

THE EFFECTS OF A SPORTS SCHOOL PROGRAM ON MOTOR SKILLS IN PRESCHOOL CHILDREN

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Abstract. *In recent years, the importance of physical activity and exercise in early childhood development has gained significant attention. The aim of this study was to determine the effects of a sport schools program on motor skills in preschool children. The sample of participants consisted of 56 girls and 74 boys of a preschool age (6.03 ± 0.45 years). Children in the experimental group were engaged in the program for six months, three times per week, while the control group followed their usual activities in kindergarten. The Test of Gross Motor Development - Second Edition (TGMD-2) was the tool for assessing the development of motor skills that require observational techniques. The ANCOVA showed that there were differences in all analyzed normative values: Total score for locomotor skills ($p=0.01$), Total score for manipulative skills ($p=0.01$), Total score for all TGMD-2 tests ($p=0.01$), and Total motor quotient ($p=0.01$). It can be concluded that there were positive effects of the sports school program on the development of motor skills in preschool children after six months. This is of great importance because motor skills have a significant role in children's physical, emotional, and cognitive development.*

Key words: *kids, physical activity, evaluation, TGMD-2*

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INTRODUCTION

Children's physical inactivity is a growing concern, contributing to various health issues and a sedentary lifestyle. Preschool-age children, typically between the ages of three and five, are at a crucial stage of physical and motor skill development. During this period, they undergo substantial growth in their motor skills, which encompass both fine and gross motor skills. Fine motor skills refer to the small, precise movements of the muscles in the hands and fingers, which are essential for tasks like writing, buttoning a shirt, or picking up small objects. Gross motor skills, on the other hand, involve the larger muscle groups and are responsible for movements such as walking, running, jumping, and throwing, allowing for physical coordination and control of the body (Malina, 2004). Consequently, there has been a growing interest in understanding the effects of exercise programs tailored specifically for preschool children and their motor skill development. Understanding the impact of physical exercise on motor skills is of great importance for public health because early childhood is recognized as a critical time interval of motor (Lubans et al., 2010), social, and cognitive development (Lopes et al., 2013; Zeng et al., 2017). Also, other important factors should not be neglected, such as cardiorespiratory fitness (Hardy et al., 2012) and adiposity (Stodden et al., 2008; Cattuzzo et al., 2016). Motor skills do not develop naturally over time and require instruction and practice (Clark & Maetcalfe, 2002). According to dynamic systems theory, the interaction between the constraints of the task, the learner, and the environment determines how dynamically motor skills will develop (Anderson, 2018). Moreover, the age range of 3 to 5 years is very sensitive (Hardy et al., 2010; Stodden et al., 2013), which requires early interventions.

There are a several exercise program modalities aimed at improving motor skills in children (Han et al., 2018). Some of the most popular programs include balance, agility, and coordination exercise. However, it is essential to adapt these programs to the needs and abilities of children, so that they are effective and safe. With an appropriate exercise program and proper nutrition, children can develop their motor skills and improve their physical fitness, which will contribute to better health and well-being. In recent years, the effects of exercise programs on motor skills in preschool children have gained substantial attention in both research and educational settings. Research findings from various studies have shed light on the profound impact of physical activity on motor skill development in young children. Maćak et al.'s (2022) study highlights the positive outcomes of daily physical education on the motor skill development and overall physical fitness of preschoolers, underscoring the importance of structured exercise in early childhood. A systematic review conducted by Bolger et al. (2021) offers a global perspective on motor skills in children and emphasizes the significance of these skills in the context of physical development. The study emphasizes that structured exercise programs play a pivotal role in enhancing these motor skills. These studies collectively underscore the importance of understanding the effects of exercise programs on motor skills in preschool children, emphasizing the potential benefits for their physical development, cognitive abilities, and overall health. As we delve further into this topic, it becomes increasingly clear that promoting structured physical activity in early childhood is a crucial step towards nurturing well-rounded and healthy individuals. Lloyd et al. (2014) proved that motor skills in childhood are a predictor of physical activity in adulthood, while Gupta & Pande (2022) found that a delay in motor development is associated with a delay in the development of children. More specifically, if children's motor skills are properly and consistently

developed at this age, it could have a significant impact on their subsequent acquisition of motor skills at school and even later in adulthood. According to Warburton, Nicol, and Bredin (2006), frequent physical activity avoids obesity and provides several health benefits, both physical and psychological. Children should acquire adequate levels of proficiency in basic motor skills by age seven, when they begin to participate in increasingly specialized physical activities (Goodway et al., 2019; Wen et al., 2018).

