

PROMOTING FUNDAMENTAL MOTOR SKILLS IN THE TRANSITION FROM KINDERGARTEN TO SCHOOL

MARTINA JAUNIK,¹ MARJETA KOVAČ,²
KLEMEN BEDENIK,³ MIHA MARINŠEK¹

¹ University of Maribor, Faculty of Education, Maribor, Slovenia
martina.jaunik@guest.um.si, miha.marinsek@um.si

² University of Ljubljana, Faculty of Sport, Ljubljana, Slovenia
marjeta.kovac@fsp.uni-lj.si

³ Association of Maribor Sports Clubs Branik, Maribor, Slovenia
klemen.bedenik@zmsd-branik.si

The aim of the study was to compare the effectiveness of interventions promoting fundamental motor skills (FMS) in preschoolers and first-year schoolchildren in north-east Slovenia and to investigate possible gender differences. The study involved 143 children with typical development aged four to seven years, divided into an experimental group and a control group. The experimental group took part in a 13-week intervention programme, while the control group followed the standard curriculum for physical education in Slovenian public kindergartens and schools. *The test of gross motor development 3* was used to assess the improvement of FMS. The results showed that after the intervention, the improvement in locomotor and ball skills were in preschool children higher than in first-year schoolchildren. No gender differences were found in FMS improvement. These results have important implications for the development of FMS in young children and for the design of intervention programmes promoting these skills.

DOI
[https://doi.org/
10.18690/um.pef.2.2024.25](https://doi.org/10.18690/um.pef.2.2024.25)

ISBN
978-961-286-899-4

Keywords:

motor skills development,
intervention,
kindergarten,
primary school,
gender differences



University of Maribor Press

DOI

[https://doi.org/
10.18690/um.pef.2.2024.25](https://doi.org/10.18690/um.pef.2.2024.25)

ISBN

978-961-286-899-4

Ključne besede:

gibalni razvoj,
vadbni program,
vrtec,
osnovna šola,
razlike med spoloma

SPODBUJANJE TEMELJNIH GIBALNIH SPRETNOSTI NA PREHODU IZ VRTCA V ŠOLO

MARTINA JAUNIK,¹ MARJETA KOVAČ,²
KLEMEN BEDENIK,³ MIHA MARINŠEK¹

¹ Univerza v Ljubljani, Pedagoška fakulteta, Ljubljana, Slovenija
martina.jaunik@guest.um.si, miha.marinsek@um.si

² Univerza v Ljubljani, Fakulteta za šport, Ljubljana, Slovenija
marjeta.kovac@fsp.uni-lj.si

³ Zveza mariborskih športnih društev Branik
klemen.bedenik@zmsd-branik.si

Cilj raziskave je bil primerjati učinkovitost vadbenih programov za usvajanje temeljnih gibalnih spretnosti (TGS) med predšolskimi otroki in otroki 1. razreda v severovzhodni Sloveniji in raziskati možne razlike med spoloma. V raziskavi je sodelovalo 143 otrok, starih od 4 do 7 let, ki so bili razporejeni v eksperimentalno oziroma kontrolno skupino. Eksperimentalna skupina je sodelovala v 13-tedenskem vadbenem programu, kontrolna skupina pa je sledila kurikulumu oz. učnemu načrtu za gibanje oz. šport za javne vrtce in šole. *Naloge za ocenjevanje grobe motorike 3* so bile uporabljene za oceno TGS. Rezultati so pokazali, da so predšolski otroci bolj napredovali v spretnostih obvladovanja telesa in spretnostih z žogo kot otroci 1. razreda. Med spoloma ni bilo razlik. Rezultati so pomembni za oblikovanje vadbenih programov, katerih namen je usvajanje TGS.



Univerzitetna založba
Univerze v Mariboru

1 Introduction

Early childhood is a critical period for the development of fundamental motor skills (FMS), which include basic movement patterns such as running, jumping, throwing, and catching (Holfelder & Schott, 2014). The acquisition of FMS during the preschool years lays the foundation for proficient movement and physical activity throughout life (Iivonen, Sääkslahti, & Nissinen, 2011). Therefore, promoting the development of FMS in young children is of paramount importance for their overall health, well-being, and academic success (Goodway, Crowe, & Ward, 2003). Children do not develop FMS naturally through maturational processes; these skills need to be learnt, practised, and reinforced (Logan et al., 2012).

