ASSOCIATION BETWEEN PHYSICAL ACTIVITY AND MOTOR PERFORMANCE IN SCHOOL-AGED CHILDREN

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Abstract

This study examined the association between physical activity frequency and motor performance indicators in school-aged children. The sample included 105 children aged 12-15 years from three primary schools. Participants were classified by reported activity frequency: less than once, 1-2 times, or more than 3 times per week. Motor performance was assessed through balance tasks on each leg, a ball-throwing coordination task, and a dart-throwing precision task. Balance was analyzed using chi-square tests; coordination and precision scores were compared using one-way analysis of variance. Physical activity frequency was significantly associated with left-leg ($p = 0.024$) and right-leg balance ($p = 0.034$). Coordination scores differed significantly between activity groups ($p = 0.033$), whereas precision scores did not ($p = 0.082$). Children reporting activity more than 3 times per week had the highest mean coordination score and the highest proportions maintaining balance for more than 10 seconds. Physical activity frequency was associated with selected motor performance indicators, particularly balance and coordination, but not precision. The findings suggest that associations vary across motor tasks.

Keywords: physical activity, motor performance, school-aged children

1. Introduction

Physical activity is an important component of healthy growth and development during childhood. Regular participation in physical activities contributes to physical fitness, musculoskeletal health, and overall well-being. The World Health Organization (WHO) recommends that children and adolescents aged 5-17 years engage in an average of at least 60 minutes of moderate-to-vigorous physical activity, mostly aerobic, per day throughout the week (Chaput *et al,* 2020). In addition to its general health benefits, physical activity provides opportunities for children to develop and improve various motor abilities through movement, play, and recreational activities (WHO, 2020). Physical activity of children of younger school age is very important for optimal acquisition of motor skills, which affects the proper growth and development of the child. No negative effects of physical activity have been determined if the content of the activity is adjusted to the characteristics of age and dosed according to the volume and intensity of the load, in accordance with the age of the child and his individual abilities (Bukvić *et al,* 2021).

Motor performance is an important aspect of childhood development and includes the ability to perform coordinated movements, maintain postural stability, and control body movements accurately. Motor competence develops through the interaction of biological maturation, opportunities for movement, and experience with different physical activities. Previous research has indicated a positive association between physical activity and motor skill development in children. Systematic reviews have reported that participation in physical activity interventions can improve motor skills, although the magnitude of improvement may vary according to the type, frequency, and characteristics of the activities and the methods used to assess motor performance (McDonough *et al,* 2020; Moon *et al,* 2024).

Among the different components of motor performance, balance and coordination are particularly relevant during school age. Motor coordination refers to the ability to organize and integrate sensory, neural, and musculoskeletal processes to produce efficient, accurate, and purposeful movements (da Silva Guimarães *et al,* 2026). Balance enables children to maintain postural stability during both static and dynamic movements, while coordination involves the

efficient organization and control of different body movements. Postural control can be defined as achieving a desired body position (e.g. upright standing) and maintaining this position in any static or dynamic situation (Verbecque *et al,* 2014). Postural control plays an important role in child development, as it is a necessity to achieve both new postures in early life and more complex motor skills (Verbecque *et al,* 2016). The development of standing balance is nonlinear and that it is accelerated beginning at a certain age. The ability to maintain the one-leg standing position with eyes open will dramatically improve in children within the period from late preschool age to early school age, and the improvement will slow down during late school age (Morioka *et al,* 2012). The structure and function of the foot are crucial to the control of postural stability. From a biomechanical point of view, this part of the locomotor system is the area of contact between the body and the ground. The ankle joint is responsible for the most essential reactions involving corrective balance control, especially in the sagittal plane (Puszczalowska-Lizis *et al,* 2017). Results from the study investigating whether participation in different recreational physical activities could induce differences in children's balance ability showed that the type of physical activity a child participates in could be a significant contributor to the balance development. Physical activities encompassing the execution of various balance tasks, such as rhythmic gymnastics, seem to offer children greater opportunities to make improvements in this area compared to children engaging in activities of low balancing requirements (Skaltsa *et al,* 2021).

Precision, which refers to the accuracy of movement when performing a specific task, is another aspect of motor performance. Opportunities to participate in regular physical and recreational activities may contribute to the development of these abilities. However, the relationship between the frequency of physical activity and individual components of motor performance may not be uniform, and findings may depend on the motor tasks and assessment methods used. Understanding the association between physical activity and motor performance in school-aged children may help identify the importance of regular opportunities for movement and recreation during childhood.

The aim of this study was to examine the association between the frequency of weekly physical activity and selected motor performance indicators, including balance, coordination, and precision, in school-aged children.