Sport schools for preschool children have gained momentum in recent years as a promising approach to early childhood development. These specialized programs introduce young children to a variety of sports and physical activities, aiming to foster a love for physical fitness and sports from an early age. Sport schools typically offer structured and age-appropriate activities that not only promote physical health but also help improve essential motor skills, coordination, and social interaction. While these programs show promise, further research is needed to fully understand their long-term effects on children's overall development and whether they indeed lead to sustained benefits in terms of physical fitness and skill acquisition as kids grow. Despite the increasing popularity of sport schools for preschool children, there is a notable gap in the research that comprehensively assesses the specific impact of these programs on the acquisition and enhancement of motor skills in this age group, making it essential to conduct a study to understand whether sport schools genuinely lead to improved motor skill development in preschoolers and identify any potential variables or conditions that may influence the outcomes. Based on the aforementioned facts, the aim of this study was to determine the effects of a sport school program on motor skills in preschool children.

METHODOLOGY

The sample of participants

The sample of participants for the study consisted of 56 girls and 74 boys of a preschool age (5-7 years) from Banja Luka. Their average age was 6.03 ± 0.45 years, while the average for the control group was 6.13 ± 0.40 years, and the average for the experimental group was 5.93 ± 0.48 years.

The participants were divided into two groups:

- an experimental group that will practice according to a sports school model (n=65).
- a control group (n=65).

Table 1 Descriptive statistics for both groups

Variables	Experimental group (n=65)		Control group (n=65)	
	Initial (mean±SD)	Final (mean±SD)	Initial (mean±SD)	Final (mean±SD)
Age (years)	5.93±0.48	6.40±0.49	6.13±0.40	6.61±0.40
Body height (cm)	118.80±6.88	121.77±6.96	119.85±5.58	123.00±5.72
Body weight (kg)	22.83±4.05	24.25±4.43	22.39±3.42	24.20±4.64

Testing procedure

Children's height and weight were assessed with an anthropometer (GPM Anthropometer 100; DKSH Switzerland Ltd., Zurich, Switzerland; ± 0.1 cm), and digital balance (BC1000, Tanita, Japan; ± 0.1 kg) with each child being measured in a private room near their classroom. The assessment of motor skills was carried out within the spaces where the participants train, which are intended for the implementation of the experimental program. In order to ensure the correct performance of the measurements and the planned study, it was necessary to establish optimal conditions for conducting the measurements. The same, trained assistants from the Faculty of Sport and Physical Education conducted the initial testing as well as the final testing of the participants. The room temperature ranged between 18°C and 22°C, creating favorable conditions for performing the tests. In addition, the planned measurement program was divided into several parts, and the tests were strategically placed to prevent the influence of fatigue caused by physically demanding tasks.

The Test of Gross Motor Development - Second Edition (TGMD-2) is a tool for assessing the development of motor skills that require observational techniques. It is a standardized test used to assess the development of gross motor skills in children aged 3 to 10 years. It was developed by Ulrich (Ulrich, 2000) as an updated version of the original TGMD test. The TGMD-2 is often used in schools, kindergartens, therapy, and research to determine the development of children's motor skills. The test consists of 12 motor skills grouped into two sub-tests. Each task is performed twice, and 1 point is awarded for a correctly executed task, while 0 points are assigned for an incorrectly executed task. The assessment usually takes between 10 and 20 minutes. The total score is obtained by adding the scores for all tasks in both subtests, resulting in a total raw score ranging from 0 to 48 points. This score is particularly useful because it reflects the core concepts embedded in the test and demonstrates a high level of reliability. Raw scores for the subtests are transformed into standard scores (ranging from 1 to 20) and percentiles (ranging from below 1 to above 99) based on age and gender, following the guidelines outlined in the TGMD-2 manual. Subsequently, the standard scores for locomotor and object control subtests are summed up and transformed into a gross motor quotient within the range of 46 to 160. Reliability and norms for all age groups were provided earlier by Ulrich (2000). For the Locomotor subtest the reliability coefficients were 0.85, for the Object Control subtest 0.88, and for the Gross Motor composite 0.91. The results of the TGMD-2 test provide information about a child's motor development in relation to their age.

The TGMD-2 test battery is divided into two subtests:

- I Tests for the assessment of locomotor skills: the run, gallop, hop, leap, horizontal jump, slide;
- II Tests for assessment of manipulative skills: striking a stationary ball, stationary dribble, kick, catch, overhand throw, and underhand roll.