Mastering FMS in early childhood is associated with numerous benefits, which are not limited only to physical competence, but to an overall physical literacy of children. FMS give children the opportunity to explore their environment and learn about the world around them, which improves their cognitive functioning, social integration, and emotional regulation (Goodway, Ozmun, & Gallahue, 2019). In addition, children with advanced FMS proficiency are more likely to engage in regular physical activity, reducing the risk of obesity and related health complications (Iivonen et al., 2011). Given the global concern about physical inactivity and childhood obesity, promoting FMS development in early childhood has gained increasing attention from educators, health professionals, and policy makers (Higgins et al., 2019). Consequently, interventions aimed at improving FMS in early childhood have the potential to bring significant public health benefits by promoting an active lifestyle from an early age (Iivonen et al., 2011).

At school, children with a well-developed FMS are better able to participate in physical education and leisure activities, facilitating better school readiness and academic performance (Kalaja et al., 2012). School readiness is a multi-faceted concept that encompasses a range of cognitive, emotional, social, and physical skills required for a successful transition into formal education (Blair & Raver, 2015). Among these skills, FMS have emerged as a critical component of school readiness, as they form the foundation for physical activity and academic achievement (Iivonen, Sääkslahti, & Nissinen, 2011).

Despite the importance of FMS, many children do not develop these skills sufficiently. This may be due to a lack of opportunities for physical activity, limited access to equipment, or a lack of instruction and guidance (Logan et al., 2012; Wick et al., 2017). According to a comprehensive systematic review of 65 separate studies on children's FMS levels, children have "below average" to "average" FMS levels (Zhang et al., 2024). Similar situation was recently found in Slovenian children (Kastelic, Kovač, & Marinšek 2022; Pavlič, Kovač, & Marinšek 2022; Marinšek, Štopfer, & Kovač 2023). Therefore, interventions are needed to promote the development of FMS in young children.

The importance of FMS in the early years has led to the introduction of intervention programmes designed to promote these skills in kindergarten. Such interventions have shown promising effects on overall FMS proficiency, as well as on specific components such as object control and locomotor skills (Lloyd et al., 2014). These interventions are particularly important for typically developing preschool children aged 2 to 6 years, as this developmental stage represents a critical window of opportunity for the acquisition and refinement of motor skills (Stodden et al., 2008).

A recent study found that just two 30-minute lessons per week with implemented games can significantly improve FMS proficiency of 8- to 10-year-old children (Costello & Warne, 2020), and the results were consistent with previous research on motor skill interventions. FMS proficiency was improved in a way that reduced the difference between FMS skills in boys and girls. Another study examining the effectiveness of a 30-week FMS programme in typically developing 3- to 8-year-old children found that locomotor and object control scores increased as children got older (Bardid et al., 2017). In addition, girls made significantly more progress in locomotor skills than boys and significantly less progress in object control skills than boys.

Despite the potential benefits of FMS interventions, there is a need for a comprehensive understanding of their effectiveness, optimal implementation strategies, and long-term effects. This is particularly important given the variability of intervention approaches, duration, and qualifications of those delivering the programmes (Robinson & Goodway, 2009).

It is the opinion of authors that there is a gap in the literature on the effectiveness of FMS interventions for typically developing preschoolers and primary school children. To fill this gap, the present study compared the effectiveness of FMS interventions in preschool children and children in the first-year of primary school in north-east Slovenia. A second aim was to investigate possible gender differences in FMS and the improvement as a result of intervention. Based on the previous intervention literature (Bardid et al., 2017; Logan et al., 2012), it was hypothesised that primary school children would improve significantly more than preschool children in locomotor skills and object control skills. It was also assumed that girls would improve significantly more in the locomotor skills and less in object control skills than boys.

The education system in Slovenia is currently being reformed (2022-2026). Through these efforts, the debate on school readiness and the criteria that allow children to enter formal education is evolving. To adequately include aspects of motor development in the educational reform, it is necessary to obtain information on acquisition of FMS during the transition of children from kindergarten to school.

