavior.[6]

The consequences of physical inactivity extend beyond physical health, also affecting psychological well-being and cognitive function. Adolescents, including junior high school students, are increasingly at risk of declining physical fitness due to the prevalence of sedentary lifestyles. This phenomenon was exacerbated during the COVID-19 pandemic, when learning, working, and social interactions shifted to online platforms. This transition contributed to longer screen time and reduced daily physical activity.[7] The combination of increased technology use and decreased physical activity has been shown to lower physical fitness and overall quality of life in adolescents.[8]

Physical inactivity affects not only physiological conditions but also psychological aspects and motor skills. Moderate-to-vigorous intensity physical activity offers numerous health benefits, including improved cardiorespiratory fitness, muscle strength, and cardiometabolic health. Moreover, physical activity can reduce the risk of depression and enhance cognitive functions such as concentration, memory, and academic performance.[9,10] Concentration is a critical component of cognitive function, supporting academic success and students' adaptive functioning in daily life.[11]

In addition to enhancing physical fitness, physical activity improves cerebral blood flow and stimulates the release of noradrenaline and endorphins. During exercise, the increased blood supply to specific brain regions activates learning processes, which have been positively associated with memory, concentration, and comprehension abilities in students.[12,13]

Learning concentration refers to a student's ability to fully focus on educational activities. Unfortunately, many students today are more inclined to play video games, access social media, or watch videos, thereby reducing the time available for studying and completing assignments. Excessive use of electronic devices can lead to eye strain, sleep disturbances, and a decline in cognitive functions, including learning concentration.[14] Poor concentration negatively impacts learning effectiveness and knowledge acquisition.[15]

Students with good concentration tend to better understand and retain information. They are more capable of completing tasks efficiently and using their time productively. This condition is commonly associated with higher academic achievement compared to students who struggle with concentration.[16]

This phenomenon has also been observed at Muhammadiyah 2 Gamping Junior High School, where teachers reported a decline in student participation and concentration following the pandemic. However, few studies have specifically investigated the relationship between physical fitness and learning concentration among junior high school students in Indonesia.

Given the importance of physical fitness in supporting cognitive functions—particularly learning concentration—and the high prevalence of physical inactivity among adolescents, this study aims to examine the relationship between physical fitness and learning concentration in students at Muhammadiyah 2 Gamping Junior High School. The hypothesis of this study is that there is a positive relationship between physical fitness and learning concentration.

Methods

This study employed a quantitative observational design with a cross-sectional approach. The target population consisted of 309 students from grades VII, VIII, and IX, enrolled in nine different classes at Muhammadiyah 2 Gamping Junior High School. Data collection was conducted in May 2025. The sample size was calculated using Slovin's formula with a 10% margin of error, resulting in a sample of 76 students. Participants were selected through random sampling using a table of random numbers.

Inclusion criteria included being an active student in grades VII to IX, being physically healthy, and being willing to participate in the study. Students with a history of cardiac or respiratory disorders, or physical injuries that could hinder walking, were excluded. The independent variable in this study was physical fitness, measured using the Six-Minute Walking Test (6MWT), while the dependent variable was learning concentration, assessed using the Grid Concentration Test. No confounding or moderating variables were analyzed.

The 6MWT is a validated submaximal test used to assess functional capacity of the cardiorespiratory system. The Grid Concentration Test evaluates concentration based on time and accuracy in identifying numbers within a grid. Both instruments have been widely used in previous studies and are recognized as valid and reliable measures.

Data collection followed three main stages. First, during the preparation phase, the researcher provided clear instructions and explanations to all participating students. Next, the implementation phase was conducted in the school yard during morning hours—at the beginning of the school day—to minimize the influence of prior activities that could introduce bias. Finally, the measurement phase involved students completing the 6MWT by walking for six minutes, with the total distance recorded in meters. Immediately afterward, students performed the Grid Concentration Test, and their scores were calculated based on the number of correct numbers identified within the given time frame.

To minimize information bias, all tests were administered directly by the researcher using consistent instructions and procedures for all participants. All collected data were reviewed for completeness, and no missing data were identified. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics—including percentages, means, and standard deviations—were used to summarize the data. Spearman's correlation test was employed to analyze the relationship between physical fitness and learning concentration, as the data were not normally distributed and measured on an ordinal scale. Confounding variables were not controlled for, as the study was exploratory in nature.

Results

Respondent Characteristics

Table 1 presents the distribution of respondents based on age, showing the range and frequency across different age groups.

Table 1. Distribution of Respondents by Age

Age	Frequency	Percentage
12 years	1	1.3%
13 years	20	26.3%
14 years	26	34.2%
15 years	20	26.3%
16 years	8	10.5%
17 years	1	1.3%
Total	76	100%

Respondents' ages ranged from 12 to 17 years. The most common age was 14 years, represented by 26 respondents (34.2%), followed by 13 and 15 years with 20 respondents each (26.3%). There were 8 respondents

(10.5%) aged 16 years, and only 1 respondent each (1.3%) aged 12 and 17 years. The sex distribution of respondents is shown in Table 2, illustrating the proportion of male and female participants included in the study.

