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The Impact of Sedentary Behavior and Organized Physical Activities on the Development of Fundamental Motor Skills in Eight-Year-Old Children: Application of the TGMD-2 Test

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ABSTRACT

The development of fundamental motor skills in children is essential for their overall physical health, success in sports, and long-term engagement in physical activity. The aim of this study was to assess fundamental motor skills in eight-year-old children and examine their relationship with participation in organized physical activities and sedentary behavior. The study included 78 eight-year-old children (37 girls and 41 boys) from two primary schools in Split, Croatia. Motor skills were evaluated using the Test of Gross Motor Development (TGMD-2), which includes six locomotor and six manipulative tasks. A questionnaire was also used to assess time spent in organized physical activities and sedentary behavior. Pearson's correlation coefficient was utilized in the statistical analysis of the research data. Correlation analysis showed no significant association (boys: r=0.11, p=0.46; girls: r=-0.05, p=0.77) between time spent in organized physical activities and the level of motor skills. This suggests that more time in sports does not necessarily lead to better motor performance; rather, the quality and type of activities appear more important. Likewise, no significant relationship was found between sedentary behavior and motor skill levels (boys: r=-0.02, p=0.91; girls: -0.25, p=0.13). Although these results differ from some earlier findings that link inactivity to poorer motor development, they highlight the value of individualized programs to enhance motor skills and offset sedentary habits. The study highlights the potential of Croatia's full-day school model to integrate kinesiology-based activities, supporting motor development and improving children's health through structured school-based sports.

1. INTRODUCTION

The development of fundamental movement skills (FMS) in early childhood serves as the foundation for lifelong physical activity, healthy development of the locomotor system, and successful participation in both sports and recreational activities. FMS, which include locomotor and manipulative (object control) skills, are essential for mastering more complex movement patterns and form the basis for building physical literacy. Numerous studies have confirmed that children with higher levels of motor competence are more likely to engage in physical activity, exhibit better physical health status, and demonstrate greater movement-related self-confidence [1,2].

At the same time, contemporary lifestyle patterns have led to a significant increase in sedentary behaviour among children, with a growing proportion of their free time spent in front of screens, engaging in passive forms of play, and leading physically inactive daily routines [3, 4]. This way of life is increasingly associated with lower fundamental motor skills, reduced physical fitness, and decreased participation in structured and unstructured physical activities [5,6]. Numerous longitudinal and cross-sectional studies emphasize that prolonged sedentary behaviour during childhood can have cumulative adverse effects extending into adolescence, including lower motor competence, poorer cardiorespiratory endurance, an increased risk of obesity, and adverse health patterns in adulthood [7,8].

Given the increasing influence of sedentary lifestyles and various forms of organized physical activity in children's daily routines, it is essential to examine the extent to which the quantitative aspects of these behaviours, such as the duration of activity or inactivity, truly impact the development

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of fundamental motor skills. While theoretical frameworks and numerous studies suggest a positive impact of physical activity and an adverse effect of sedentary behaviour, findings in the literature remain inconsistent [9,10]. Some research emphasizes the importance of the quality and context of physical activity in shaping motor competence [11,12], whereas other studies highlight significant differences among children based on socioeconomic status and access to movement opportunities [13]. Therefore, this study aimed to examine the relationship between the time spent in organised physical activities and sedentary behaviour and the level of fundamental motor skill development in eight-year-old children, using a standardised assessment instrument (TGMD-2).

2. MATERIALS AND METHODS

2.1. Participants

The study was conducted on 78 eight-year-old children, including 37 girls and 41 boys. The participants were students from two primary schools in Split, Croatia. All participants and their parents or legal guardians were informed in advance about the aims and procedures of the study and provided written informed consent for participation. Inclusion criteria were regular school attendance and the absence of diagnosed motor, cognitive, or sensory impairments that could affect performance in motor skill assessments.

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki of the World Medical Association. The research protocol was approved by the Ethics Committee of the Faculty of Kinesiology (number: 2181-205-02-01-21-013, date: 23 September 2021).

2.2. Instrument

To assess fundamental movement skills in children, the Test of Gross Motor Development—Second Edition (TGMD-2) [14] was used. This standardised and validated instrument is designed for children aged 3 to 10 [15,16,17]. It is based on developmental norms and allows for a quantitative evaluation of gross motor skill proficiency across two primary domains: locomotor and object control (manipulative) skills.