2 Materials and methods

2.1 Participants

A sample of children with typical development was used in the study, including preschoolers and children in the first-year of primary schools in north-east Slovenia. A total of 143 children aged four to seven years ($M = 5.72$; $SD = 1.05$; 46.9% girls) participated in the study, which was divided into an experimental group ($n = 72$) and a control group ($n = 71$). The experimental group was further divided into two subgroups: a kindergarten group (EG-K) consisting of 39 children ($M = 5.23$; $SD = 0.74$) and a school group (EG-S) consisting of 33 children ($M = 6.86$; $SD = 0.36$). Both EGs took part in a 13-week intervention programme and completed pre-, post- and retention tests. During the same period, the control group from kindergarten (CG-K) participated in a programme based on a standard kindergarten curriculum (Bahovec et al., 1999) used in Slovenian public kindergartens. A control group from school (CG-S) participated in a programme based on a standard curriculum for primary school physical education (Kovač et al., 2011) used in Slovenian public

schools. The CG-K comprised 37 children ($M = 5.20$; $SD = 0.98$) and the CG-S 34 children ($M = 6.81$; $SD = 0.28$).

The study was conducted in accordance with the principles of the Declaration of Helsinki and received ethical approval from the Ethics Committee of the University of Maribor (protocol code 038-21-111/2021/4/FFUM). Consent for participation in the study was acquired from the parents of children as well as from kindergarten- and school-teachers. Study was partly funded by a grant number RR-23-012 from the Sports Foundation of Slovenia.

2.2 Design and intervention programmes

In the study, a pre-test, a post-test, and a retention test were conducted to assess the effects of the intervention. The initial FMS assessment was followed by a further assessment one week after the intervention (post-test) and five weeks after the intervention (retention test). Participants completed a 13-week programme consisting of 13 sessions, each lasting approximately 40 minutes. Each exercise session took place once a week either in the kindergarten or in the school gym for each group individually. In contrast, the control group took part in physical education lessons, typical for Slovenian public kindergartens and schools.

The intervention was implemented in collaboration between university researchers, students, and teachers to integrate key components into the physical education curriculum. It did not include a written curriculum, but rather it was focusing on encouraging implementers to adapt teaching practises and the classroom environment according to their teaching style, classroom dynamics, and the needs of the children.

The intervention comprised structured practise sessions with warm-up (10 minutes), movement skills instruction (20–25 minutes), and closing activity (5 minutes); specific learning objectives; planned skill progression; and feedback, guidance, and correction to support children's improvement in FMS. The aim was to improve the performance of the planned FMS during each practise session. The number of FMS skills covered in each session was at the discretion of the implementer.

Daily fidelity tests were carried out to measure the feasibility of the intervention. Fidelity was assessed by calculating the percentage of intervention sessions that met all explicit criteria, thus ensuring the consistency and quality of the implementation process.

2.3 Procedures and measures

The Test of Gross Motor Development – Third Edition (TGMD-3), a valid and reliable process-based assessment tool for children aged 3-10 years, was used to assess FMS (Marinšek et al., 2023; Ulrich, 2019). The TGMD-3 measures the execution of movements and comprises six locomotor and seven ball-related skills; every child had two attempts to execute individual skills, which were first verbally described and demonstrated. Executed attempts were then scored against a checklist of three to five performance criteria, which were scored as either correct (1 point) or not performed (0 points). The raw scores were calculated by adding up the correctly performed criteria with the maximum possible score being 46 points for locomotor skills and 54 points for the ball skills (100 points in total). A higher score means a higher level of FMS acquired.

Six locomotor skills and seven ball skills were recorded using video footage, which were then assessed by three trained assessors who had completed a comprehensive training programme prior to the study to ensure competency in the TGMD-3 assessment protocol. The assessors were trained for a fortnight and were required to achieve greater than 80% agreement with the results of the reference assessor to demonstrate their competence.

The TGMD-3 showed a high degree of internal consistency, with a Cronbach's alpha of .90 for all tests in the present study. Subtest scores ranged from .93 for locomotor to .89 for ball skills. According to Fayers and Machin (2013), the tests showed acceptable internal consistency with a Cronbach's alpha value of .70 or more.

