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Physical Activity and Concentration in Children: A Cross-Sectional Study in Denpasar

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Abstract

Background: This study investigated the relationship between physical activity and concentration among primary school children in Denpasar, Bali.

Objective: This study aimed to examine the association between physical activity levels and concentration ability among primary school children aged 7–12 years in Denpasar, Bali.

Methods: A quantitative, cross-sectional study was conducted at SDN 14 Dauh Puri involving 69 students aged 7–12 years, selected via simple random sampling from a population of 158. Physical activity was assessed using the Physical Activity Questionnaire for Children (PAQ-C), and concentration was measured using the Grid Concentration Test. Anthropometric measurements were also recorded. Data were analyzed using Spearman's rho correlation test with a significance threshold of $p < 0.05$.

Results: A statistically significant weak positive correlation was found between physical activity and concentration ($r = 0.373$, $p = 0.002$), indicating that higher physical activity levels were associated with better concentration among children in this age group.

Conclusion: Physical activity is positively associated with concentration in children aged 7–12 years. Promoting appropriate physical activity in primary school settings may enhance concentration and support cognitive function.

Keywords

Physical Activity; Concentration; Primary School Children; PAQ-C; Cognitive Function

Introduction

The development of primary school–aged children is greatly influenced by their daily level of physical activity. Such activity not only supports physical health but also plays an important role in enhancing brain function, including concentration and learning ability, through the increased production of brain-derived neurotrophic factor (BDNF), which is associated with memory and attention in children. Physical activity has been shown to elevate BDNF levels, which are directly linked to cognitive function in children, as demonstrated by Yang et al.[1] Laksono et al. further reported that physical activity contributes to increased BDNF levels, which are crucial for memory processes and concentration in children.[2] However, these studies have generally examined the overall effects of physical activity without taking into account the intensity level, type of activity, or external factors that may influence this relationship.

Physical activity constitutes a vital aspect of the lives of primary school children, who are at a stage of rapid physical, cognitive, and social development. Beyond structured activities, such as school-based physical education, unstructured play—such as cycling, playing hide-and-seek, or engaging in traditional games like *dengkleng* and marbles—also contributes to fulfilling physical activity needs while fostering social, emotional, and cognitive development.[3]

Within the primary school environment, children are expected to participate in various physical activities both inside and outside the classroom. However, the increasing use of technology and prolonged screen time have been associated with a decline in physical activity levels. This trend raises concerns about potential long-term effects on children's physical and mental health, including their capacity for sustained concentration.[4,5]

Given this background, it is important to conduct an in-depth and comprehensive investigation into the specific relationship between physical activity and concentration levels among primary school students, particularly within SD Negeri 14 Dauh Puri, Denpasar. This study aims to provide a clearer understanding of how physical activity influences concentration in children, including internal and external factors that may mediate this association.

The objectives of this study are to describe the levels of physical activity and concentration among students, analyze the relationship between these variables, and determine concentration levels according to the type and intensity of physical activity performed. The findings are expected to offer practical recommendations for improving the effectiveness of physical activities and learning strategies in primary school settings.

Methods

This study employed a quantitative approach with a correlational research design to examine the relationship between physical activity and concentration levels among primary school students. The research was conducted at SDN 14 Dauh Puri, Denpasar, located at Jl. Pulau Ayu No. 29, Dauh Puri Kauh, West Denpasar District, Bali, on May 6, 2025. Participant recruitment and orientation were carried out in late April 2025.

Primary data were obtained through observation, interviews, and questionnaires assessing students' physical activity and concentration levels, as well as direct measurements. Secondary data were gathered from relevant documents and journals to support the analysis. Data collection began with the researcher introducing themselves to the students, explaining the study's objectives and procedures, and providing instructions for completing the questionnaires.

Two standardized instruments were used: the *Physical Activity Questionnaire for Children* (PAQ-C) and the *Grid Concentration Test*. The PAQ-C is a validated tool for children aged 8–14 years, consisting of 10 items that assess physical activity over the previous seven days. Scores range from 1 to 5, with the following interpretations: very low (1), low (2), moderate (3), high

(4), and very high (5). The *Grid Concentration Test* was administered individually in the classroom with a two-minute completion time, and scores were based on the total number of correctly identified numbers.

Anthropometric measurements, including height and weight, were taken to calculate body mass index (BMI). Prior to correlation analysis, data distribution was tested for normality. The independent variable was students' physical activity level, while the dependent variable was concentration level. Confounding variables such as age and sex were recorded but not analyzed separately.