2. Methods

2.1. Study design and participants

This observational study included 105 school-aged children aged 12-15 years (mean age: 13.5 ± 0.6 years). The sample consisted of 59 boys (56.2%) and 46 girls (43.8%), with 35 students recruited from each of three primary schools: "Hasan Prishtina" in Skopje, "Vancho Prke" in Shtip, and "Todor Angelevski" in Bitola, North Macedonia.

2.2. Data collection and assessment of physical activity

Information about the children's demographic characteristics and physical activity was obtained using a researcher-developed questionnaire consisting of 24 questions. The questionnaire was completed by parents and included questions about the children's physical activity and other aspects of their daily habits. An unstructured interview with parents was also used as part of the data collection process. Children were classified according to the reported frequency of weekly physical activity into three groups: less than once per week, 1-2 times per week, and more than 3 times per week.

2.3. Assessment of motor performance

Motor performance was assessed using three tasks evaluating balance, coordination, and precision:

- ***Balance*** was assessed using a balance cushion. Children were asked to maintain a standing position on one leg, and performance was evaluated separately for the right and left legs. The duration of maintaining the position was classified into three categories: ≤ 5 seconds, 6-10 seconds, and 11-15 seconds;
- ***Coordination*** was assessed using a ball-throwing task in which children attempted to throw a ball into a hoop. Performance was recorded as a numerical score;
- ***Precision*** was assessed using a dart-throwing task directed at a dartboard. Performance was recorded as a numerical score.

2.4. Statistical analysis

Descriptive and comparative statistical methods were used. Categorical variables were presented as frequencies and percentages, while continuous variables were described using mean and standard deviation (SD). Associations between physical activity frequency and balance categories for the right and left legs were examined using the chi-square test. Differences in coordination and precision scores among the three physical activity groups were assessed using one-way analysis of variance (ANOVA). A p-value < 0.05 was considered statistically significant.

3. Results

A total of 105 school-aged children were included in the analysis. According to the reported frequency of weekly physical and recreational activities, 50 children (47.6%) participated less than once per week, 13 (12.4%) participated 1-2 times per week, and 42 (40%) participated more than three times per week. Distribution of children in terms of the participating in sport and exercise weekly is displayed in Figure 1.

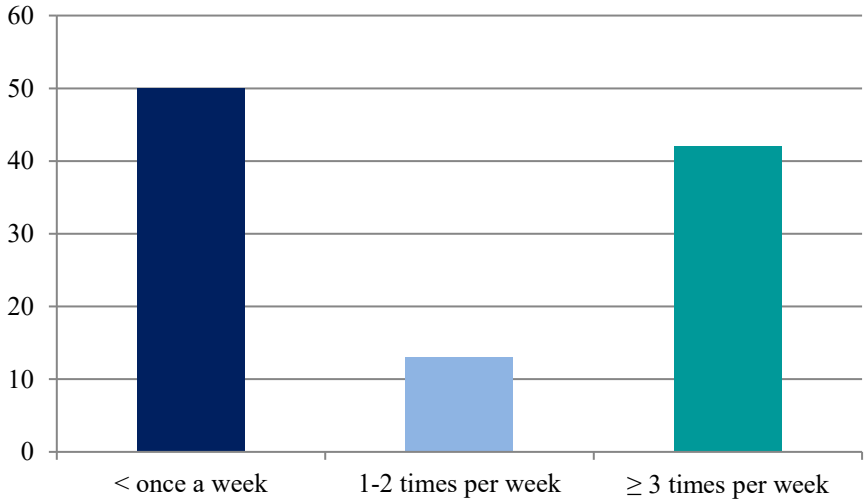


Figure 1. Distribution of children in terms of the participating in sport and exercises weekly

Motor performance assessment included tasks for evaluation of balance, coordination, and precision. Procedures for balance, coordination, and precision testing and scoring are illustrated in Figure 2.