2.4 Statistical analyses

Two separate 4×3 (group x test) ANCOVAs were performed, with repeated measures on the last factor using the raw scores of the locomotor and ball skills subscales, respectively. The aim was to evaluate the effects of the FMS interventions

on the development of the children's locomotor and ball skills. The partial eta-square (η^2) was used as an indicator to assess the effect size, with values of 0.01, 0.06, and ≥ 0.14 indicating small, medium, and large effects respectively (Cohen, 1988). The results of the pre-test and age served as covariates in this analysis. Post-hoc comparisons with Bonferroni corrections were performed after a significant main effect was found. Cohen's *d* was used to assess the effect size (Cohen, 1992). The values corresponded to the following: 0–0.1 = trivial, 0.2–0.4 = small, 0.5–0.7 = medium, and ≥ 0.8 = large.

Normality was assessed separately for kindergarten and school children on the basis of skewness and kurtosis. With the exception of the locomotor score on the pre-test for the school children, the results showed that all values for skewness and kurtosis were below 2.0, which indicates a normal distribution of the data. All assumptions regarding homogeneity (assessed by the Levene test > 0.074) and sphericity were met, with the exception of the sphericity of the motor skills *jump*, *ball strike*, and *underarm throw*, for which the Greenhouse-Geiser correction was applied. All statistical analyses were performed with JASP version 0.17.2 (JASP Team, 2023).

3 Results

The fidelity check showed that all exercise sessions met all the explicit criteria set before the intervention programmes. This ensured the consistency and quality of the moderation process.

3.1 Locomotor skills

Preschool and school children differed statistically significantly in the results of the pre-test. School children (36.3 points or 79% of the maximum score) scored on average 20 percentage points (pp) better in locomotor skills than preschool children (27.2 points or 59% of the maximum score) (Figure 1).

The EG-K showed an improvement in all locomotor skills, from 27.9 to 34.4 points, which corresponds to an improvement of 14 pp. However, all other groups showed only a minimal improvement of 7 pp (EG-S), 4 pp (CG-K) and 3 pp (CG-S). In the post-test, the difference between EG-K (34.9 points or 76% of the maximum score)

and CG-S (37.8 points or 82% of the maximum score) was only 6 pp and in the retention test 9 pp (75% vs. 84%).

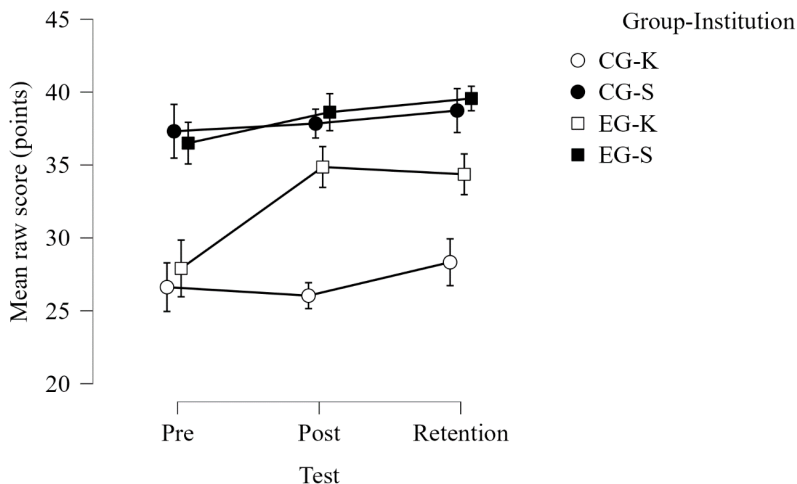


Figure 1: Locomotor results (dots) before, after and during retention as well as 95% confidence intervals (vertical lines) for the kindergarten/school experimental groups (EG-K and EG-S) and the control groups (CG-K and CG-S).

Source: own

A 4×3 (group x test) ANCOVA with repeated measures on the last factor and pre-test scores and age as covariates revealed a significant group-by-test interaction for locomotor skills $F(6, 210) = 9.98, p < .001, \eta p^2 = .28$, with a strong intervention effect size. Both covariates, pre-test score and age ($p < .001$), were statistically significant. Post-hoc t-tests revealed significant improvements from the pre-test to the post-test ($p < .001, d = 2.42$) and from the pre-test to the retention test ($p < .001, d = 2.18$) for the EG-K. No significant improvements were observed for the other groups EG-S, CG-K, and CG-S ($p > .05$) (Figure 1).