Table 2. Distribution of Respondents by Sex

Sex	Frequency	Percentage
Male	36	47.4%
Female	40	52.6%
Total	76	100%

There were 36 male respondents (47.4%) and 40 female respondents (52.6%). The initial population consisted of 309 students. A total of 233 students were excluded due to not meeting the inclusion criteria or being absent during data collection. No missing or incomplete data were identified in the analysis. Table 3 outlines the classification of respondents' physical fitness levels according to the Six-Minute Walking Test (6MWT).

Data Description

Table 3. Fitness Category Distribution Based on the Six-Minute Walking Test (6MWT)

Category	Frequency	Percentage
Normal	13	17.1%
Poor	10	13.2%
Very Poor	53	69.7%
Total	76	100%

The majority of respondents fell into the "Very Poor" category (53 students, 69.7%), indicating low fitness levels. Ten respondents (13.2%) were categorized as "Poor", while 13 (17.1%) were classified as "Normal". Descriptive statistics of the 6MWT scores, including minimum, maximum, mean, and standard deviation, are summarized in Table 4.

Table 4. Descriptive Statistics of the Six-Minute Walking Test (6MWT) Scores

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Fitness (6MWT)	76	215	542	360.58	86.905

Fitness scores ranged from 215 to 542 meters, with a mean of 360.58 meters and a standard deviation of 86.905. Table 5 illustrates the distribution of learning concentration levels as measured by the Grid Concentration Test, categorized from very poor to very good.

Table 5. Distribution of Learning Concentration Categories Based on the Grid Concentration Test

Category	Frequency	Percentage
Very Good	2	2.6%
Good	12	15.8%
Fair	14	18.4%
Poor	25	32.9%
Very Poor	23	30.3%
Total	76	100%

Most respondents were categorized as having "Poor" (32.9%) and "Very Poor" (30.3%) learning concentration. The remaining were classified as "Fair" (18.4%), "Good" (15.8%), and "Very Good" (2.6%). The descriptive statistical data of learning concentration scores, including central tendency and variability, are presented in Table 6.

Table 6. Descriptive Statistics of Grid Concentration Test Scores

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Learning Concentration	76	2	24	9.61	5.274

Learning concentration scores ranged from 2 to 24, with a mean of 9.61 and a standard deviation of 5.274. Table 7 displays the results of the Spearman correlation analysis between physical fitness and learning concentration.

Table 7. Spearman Correlation Test Between Physical Fitness and Learning Concentration

Variable X	Variable Y	Correlation Coefficient (r)	Sig. (p-value)	N
Fitness (6MWT)	Learning Concentration	0.763	0.000	76

The Spearman correlation test revealed a correlation coefficient of 0.763 with a significance level of 0.000 ($p < 0.05$), indicating a strong and statistically significant relationship between physical fitness and learning concentration. This analysis was conducted using a bivariate approach, with no adjustments for confounding variables. All data were complete, with no missing values.

Interestingly, most respondents categorized as having "Very Poor" physical fitness also scored in the "Poor" and "Very Poor" categories for learning concentration, reinforcing the observed relationship between the two variables.

Discussion

This study was conducted on 76 respondents, both male and female, aged between 12 and 17 years. The findings are consistent with those reported by Putra and Wahjuni, who studied junior and senior high school students aged 12–16 years and found a positive correlation between physical fitness and learning concentration in Physical Education classes.[17] This supports the notion that physical fitness plays a critical role in adolescent cognitive

performance. Similarly, a study by Reigal et al. involving 210 adolescents aged 11–15 years in Málaga, Spain, demonstrated a significant correlation between physical fitness and both selective attention and concentration, with VO_2max identified as the primary predictor of concentration performance.[18]

The age range of 12 to 18 years represents a crucial transitional period from childhood to adulthood. This developmental stage is vital for both physical and emotional growth, during which physical fitness serves not only to support physical development but also to prevent metabolic syndrome.[18] This is particularly relevant given the increasing prevalence of sedentary lifestyles among adolescents.[19]

The respondent group consisted of 36 male students (47.4%) and 40 female students (52.6%), indicating a relatively balanced gender distribution that allows for a more comprehensive understanding of gender differences in physical fitness. Maulana et al. found that male students generally exhibit higher levels of physical fitness compared to their female counterparts.[20] However, subgroup analysis based on sex and age was not performed in the present study, so potential intergroup differences were not explored in detail.

Results from the Six-Minute Walking Test (6MWT) showed an average distance of 360.58 meters, with a minimum of 215 meters and a maximum of 542 meters. Most participants fell into the "very poor" category, indicating low physical fitness. This is in line with the findings of Septi et al., who reported a mean of 376.16 meters,[21] and Rohmah and Dewi, who reported an average of 366.14 meters.[22] When compared to the normative values of >483 meters for males and >442 meters for females, the mean distance observed in this study remains below the healthy fitness threshold. These classification standards are based on the guidelines of the American Thoracic Society (ATS).[6] All data were collected completely, with no missing or invalid entries. All students who met the inclusion criteria participated in every stage of the study and none were excluded.