Interventions

The program lasted 6 months, and the training sessions were held in a gymnasium with optimal working conditions, three times a week for an hour, with 45 minutes of active work. In addition to these three classes of exercise, all children took part in the regular activities in the kindergartens where the teachers worked. The control group only had regular daily activities in kindergartens without additional engagement in organized physical activity. The experimental program included elements of ball sports (basketball, football, handball), elements of athletics, gymnastics (developmental, corrective, rhythmic), yoga for

children, aerobics for children, dance (folk dances and standard dances), and a display of martial arts. The programs in sport school were frontal type and group activities, with a predominant emphasis on circuit training and polygon or station training. When exercises occurred within the polygon, children completed the task before progressing to the subsequent station, where the obstacles included a diverse array of gymnastic equipment and props designed for solving motor challenges, incorporating gymnastic and athletic exercises along with basic games. All activities were carried out in the afternoon.

The experimental program consisted of:

- 5-10 minutes warm-up (various running games, chasers, etc.)
- 10 minutes of shaping exercises in place and in motion
- 15-20 minutes of the active and main part of the training, where various dexterity polygons with natural forms of movement (crawling, crawling, jumping, catching, passing, jumping, elements of gymnastics, athletics, etc.) were done with the children
- Relaxation and stretching exercises were done for 5-10 minutes at the end.

Statistical analysis

The results obtained in the study were analyzed using the statistical software SPSS, version 20. For all data obtained during the measurements, the basic descriptive parameters were calculated. The normality of the distribution was checked using the Kolmogorov-Smirnov test. Following the confirmation of normal distribution, the analysis of covariance (ANCOVA) was used to determine the differences in the effects of different exercise programs on motor skills in the experimental and control groups, with baseline variables included as covariates in the model. Partial eta squared (η^2p) was also reported as measures of the effect size, and defined as small (0.01), medium (0.06), and large (0.14). A p value of ≤ 0.05 was set to state statistical significance.

RESULTS

When analyzed in terms of gender, the sample included 56 boys and 74 girls. The average age of the entire sample was 6.03 ± 0.45 years. The average age of the participants of the experimental group was 5.93 ± 0.48 years, and of the control group was 6.13 ± 0.40 years (Table 1).

Table 2 TGMD-2 test raw and normative values at the initial and final measurement

Variables	Experimental group (n=65)		Control group (n=65)		F	p	η^2p
	Initial	Final	Initial	Final			
Raw score for LS	26.45±6.69	37.52±4.72	27.11±5.86	30.92±5.15	151.00	0.01	0.080
Raw score for MS	18.60±4.45	32.32±4.90	19.11±4.89	22.46±4.75	281.42	0.01	0.193
Raw score of all TGMD-2 tests	45.05±9.31	70.00±8.42	46.23±8.88	53.23±9.11	311.57	0.01	0.232
Total normative score for LS	6.83±2.05	9.97±1.97	6.49±1.76	7.15±1.71	116.26	0.01	0.154
Total normative score for MS	5.34±1.47	9.45±1.74	5.02±1.67	5.42±1.62	237.32	0.01	0.176
Total normative score of all TGMD-2 tests	12.18±3.02	19.42±3.27	11.51±2.96	12.54±2.96	250.01	0.01	0.189
Total motor quotient	76.51±9.05	98.25±9.82	74.52±8.89	77.62±8.90	250.01	0.01	0.321

Legend: n – number of participants; F – F-test statistics; p – probability value; LS – locomotor skills; MS – manipulative skills; η^2p – partial eta squared

At the univariate level, the ANCOVA showed a statistically significant difference for all raw scores for locomotor skills ($F = 151.0$, $p = 0.01$), manipulative skills ($F = 281.4$, $p = 0.01$), as well as for all TGMD2 scores ($F = 311.6$, $p=0.01$), where the experimental group had better results (Table 2). Regarding the normative scores, similar results were achieved in favor of the experimental group. There were significant differences in the analyzed variables: Total score for locomotor skills ($p=0.01$), Total score for manipulative skills ($p=0.01$), Total score for all TGMD-2 tests ($p=0.01$), as well as for Total motor quotient ($p=0.01$). Moreover, partial eta squared showed large effect size (>0.14) for all the variables except for Raw score for locomotor skills (0.80), where medium effect size was found.

DISCUSSION

Motor skills are of paramount importance in preschool children as they form the foundation for various aspects of a child's physical, cognitive, and social development. Developing these motor skills not only supports a child's ability to explore and interact with their environment but also lays the groundwork for future overall well-being.