A separate ANCOVA with repeated measures for school and preschool children revealed a non-significant group-by-test interaction for locomotor skills in school children ($p = .379$) and a significant group-by-test interaction for locomotor skills in preschool children ($p < .001$).

The improvement with the largest effect size (Cohen’s *d* from pre-test to post-test and from pre-test to retention test) in the individual locomotor scores in preschool children was observed in motor skills *run* (*d* = 1.349 and *d* = 1.058), *skip* (*d* = 0.987 and *d* = 1.161), *slide* (*d* = 0.606 and *d* = 1.277), and *hop* (*d* = 1.063 and *d* = 0.918). A significant improvement from the pre-test to the post-test, but without retention, was observed for the motor skill *horizontal jump* (*d* = 0.952) and a non-significant improvement for motor skill *gallop*. In school children, an improvement from the pre-test to the retention test was observed for motor skill *run* (*d* = 1.532), *gallop* (*d* = 1.334), and *hop* (*d* = 1.240). However, no significant improvement was observed for motor skills *skip*, *horizontal jump* and *slide*.

Table 1: Descriptive statistics for locomotor skill scores across gender, tests, and institutions

Test	Gender	Institution	Locomotor skills		
			Mean	SD	SE
Pre	Boys	Kindergarten	26.107	9.697	1.832
		School	35.059	5.900	1.431
	Girls	Kindergarten	29.000	11.499	2.710
		School	38.722	2.653	0.625
Post	Boys	Kindergarten	29.000	8.932	1.688
		School	37.765	2.751	0.667
	Girls	Kindergarten	32.222	10.519	2.479
		School	38.611	2.831	0.667
Retention	Boys	Kindergarten	30.107	8.821	1.667
		School	38.471	2.154	0.522
	Girls	Kindergarten	32.944	8.888	2.095
		School	39.722	2.866	0.675

Source: own

A separate ANCOVA with repeated measures for preschool and school children revealed a non-significant interaction between group, test, and gender for the locomotor skills of preschool children ($p = .230$) and school children ($p = .573$), suggesting that there were no differences in improvement between girls and boys in the control or experimental group (Table 1).

3.2 Ball skills

Preschool and school children differed statistically significantly in the results of the pre-test. School children (35.0 points or 65% of the maximum score) performed on average 20 pp better in ball skills than preschool children (24.2 points or 45% of the maximum score) (Figure 2).

The EG-K showed improvements in all ball motor skills, from 25.5 to 35.0 points, an improvement of 18 pp. However, all other groups showed only a minimal improvement of 5 pp (EG-S), 4 pp (CG-K) and 3 pp (CG-S). In the post-test, the difference between EG-K (32.3 points or 60% of the maximum score) and CG-S (36.6 points or 68% of the maximum score) was 8% points and in the retention test none (65% vs. 65%) (Figure 2).

A 4×3 (group x test) ANCOVA with repeated measures on the last factor and pre-test scores and age as covariates revealed a significant group-by-test interaction for ball skills $F(6, 210) = 7.22, p < .001, \eta p^2 = .21$, with a strong intervention effect size. Both covariates, pre-test score and age ($p < .001$), were statistically significant. Post-hoc t-tests revealed significant improvements from the pre-test to the post-test ($p < .001, d = 5.74$) and from the pre-test to the retention test ($p < .001, d = 7.28$) for the EG-K. Non-significant improvements were found for the other groups EG-S, CG-K, and CG-S ($p > .05$) (Figure 2).