The TGMD-2 consisted of two subtests. The locomotor subtest included six tasks: run, gallop, hop, leap, horizontal jump and slide. The second, the object control subtest, also comprised six tasks: triking a stationary ball, stationary dribble, catch, kick, overhand throw and underhand roll. Each skill was operationalised through predefined performance criteria, and each participant was given two opportunities to perform each task. Scoring was based on a binary system, with one point awarded for each correctly performed component. The total score for each subtest was calculated by summing the individual item scores, with higher scores indicating a higher level of motor skill proficiency.

In addition to the fundamental movement skills assessment, a structured anamnesis questionnaire was administered and completed by the child's parent or legal guardian. The questionnaire collected data on the average daily duration of participation in organised physical activities (e.g., sports training, structured extracurricular activities) and sedentary behaviour (e.g., screen time, passive play). The collected data were used for additional analysis of physical activity patterns and their relationship with the level of motor skill proficiency.

3.3. Measurement

All measurements were conducted during regular school hours in the gymnasiums of the participating primary schools. Before testing, the purpose and procedure were explained to each child in an age-appropriate manner to ensure understanding and cooperation. Children were dressed in sportswear and performed all motor tasks individually under the supervision of trained researchers.

The assessment of fundamental motor skills was carried out using the TGMD-2. The testing followed the standardised administration protocol outlined in the test manual. Each child completed the locomotor and object control subtests, which included six tasks each. Before each task, a visual demonstration was provided, followed by one practice trial and two formal test trials. Performance was recorded using observation sheets based on specific performance criteria for each skill.

Physical activity and sedentary behaviour data were collected through a structured parental questionnaire. Parents or legal guardians completed the questionnaire at home and returned it to the researchers via the child's classroom teacher. The questionnaire included the average daily duration of participation in organised physical activities (such as sports or physical education) and sedentary behaviours (such as screen time and passive play).

3.4. Statistical analysis

The data were analyzed using SPSS software, version 29.0.2.0. First, a descriptive analysis was conducted to calculate the mean values and standard deviations for all key variables, including

fundamental movement skill (TGMD-2) scores, time spent in organized physical activity, and sedentary behaviour. A Pearson correlation analysis was performed to examine the relationship between TGMD-2 scores, physical activity, and sedentary time. The level of statistical significance was set at $p < 0.05$.

3. RESULTS

The results presented in Table 1 and Table 2 represent a descriptive statistical analysis of the key variables for boys and girls included in the study on the relationship between physical activity, sedentary behaviour, and fundamental motor skills. In boys (Table 1), the average daily duration of organized physical activity (PA) was 138.89 minutes, with a high standard deviation (SD = 111.43), indicating substantial variability in activity levels among participants. The sedentary behaviour (SA) values were significantly higher, with an average of 1259.76 minutes per day, corresponding to approximately 21 hours, including sleep time, also reflecting a wide range between minimum and maximum values. The average total score on the TGMD-2 test was 65.22 points, suggesting a relatively high level of development in fundamental motor skills.

Table 1. Descriptive analysis boys

VARIABLE	M	±	SD	Min	Max
PA	138.89	±	111.43	14.83	607.93
SA	1259.76	±	385.54	420.00	2350.00
TGMD-2	65.22	±	16.47	21.00	86.00
LOC	32.56	±	9.29	7.00	45.00
MAN	32.59	±	8.41	12.00	46.00

Table 2 shows that girls were, on average, slightly more physically active (PA = 159.06 minutes per day) but exhibited higher levels of sedentary behaviour (SA = 1417.84 minutes). Despite their higher activity levels, the overall TGMD-2 test score was lower (M = 55.51), which may indicate differences in the activities' quality or the approach to physical activity.

Table 2. Descriptive analysis girls

VARIABLE	M	±	SD	Min	Max
PA	159.06	±	95.08	9.89	444.83
SA	1417.84	±	387.01	840.00	2400.00
TGMD-2	55.51	±	12.31	33.00	82.00
LOC	31.41	±	7.00	19.00	43.00
MAN	24.11	±	6.87	13.00	39.00

The results presented in Table 3 and Table 4 represent an analysis of Pearson correlation coefficients aimed at examining the relationship between the level of fundamental motor skills and two behavioural factors—organized physical activity (PA) and sedentary behaviour (SA)—separately for boys and girls. In boys, the correlation coefficients between the total TGMD-2 score and PA ($r = 0.11$, $p = 0.46$), as well as SA ($r = -0.02$, $p = 0.91$), did not reach statistical significance, thereby excluding the presence of a linear relationship between the observed variables. Similar trends were observed for the TGMD-2 subcomponents—locomotor (LOC) and manipulative (MAN) skills—which also showed low correlation coefficients and high p-values, well above the conventional threshold of statistical significance ($p < 0.05$).