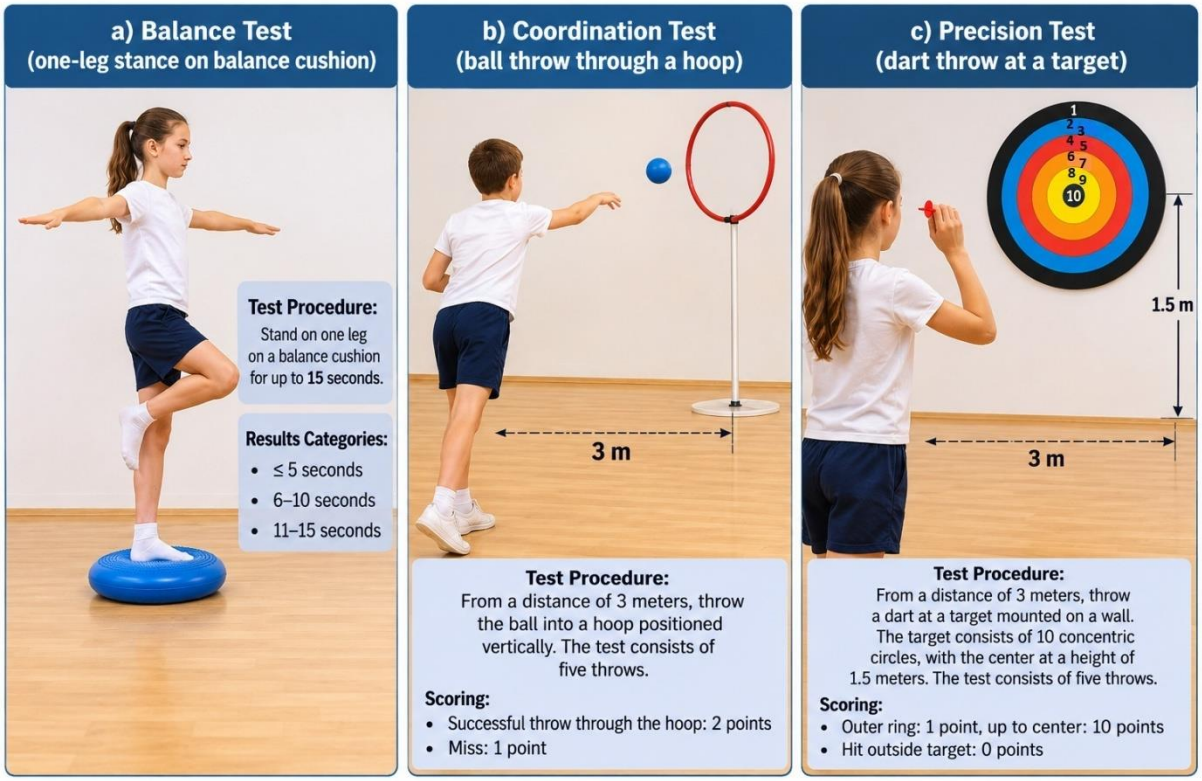


Figure 2. Procedures for balance, coordination, and precision testing

3.1. Physical activity frequency and balance

The association between the frequency of weekly physical and recreational activities and balance performance was examined using the Pearson chi-square test. Statistically significant associations were found for both left-leg balance ($\chi^2 = 11.259$, df = 4, p = 0.024) and right-leg balance ($\chi^2 = 10.409$, df = 4, p = 0.034). As shown in Table 1, a higher proportion of children in the most physically active group achieved balance durations exceeding 10 seconds on both legs. In this group, 83.3% of children maintained left-leg balance for more than 10 seconds, compared with 66% of children participating in physical and recreational activities less than once per week. The corresponding proportions for right-leg balance were 81% and 68%, respectively. Percentages are calculated within each physical activity group.

Table 1. Physical activity frequency and balance performance

Balance Performance	< once/week (n = 50)		1-2 times/week (n = 13)		≥ 3 times/week (n = 42)	
	No	%	No	%	No	%
Left-leg balance						
≤ 5 seconds	9	18	3	23.1	2	4.8
6-10 seconds	8	16	5	38.5	5	11.9
> 10 seconds	33	66	5	38.5	35	83.3
Right-leg balance						
≤ 5 seconds	8	16	1	7.7	2	4.8
6-10 seconds	8	16	6	46.2	6	14.3
> 10 seconds	34	68	6	46.2	34	81

3.2. Physical activity frequency and coordination

Differences in coordination and precision scores between the three physical activity groups were assessed using one-way analysis of variance (ANOVA).
A statistically significant difference was observed in coordination performance between the groups ($F(2.102) = 3.523$, $p = 0.033$, $\eta^2 = 0.065$). The highest mean coordination score was recorded among children participating in physical and recreational activities more than three times per week (9.17 ± 0.96), followed by those participating less than once per week (8.70 ± 1.02) and those participating 1-2 times per week (8.46 ± 1.20). The descriptive results and ANOVA findings for coordination are presented in Table 2.

Table 2. Coordination scores according to weekly physical activity frequency

Physical activity frequency	n	Mean ± SD	ANOVA F (df)	p-value
< once/week	50	8.70 ± 1.02	3.523 (2,102)	0.033
1-2 times/week	13	8.46 ± 1.20		
≥ 3 times/week	42	9.17 ± 0.96		

3.3. Physical activity frequency and precision

In contrast, no statistically significant difference was found in precision performance between the three groups ($F(2,102) = 2.564$, $p = 0.082$, $\eta^2 = 0.048$). Although the highest mean precision score was observed in the group participating 1-2 times per week (19.15 ± 9.00), the difference between groups did not reach statistical significance. The descriptive results and ANOVA findings for precision are presented in Table 3.