The sample size was determined using Slovin's formula with a 10% margin of error from the total population of 158 students, yielding a minimum sample of 62 participants. Ultimately, 69 students met the inclusion criteria and participated in the study. Inclusion criteria were: (1) students in grades 2–6 at SDN 14 Dauh Puri, (2) aged 7–12 years, (3) willingness to complete the questionnaires, and (4) parental consent. Exclusion criteria included cognitive impairments or medical conditions that could interfere with concentration or physical activity.

To minimize bias in questionnaire completion, the researcher read the instructions aloud and supervised students during the process. Responses were kept confidential to encourage honest answers. All assessments were conducted in the morning to reduce the effects of fatigue or attention decline.

Data were processed and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize demographic and anthropometric characteristics. Normality was tested using the Kolmogorov–Smirnov test, and linearity was assessed before performing correlation analysis. Because the data were not normally distributed, Spearman's rho correlation test was applied, with statistical significance set at $p < 0.05$. No missing data occurred, as all students completed the questionnaires under direct supervision. This study was approved by the Research Ethics Committee of the Faculty of Medicine, Dhyana Pura University (Ethical Approval No. 001410/KEP Universitas Dhyana Pura/2025).

Results

From a total population of 158 students in grades 2–6, 75 were invited to participate in the study. Sixty-nine students met the inclusion criteria and completed all questionnaires, resulting in no missing data. Table 1 presents a detailed overview of the respondents' characteristics based on their age groups, providing an initial demographic profile for the study population.

Table 1. Respondent characteristics by age

Age (years)	n	%
7	7	10.1
8	6	8.7
9	7	10.1
10	7	10.1
11	26	37.7
12	16	23.2
Total	69	100

Most respondents were aged 11 years (n = 26, 37.7%), followed by those aged 12 years (n = 16, 23.2%). Students aged 7–10 years each accounted for 8.7–10.1% of the sample. Table 2 describes the respondents' characteristics categorized according to their physical activity levels, offering insight into the distribution of activity patterns among participants.

Table 2. Respondent characteristics by physical activity level

Physical activity level	n	%
Very low	3	4.3
Low	20	29.0
Moderate	36	52.2
High	10	14.5
Very high	0	0
Total	69	100

The majority of respondents had a moderate level of physical activity (n = 36, 52.2%). Table 3 outlines the respondents' characteristics based on their concentration levels, which serves as a reference for analyzing potential associations with other variables.

Table 3. Respondent characteristics by concentration level

Concentration level	n	%
Very good	1	1.4
Good	14	20.3
Fair	27	39.1
Poor	24	34.8
Very poor	3	4.3
Total	69	100

Most respondents had a fair concentration level (n = 27, 39.1%). However, 34.8% were categorized as poor and 4.3% as very poor in concentration. Table 4 displays the results of the Kolmogorov–Smirnov normality test conducted to assess whether the data for each variable met the assumptions of normal distribution.

Table 4. Kolmogorov–Smirnov normality test results

Variable	P valaue
Physical activity	0.027
Concentration level	0.200

The results show that physical activity scores were not normally distributed ($p = 0.027 < 0.05$), while concentration scores were normally distributed ($p = 0.200 > 0.05$). Consequently, hypothesis testing was performed using the non-parametric Spearman's rho correlation test. Table 5 presents the results of the linearity test, which was carried out to determine whether the relationship between the studied variables follows a linear pattern.

Table 5. Linearity test results

Group	Sig.
Children aged 7–12 years at SDN 14 Dauh Puri	0.681

The significance value (p = 0.681 > 0.05) indicates a linear relationship between the independent and dependent variables. Table 6 summarizes the findings of the Spearman's rho correlation analysis, highlighting the strength and direction of the relationship between physical activity and concentration levels.

Table 6. Spearman's rho correlation between physical activity and concentration level

Variables	Spearman's rho (r)	p-value	n
Physical activity vs. concentration level	0.373**	0.002	69

Note: p < 0.01, ** indicates significant correlation.

The correlation coefficient between physical activity and concentration was 0.373, indicating a weak positive relationship. The significance value (p = 0.002 < 0.05) confirms that this relationship is statistically significant. No confidence intervals were calculated, as the analysis was limited to bivariate correlation. No adjustments for confounding variables were made, and subgroup or sensitivity analyses were not conducted due to the limited sample size. Future research should consider evaluating the effects of variables such as sex, age, or type of physical activity separately.

Discussion

Respondent Characteristics

This study aimed to investigate the relationship between physical activity and concentration levels among children aged 7–12 years. The analysis revealed a statistically significant positive correlation between the two variables. The sample comprised 69 primary school students aged 7–12 years from grades 2 to 6 at SDN 14 Dauh Puri, Denpasar, who met the inclusion criteria. Variations in physical activity scores and concentration levels among these respondents are presented in Table 6.