Table 3. Correlation between TGMD-2 and organized physical activities and sedentary behavior in boys

	PA	P-Value	SA	P-Value
TGMD-2	0.11	p=0.46	-0.02	p=0.91
LOC	0.16	p=0.33	0.01	p=0.98
MAN	0.06	p=0.73	-0.06	p=0.75

Test of Gross Motor Development Second Edition (TGMD-2), locomotor (LOC) and manipulative (MAN)

Statistically significant correlations were also absent among girls. Although the correlation between SA and the overall TGMD-2 score was negative and relatively higher than the others ($r = -0.25$, $p = 0.13$), it still did not reach the threshold for statistical significance. Other associations, including those between PA and the individual dimensions o the TGMD-2 test (LOC and MAN), exhibited even weaker relationships.

Table 4. Correlation between TGMD-2 and organized physical activities and sedentary behavior in girls

	PA	P-Value	SA	P-Value
TGMD-2	-0.05	p=0.77	-0.25	p=0.13
LOC	-0.07	p=0.67	-0.26	p=0.12
MAN	-0.01	p=0.92	-0.19	p=0.27

4. DISCUSSION

The study's results did not reveal statistically significant associations between the time spent in organized physical activities and fundamental movement skills in eight-year-old children, regardless of gender. No significant correlation was observed between sedentary behaviour and fundamental movement skills, although a slight negative association between sedentary time and TGMD-2 test scores was noted in girls. These findings point to the complexity of factors influencing fundamental movement skill development and suggest that the quantitative aspects of activity alone cannot explain variations in children's motor competence.

The findings of this study diverge from those of specific previous empirical investigations that have demonstrated significant associations between physical activity behaviours and the development of fundamental movement skills. Specifically, Kracht et al. [5] reported a significant relationship between adherence to the 24-hour movement guidelines and the level of motor skill proficiency. Similarly, Carvalho et al. [6] found that objectively measured physical activity and reduced time spent in sedentary behaviours were associated with higher levels of fundamental movement skills.

However, the findings of this study are consistent with those of Mota et al. [18], who emphasized that replacing sedentary time with low-intensity physical activity does not necessarily lead to improvements in motor skills, notably when the activity lacks motor challenge. Idamokoro et al. [19] highlight the importance of socioeconomic status and obesity as potential mediators in the relationship between movement behaviours and motor development, further complicating the analysis. The quality and content of the activity play a crucial role. Robinson et al. [1] emphasized that activity diversity strongly predicts motor competence. Tsuda et al. [2] underscore the importance of self-perception and free play as factors contributing to motor development, regardless of formal activity structures.

In the context of the educational system, particularly in light of the implementation of full-day schooling in Croatia, findings such as those by Idamokoro et al. [19] support the notion that targeted programs aimed at developing motor skills within schools can have a lasting impact on overall physical activity levels. Accordingly, future interventions should emphasize not only the quantity but also the qualitative characteristics of activities, while taking into account the contextual and developmental needs of the child [20,21].

5. Conclusion

This study did not find significant associations between the time spent in organized physical activities or sedentary behaviour and the level of fundamental motor skills in eight-year-old children. The results suggest that the quantity of activity alone is not a sufficient indicator of motor competence; instead, the quality and content of activities play a crucial role.

The study's main limitations include a small sample size, reliance on subjective measurement tools for assessing physical activity and sedentary behaviour, and a cross-sectional design that does not allow for causal inferences. Future research should incorporate objective measurement methods, larger and more diverse samples, and a longitudinal design.

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Conflict of Interest

No conflict of interest is declared by tehe authors. In addition, no financial support was received.

Ethics Committee

The research protocol was approved by the Ethics Committee of the Faculty of Kinesiology (number: 2181-205-02-01-21-013, date: 23 September 2021)

Author Contributions

Study Design, FŽ; Data Collection, FŽ; Statistical Analysis, FŽ, PM; Data Interpretation, FŽ, PM, AP; Manuscript Preparation, PM, AP; Literature Search, FŽ, PM, AP. All authors have read and agreed to the published version of the manuscript.

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