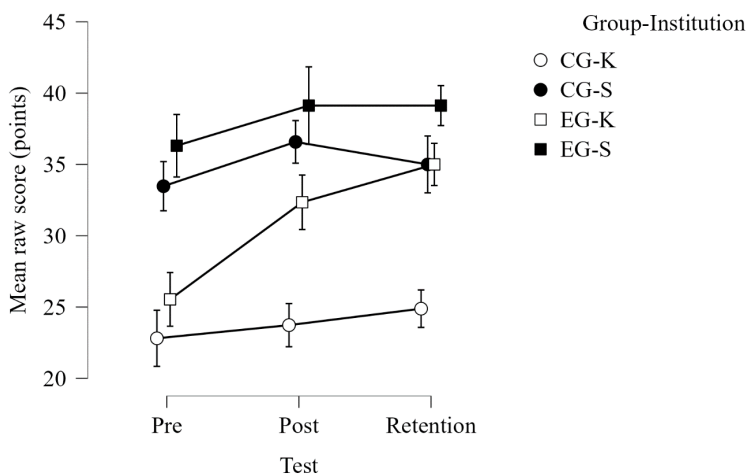


Figure 2: Pre-, post- and retention values of ball skills (dots) and 95% confidence intervals (vertical lines) for the kindergarten/school experimental groups (EG-K and EG-S) and the control groups (CG-K and CG-S).

Source: own

A separate ANCOVA with repeated measures for school and preschool children revealed a non-significant group-by-test interaction for ball skills in school children ($p = .435$) and significant group-by-test interaction for ball skills in preschool children ($p < .001$).

In preschool children, significant improvement was found from pre-test to post-test for *ball strike* ($d = 0.865$) and from pre-test to retention for *stationary dribble* ($d = 1.378$) and *overhand throw* ($d = 1.358$). In addition, a significant improvement with a large effect size was found from the pre-test to the post-test and from the pre-test to the retention for the *forehand strike* ($d = 3.431$ and $d = 5.055$) and the *underhand throw* ($d = 2.373$ and $d = 1.952$). A non-significant improvement was found for *catch* and *kick*. In the school children, a significant improvement in individual ball skills from the pre-test to the post-test and from the pre-test to retention was found in *stationary dribble* ($d = 1.429$ and $d = 1.336$).

Table 2: Descriptive statistics for ball skills scores across gender, tests, and institutions

Test	Gender	Institution	Ball skills		
			Mean	SD	SE
Pre	Boys	Kindergarten	27.966	8.113	1.507
		School	38.529	7.046	1.709
	Girls	Kindergarten	19.391	6.966	1.452
		School	31.222	6.264	1.477
Post	Boys	Kindergarten	30.759	8.078	1.500
		School	41.647	5.291	1.283
	Girls	Kindergarten	24.609	8.489	1.770
		School	34.056	7.033	1.658
Retention	Boys	Kindergarten	32.690	7.663	1.423
		School	39.941	5.141	1.247
	Girls	Kindergarten	26.478	9.760	2.035
		School	34.000	6.869	1.619

Source: own

A separate ANCOVA with repeated measures for preschool and school children revealed a non-significant interaction between group, test, and gender for the ball skills of preschool children ($p = .738$) and school children ($p = .754$), suggesting that there were no differences in improvement between girls and boys in the control or experimental group (Table 2).

4 Discussion

The study emphasises the importance of early intervention and the potential for significant improvements in the early stages of FMS development. The results showed that the FMS interventions had a significant effect on the development of

locomotor and ball skills in preschool children, and less significant in school children. This suggests that the FMS interventions in the study were more effective in preschool children (4- to 5-years-old) than in school children (6- to 7-years-old). This is consistent with some of the early studies on teaching strategies, suggesting that instruction is useful in motor learning, especially in the first attempts, whereas the effects on subsequent learning attempts after instruction are rather small (Singer, 1977). In most FMS, children aged 4 to 5 years are in the initial and/or elementary stage and are therefore early trial learners. This is reflected in their mean pre-test score, which was 59% of the maximum score. In contrast, the school children in present study achieved a mean score of 79% of the maximum score in the pre-test. It is plausible that the school children did not improve their motor performance after the intervention due to the high pre-test score that caused only negligible improvement.

The specific analysis of individual locomotor and ball skills revealed noticeable improvements in various skills such as *run*, *hop*, *slide*, *forehand strike*, *underhand throw* and *stationary dribble*, especially in preschool children. These improvements emphasise the effectiveness of FMS interventions in the targeted promotion of specific movement skills that are essential for the motor development of young children.