These findings are consistent with those reported by Pranata et al., who emphasized that concentration is essential not only in daily activities but also during physical activity, such as sports, to achieve optimal performance.[6] Similarly, Sember et al. found that physical activity among school-aged children was significantly associated with improved concentration and working memory. This underscores the dual benefits of physical activity—enhancing both physical health and cognitive function—which can directly impact academic achievement.[7]

Comparable results were reported by Yugan et al., who concluded that higher levels of physical activity were significantly associated with higher body mass index (BMI). Their study, involving 110 children (54 with obesity), also showed that most participants were moderately active.[8] Considering the characteristics of students at SDN 14 Dauh Puri, it is important to note that the type and intensity of physical activity, as well as BMI, may influence concentration differently for boys and girls.[9]

The relevance of this study is heightened by current trends in which many children experience reduced physical activity due to technological advancements and increasingly sedentary lifestyles. Understanding the link between physical activity and concentration offers valuable insights for educators and parents in supporting children's holistic development.

Relationship Between Physical Activity and Concentration in Children Aged 7–12 Years

The Spearman's rho test revealed a correlation coefficient of 0.373, indicating a weak yet positive association between physical activity and concentration levels among students at SDN 14 Dauh Puri. This positive relationship suggests that more frequent engagement in physical activity is associated with higher concentration. However, these results should be interpreted with caution due to potential unmeasured confounders and the non-longitudinal nature of the study design.

These results align with those of Runesi et al., who found that physical activity correlated positively with cognitive function in students (r = 0.58; p < 0.001). The authors suggested that physical activity increases cerebral blood flow, facilitating neurogenesis in the hippocampus. Active children also tend to have better sleep patterns, which are essential for brain recovery and memory processes.[10]

Aries Diana et al. reported that children aged 7–9 years typically possess fundamental motor skills—such as throwing and catching balls, playing traditional games like *kasti*, and mastering basic swimming styles such as the breaststroke.[11] Dara Rizkita et al. and Latino and Tafuri found that children aged 10–12 years tend to engage in more physical activity compared to those aged 13–14 years. The younger group also places greater importance on friendship and social interaction, reflecting their concurrent physical and interpersonal development. [12,13] Laksono et al. further reported that motor skills and physical activity levels are closely related; higher motor abilities are associated with greater physical activity, which in turn enhances motor skill development. [2]

In this developmental stage, children often gain self-confidence through achievements in physical strength compared to their peers. Moreover, regular exercise can help reduce stress and anxiety—both of which can hinder learning. Physically active students are generally more energetic and healthier, making them more likely to participate actively in class and strive for academic success. Physical activity also stimulates the release of neurochemicals beneficial for learning and memory, including dopamine (linked to motivation and focus), serotonin (associated with positive mood), and norepinephrine (which enhances attention and motivation).[14] From a theoretical perspective, these findings align with developmental neuropsychology, which posits that physical activity stimulates the brain to form new neural pathways that support executive functions such as attention and concentration.[15]

Study Limitations

This study has several limitations. First, the cross-sectional design does not allow causal inference regarding the relationship between physical activity and concentration levels. Second, the relatively small sample size, drawn from a single school in Denpasar, limits the generalizability of the findings. Third, no adjustments were made for potential confounding variables such as gender, nutritional status, screen time, and sleep quality. Finally, the use of self-reported questionnaires may introduce subjective bias from respondents.

Given that this research was conducted in an urban primary school setting, the results may not be applicable to all Indonesian schoolchildren, particularly those in rural areas or with differing socioeconomic conditions. Future studies should involve larger and more diverse samples and consider controlling for additional confounding variables.

Conclusion

The results of this study, analyzed using Spearman's rho correlation test, revealed a statistically significant but weak positive correlation between physical activity and concentration levels among primary school children, with a correlation coefficient of r = 0.373 and a significance level of p = 0.002. Based on these findings, it is recommended that students at SDN 14 Dauh Puri, Denpasar, maintain their physical health and concentration to achieve better academic performance. Teachers are encouraged to promote physical activity by incorporating engaging and enjoyable exercise innovations into the school routine. Furthermore, parents are advised to support and encourage their children's participation in physical activities while ensuring a balanced diet to enhance both cognitive abilities and overall health.

Author Contribution

Ni Made Diwi Sudyawati: Conceptualization, data collection, formal analysis, writing—original draft.
Daryono: Methodology, data collection, supervision.
Ni Luh Made Reny Wahyu Sari: Supervision, validation, writing—review and editing.
I Made Yoga Parwata: Methodology, statistical review, writing—review and editing.
All authors have read and approved the final manuscript.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

This study was approved by the Research Ethics Committee of the Faculty of Medicine, Dhyana Pura University (Approval No. 001410/KEP Universitas Dhyana Pura/2025). Written informed consent was obtained from the parents or guardians of all participating students prior to data collection.

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