Analyzing the impact of the experimental sports school program on the development of motor skills of preschool children, assessed by the TGMD-2 battery tests, it can be seen that there are statistically significant differences in favor of the participants of the experimental group compared to the control group. Using the ANCOVA, statistically significant differences were observed in all normative data: Total score for locomotor skills ($p=0.01$), Total score for manipulative skills ($p=0.01$), Total score of all TGMD-2 tests ($p=0.01$), and Motor quotient ($p=0.01$). The participants of the experimental group achieved better results in all the mentioned variables. One interesting fact is that improvements are more noticeable in manipulative skills. Considering that the children in the sports school often practiced skills with a ball (throwing, catching, passing, guiding the ball, as well as many others), this result could be expected. Moreover, most children in kindergartens do not have enough space to practice these skills. Therefore, additional three classes may have significantly contributed to these differences. As for locomotor skills, the improvement is less pronounced compared to manipulative skills, but it is still statistically significant. Our findings are in line with two similar studies on preschool children. According to findings of Popović et al. (2020) and Mačak et al. (2022), engaging preschool children in structured multisport programs and daily physical activity interventions can yield significant improvements in their motor skills. These studies indicate that nine months of participation in a structured multisport program and consistent daily physical activity interventions positively impact the motor skills of preschool children. These improvements likely contribute to enhanced motor skills development in this age group. Regular physical activity not only fosters physical fitness but also promotes the development of fundamental motor skills, which are crucial for their overall physical and cognitive development during their formative years.

Considering how important motor skills are for child development, it can be said that improving them through physical activity can bring many health benefits to children (Wood et al, 2020). A study conducted by (Wood et al., 2020) aimed to examine the relationship between specific types of physical activity and motor skill development in children aged 3-5 years in a nationally representative sample in the United States. What we

can compare with our results is the TGMD-2 test that was done, and it turned out that the most common activities in which children participated were running, playing outdoor games, riding a bicycle, playing active games and walking. The physical activities that were positively associated with the results of a higher gross motor quotient are riding a bicycle, playing active outdoor games, jumping on a trampoline, riding a scooter, and swimming. Unlike our study, theirs included a more comprehensive range of physical activities that were performed, which is an advantage and allows for a better and broader view of the end result. Logan et al. (2011) in their study attempted to compare the performance of school children on the TGMD-2 to examine the risk of developmental coordination disorder or developmental delay. What is important to point out is that the performance on the TGMD-2 test suggested lower motor competence and a delay in the development of gross motor skills, and as the reason for such a results, they blamed the lack of opportunities for children to develop specific skills through quality physical education classes. In the current study, we have confirmed the importance of additional exercise at this age, where the children from the sports school achieved much better results for motor skills after six months of the program compared to the control group that followed only the kindergarten program. However, the study has some limitations that must be mentioned. Firstly, we did not evaluate the effects separately for boys and girls. Moreover, we did not control for the leisure time physical activity for both groups. This could affect the results and conclusions.

In summary, there are positive effects of exercise on the development of motor skills in preschool children after a six-month experimental program. In addition, the participants of the experimental group achieved better results in all motor skill tests compared to the control group. This is of great importance because motor skills have a significant role in children's physical, emotional, and cognitive development. This study offers a possible solution of how to organize physical activities and what type of physical exercise regimen is more effective in enhancing motor skills in preschool children.

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EFEKTI ŠKOLICE SPORTA NA MOTORIČKE VEŠTINE KOD PREDŠKOLSKE DECE

Poslednjih godina značaj fizičke aktivnosti i vežbanja u ranom razvoju dece dobija značajnu pažnju. Cilj ovog istraživanja bio je da se utvrde efekti programa baziranog na sportskim školama na motoričke sposobnosti dece predškolskog uzrasta. Uzorak učesnika za istraživanje činilo je 56 devojčica i 74 dečaka predškolskog uzrasta (6,03 ± 0,45 godina). Deca eksperimentalne grupe su bila uključena u program u trajanju od 6 meseci, tri puta nedeljno, dok je kontrolna grupa pratila uobičajene aktivnosti u vrtiću. Test opšteg motoričkog razvoja – drugo izdanje (TGMD-2) je bio alat za procenu razvoja motoričkih sposobnosti koje zahtevaju tehnike posmatranja. ANCOVA je pokazala da postoje razlike u svim analiziranim varijablama: Ukupan skor za lokomotorne veštine ($p=0,01$), Ukupan skor za manipulativne veštine ($p=0,01$) i Ukupan skor za sve TGMD-2 testove ($p=0,01$). Može se zaključiti da postoje pozitivni efekti programa škole sporta na razvoj motoričkih sposobnosti kod dece predškolskog uzrasta nakon šestomesečnog eksperimentalnog programa. Kako su motoričke sposobnosti ključni aspekt razvoja dece i igraju izuzetno važnu ulogu u njihovom fizičkom, emocionalnom i kognitivnom razvoju, njihova procena je izuzetno važna.

Ključne reči: *deca, fizička aktivnost, evaluacija, TGMD-2*