It has been stated that the development of FMS in preschool children plays an important role in preparing them for the academic and physical demands of formal schooling (Aydoner & Bumin, 2023). Therefore, it is important that strong motor skills are developed in preschool period, as this will crucially contribute to holistic development and school readiness in children. Namely, motor skills are directly related to the ability of children to participate in classroom activities, play sports, and complete tasks such as writing, cutting, and drawing. Furthermore, fine motor skills involving the coordination of smaller muscle groups, will subsequently develop on the foundation of gross motor development. Additionally, the refinement of manual dexterity and precision in fine motor tasks is closely linked to the underlying strength, balance and coordination built through gross motor experiences (Goodway et al., 2019). Thus, children entering school with well-developed motor skills, will better cope with the demands of the classroom, which will lead to better academic performance and overall school readiness (Jones et al., 2021). It can be concluded

that targeted interventions and instruction to improve preschool children's motor skills could have a positive long-term impact on their academic success.

Due to the stated overall positive effects, the development of FMS should be emphasised in the kindergarten curriculum. Because it promotes school readiness, special attention should be given to monitoring FMS in preschool children. An objective measure to assess the quality of FMS should be introduced in public kindergartens so that practitioners and researchers can monitor the development of children's motor skills for intervention, school readiness and other purposes.

The study provided valuable insights into FMS interventions for young children. However, some limitations should be considered. First, the study included 143 children aged four to seven years, which is not a sufficient number to draw general conclusions. Second, longer interventions or more intensive programmes may be needed to observe more substantial improvements or long-term effectiveness of the interventions. Third, although the TGMD-3 is a valid and reliable instrument, it focuses on the qualitative assessment of motor skills. The study could benefit from the inclusion of additional quantitative measures to provide a more comprehensive assessment of skill acquisition.

Overall, the results of the study emphasise the different response of kindergarten and school children to FMS interventions and highlight the potential for tailored strategies to promote motor development in each age group. This emphasises the importance of considering age-specific factors when developing and implementing interventions to improve FMS in children.

As research continues to highlight the profound impact of FMS on early childhood development, it is critical for teachers and policy makers to prioritise the integration of these skills into children's curricula and daily routines. This can include structured activities such as obstacle courses, balancing games, and ball games, as well as free play opportunities that allow children to explore different movements and physical challenges. In this way, young children will build a strong foundation for their physical, cognitive, and social well-being.

5 Conclusions

Present study emphasises the importance of early intervention and the potential for significant improvements in FMS in the early stages of development. The results suggest that targeted interventions can improve children's FMS proficiency and contribute to their overall development. Key findings of the study include:

- Both the preschool children and the school children who took part in the intervention programme showed significant improvements in their individual locomotor skills and ball skills. The preschool children showed greater improvements than the school children.
- No significant differences in improvement were found between girls and boys, suggesting that interventions do not have to be tailored differently for each gender.
- The study demonstrated the effectiveness of the FMS interventions in targeting specific movement skills, making them an important tool for the motor development of young children.

In summary, the study highlights the need for early intervention and targeted FMS programmes in preschools and primary schools to promote children's motor development and improve their school readiness. Mastery of FMS plays a central role in school readiness as it forms the basis for a child's physical, social, and cognitive development. The importance of FMS for school readiness becomes even more apparent in the context of educational reforms aimed at improving kindergarten and primary school curricula. By incorporating FMS into the kindergarten curriculum and providing appropriate interventions, educators can promote a more comprehensive and holistic approach to child development that ultimately leads to improved school readiness and academic success. As efforts to reform the school system continue, it is critical to prioritise the integration of FMS to ensure that all children have the necessary skills and abilities to succeed in their educational environment.

Acknowledgments

This research was funded by grant RR-23-012 from the Sports Foundation of the Republic of Slovenia.