Learning concentration, assessed using the Grid Concentration Test, yielded a mean score of 9.61, with scores ranging from 2 to 24. A total of 63.2% of students were categorized as having low concentration (poor and very poor).[23] These findings are supported by Sabilla et al., who found that the majority of seventh-grade junior high school students did not demonstrate adequate concentration levels.[7] Overall, this suggests that low learning concentration is a common issue among school-age children and adolescents, potentially influenced by low physical fitness, insufficient physical activity, and suboptimal cognitive development.

The main finding of this study was a strong and statistically significant relationship between physical fitness and learning concentration, with a Spearman correlation coefficient of $r = 0.763$, $p = 0.000$, and 95% CI: 0.635–0.847. This is supported by Krissanthy et al., who reported a significant positive correlation ($r = 0.578$, $p < 0.05$) between the same variables.[24] Although the correlation in Krissanthy et al.'s study was lower, both studies consistently indicate a meaningful relationship between physical fitness and cognitive function. Similar results were reported by Putra and Wahjuni, with a significant correlation ($p = 0.01$), albeit with a weaker strength.[25] The variation in correlation strength may be attributed to differences in participant age ranges, the types of fitness and concentration tests employed, and differences in educational and physical activity contexts.

Engaging in physical activity enhances cerebral blood flow, stimulates the production of neurotransmitters such as dopamine and norepinephrine, and supports executive brain functions related to attention, sustained focus, and decision-making. During physical exertion, oxygen exchange and diffusion occur in the alveoli, enabling systemic oxygen distribution. Increased muscle contraction elevates oxygen consumption, which in turn leads to vasodilation in muscle capillaries, increased venous return, and elevated cardiac output. These physiological processes contribute to improved maximal oxygen uptake (VO_2max), which ultimately enhances physical fitness.[26]

According to the optimal arousal theory, moderate physical activity stimulates the central nervous system, thereby increasing mental readiness to receive and process information.[26] A good level of physical fitness positively impacts students' intelligence, encompassing psychomotor, affective, and cognitive aspects. Frequent physical activity raises hemoglobin levels, the primary carrier of oxygen in the body. Adequate oxygen supply improves concentration and metabolism, which directly affects academic performance. Conversely, students who are inactive and do not regularly engage in physical education may experience declines in both physical fitness and learning concentration.[27]

This study has several limitations. The cross-sectional design only allows for the identification of correlational relationships and not causality. Fitness was assessed solely using the 6MWT, which primarily measures cardiorespiratory endurance and does not capture other components such as muscular strength or flexibility. Additionally, concentration was measured using only a single instrument—the Grid Concentration Test—whose results may be influenced by temporary motivation or psychological conditions at the time of testing.

Based on these findings, schools are encouraged to implement programs that improve students' physical fitness through regular physical education, increased PJOK lesson hours, and the development of movement-based extracurricular activities. Educational efforts directed at students and parents should also be enhanced, as an active lifestyle has been shown to support not only physical health but also academic achievement.

Conclusion

Based on the findings from 76 junior high school students, it can be concluded that there is a very strong and statistically significant relationship between physical fitness and learning concentration. The majority of students demonstrated suboptimal physical fitness levels, with an average Six-Minute Walking Test (6MWT) distance of 360.58 meters. Concurrently, the results of the Grid Concentration Test indicated that most students exhibited low or very low learning concentration levels, with an average score of 9.61.

The Spearman correlation analysis yielded a coefficient of $r = 0.763$ with a p-value of 0.000, indicating a very strong positive relationship between the two variables. These findings suggest that improvements in students' physical

fitness are closely associated with enhanced learning concentration. This is consistent with previous studies reporting associations between physical fitness and cognitive function.

This study highlights the importance of physical fitness as a contributing factor to the quality of students' learning processes, particularly in enhancing concentration. Schools are encouraged to increase both the duration and intensity of structured physical activities, such as morning exercises and outdoor activities, to support students' cognitive performance. Further research is recommended using a longitudinal design to evaluate the long-term impact of physical fitness enhancement on academic achievement.

Author Contribution

Afilia Insan Khasanah conceptualized and designed the study, coordinated data collection, and drafted the initial manuscript.
Asyhara Naela Arifin contributed to methodology development, data analysis, and interpretation of the results.
Indriani supervised the research process, provided critical revisions, and ensured the overall scientific validity of the study.
All authors reviewed, edited, and approved the final version of the manuscript prior to submission.

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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 did not require formal ethical approval because it involved non-invasive procedures, posed no potential harm to participants, and was conducted as part of routine academic assessment. Participation was entirely voluntary, and written informed consent was obtained from all students and their parents or legal guardians before data collection. All data were kept confidential and used solely for research purposes.

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