Table 3. Precision scores according to weekly physical activity frequency

Physical activity frequency	n	Mean ± SD	ANOVA F (df)	p-value
< once/week	50	14.56 ± 7.27	2.564 (2,102)	0.082
1-2 times/week	13	19.15 ± 9.00		
≥ 3 times/week	42	17.12 ± 7.11		

4. Discussion

The present study examined the association between the frequency of weekly physical activity and selected indicators of motor performance in school-aged children. The findings suggest that the relationship between physical activity frequency and motor performance may differ across specific motor tasks. Statistically significant associations were observed for balance and coordination, whereas no statistically significant difference was found in precision performance. Dapp *et al.* (2021) found that engaging in structured physical activity, either exclusively or in combination with unstructured physical activity, is beneficial for children's gross motor development, whereas engaging in unstructured physical activity lacks such effectiveness. As to fine motor skills, a beneficial tendency of structured physical activity was observed as well. Hence, physical activity seems to be beneficial for motor skill development particularly when implemented in a formal setting with guided opportunities for practice.
In our study, balance performance was significantly associated with the reported frequency of weekly physical activity for both the left and right legs. In general, children who participated in physical activities more than three times per week more frequently maintained their balance for longer periods than those in the other activity groups. This pattern suggests that regular

engagement in physical activities may be related to better postural control. Activities involving changes in body position, movement, and maintenance of stability may provide opportunities to develop balance-related abilities. However, the relationship was not entirely consistent across all activity-frequency groups, indicating that frequency alone may not fully explain differences in balance performance.

A statistically significant difference was also observed in coordination scores among the three physical activity groups. The highest mean score was recorded in children reporting physical activity more than three times per week, although the differences between individual groups cannot be established without further post-hoc analysis. This finding is broadly consistent with previous research suggesting that physical activity can contribute to the development of children's motor skills. A systematic review of randomized controlled trials by McDonough *et al.* (2020) reported improvements in motor skill performance in most of the included physical activity interventions. Similarly, the systematic review and meta-analysis by Moon *et al.* (2024) found that various school-based physical activity interventions were associated with improvements in children's motor competence. Nevertheless, these intervention studies differ from the present observational analysis in their design and assessment methods, and their findings should therefore be compared cautiously. Vallence *et al.* (2019) found that participation in organized sport in school-aged children is positively associated with motor performance across the coordination-fitness spectrum. In particular, participation in organized handball and gymnastics was positively associated with coordination-related and fitness-related motor performance. This suggests that participation in organized handball and gymnastics, or indeed any sport requiring coordination, agility, and fitness, could be an effective method for improving motor performance in children. A recent systematic review and meta-analysis identified positive associations between motor competence and physical activity, composite fitness scores, muscular endurance, muscular power, muscular strength, cardiovascular endurance, perceived motor competence and motivation, in addition to inverse associations between motor competence and weight status, speed and agility (Burton *et al,* 2023).

In the present study, no statistically significant difference was identified in precision performance between the physical activity groups. Although the mean scores varied, the observed differences did not reach statistical significance. This finding may indicate that the relationship between general physical activity frequency and precision is less pronounced than that observed for balance and coordination. Precision tasks may depend on specific practice and task-related experience, which were not assessed in this study. Therefore, participation in physical activity in general may not necessarily be reflected in better performance on a particular precision task.

Taken together, these findings highlight the importance of considering different components of motor performance separately rather than treating motor ability as a single, uniform outcome. Physical activity may be associated with some motor abilities more strongly than with others, depending on the nature of the activity and the specific skills involved. The results also suggest that the frequency of participation should not be considered the only factor potentially related to motor performance. The type, duration, intensity, and regularity of activities, as well as individual developmental characteristics, may also be relevant.

The present study provides information about the relationship between reported physical activity frequency and selected aspects of motor performance in school-aged children. Future studies involving larger samples, objective measurements of physical activity, and standardized motor assessment instruments are needed to clarify these relationships and to examine the potential influence of the type, duration, and intensity of physical activity.

5. Conclusions

The findings indicate that the reported frequency of weekly physical activity was significantly associated with balance performance in both legs and with coordination scores among school-aged children. No statistically significant association was found between physical activity frequency and precision performance. These results suggest that the relationship between physical activity and motor performance may vary according to the specific motor ability assessed. Further studies using larger samples, more comprehensive motor assessments, and objective measurements of physical activity are needed to confirm and extend these findings.

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