References

- Aydoner, S., & Bumin, G. (2023). The factors associated with school readiness: Sensory processing, motor, and visual perceptual skills, and executive functions in kindergarten children. *Applied Neuropsychology: Child*, 1–9. <https://doi.org/10.1080/21622965.2023.2275677>
- Bahovec, E. D., Bregar, K. G., Čas, M., Domicelj, M., Saje Hribar, N., Japelj, B., Jontes, B., Kastelic, L., Kranjc, S., Marjanovič Umek, L., Požar Matijašič, N., Vonta, T., & Pezdir Vovk, A. (1999). *Kurikulum za vrte [Curriculum for kindergartens]*. Ministrstvo za šolstvo in šport.
- Bardid, F., Lenoir, M., Huyben, F., De Martelaer, K., Seghers, J., Goodway, J. D., & Deconinck, F. J. (2017). The effectiveness of a community-based fundamental motor skill intervention in children aged 3–8 years: Results of the “Multimove for Kids” project. *Journal of Science and Medicine in Sport*, 20(2), 184–189.
- Blair, C., & Raver, C. C. (2015). School readiness and self-regulation: A developmental psychobiological approach. *Annual Review of Psychology*, 66, 711–731. <https://doi.org/10.1146/annurev-psych-010814-015221>
- Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). New York: Lawrence Erlbaum.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155–159.
- Costello, K., & Warne, J. (2020). A four-week fundamental motor skill intervention improves motor skills in eight to 10-year-old Irish primary school children. *Cogent Social Sciences*, 6(1), 1724065. <https://doi.org/10.1080/23311886.2020.1724065>
- Fayers, P. M., & Machin, D. (2013). *Quality of life: The assessment, analysis and reporting of patient-reported outcomes*. Chichester, England: Wiley.
- Goodway, J. D., Crowe, H., & Ward, P. (2003). Effects of motor skill instruction on fundamental motor skill development. *Adapted Physical Activity Quarterly*, 20(3), 298–314. <https://doi.org/10.1123/apaq.20.3.298>
- Goodway, J. D., Ozmun, J. C., & Gallahue, D. L. (2019). *Understanding motor development: infants, children, adolescents, adults (8th ed.)*. Jones & Bartlett Learning.
- Higgins, J. P. T., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2019). *Cochrane handbook for systematic reviews of interventions (2nd ed.)*. John Wiley & Sons.
- Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: A systematic review. *Psychology of Sport and Exercise*, 15(4), 382–391. <https://doi.org/10.1016/j.psychsport.2014.03.005>
- Iivonen, S., Sääkslahti, A., & Nissinen, K. (2011). The development of fundamental motor skills of four- to five-year-old preschool children and the effects of a preschool physical education curriculum. *Early Child Development and Care*, 181(3), 335–343. <https://doi.org/10.1080/03004430903387461>
- JASP Team. (2023). *JASP (Version 0.17.2) [Computer software]*.
- Jones, D., Innerd, A., Giles, E. L., & Azevedo, L. B. (2021). The association between physical activity, motor skills and school readiness in 4–5-year-old children in the northeast of England. *International Journal of Environmental Research and Public Health*, 18(22), 1–13. <https://doi.org/10.3390/ijerph182211931>
- Kalaja, S., Jaakkola, T., Liukkonen, J., & Watt, A. (2010). Fundamental movement skills and motivational factors influencing engagement in physical activity. *Perceptual and Motor Skills*, 111(1), 115–128. <https://doi.org/10.2466/06.10.25.PMS.111.4.115-128>
- Kastelic, A., Kovač, M., & Marinišek, M. (2022). Spremembe v lokomotornih spretnostih učencev in učenk od 1. do 5. razreda osnovne šole. In M. Kovač, M. Plavčak, & L. Dobovičnik (Eds.),

- Zbornik 35. strokovnega in znanstvenega posveta športnih pedagogov Slovenije. (pp. 66–81). Prebold: Zveza društev športnih pedagogov Slovenije.
- Kovač, M., Markun Puhar, N., Lorenci, B., Novak, L., Planinšec, J., Hrastar, I., Pleteršek, K., & Muha, V. (2011). *Učni načrt za športno vzgojo - osnovna šola [Curriculum for physical education - primary school]*. Ministrstvo RS za šolstvo in šport, Zavod RS za šolstvo.
- Logan, S. W., Robinson, L. E., Wilson, A. E., & Lucas, W. A. (2012). Getting the fundamentals of movement: A meta-analysis of the effectiveness of motor skill interventions in children. *Child: Care, Health and Development*, 38(3), 305-315.
- Lloyd, M., Saunders, T. J., Bremer, E., & Tremblay, M. S. (2014). Long-term importance of fundamental motor skills: A 20-year follow-up study. *Adapted Physical Activity Quarterly*, 31(1), 67-78.
- Marinšek, M., Bedenik, K., & Kovač, M. (2023). Psychometric Proprieties of the Slovenian Version of the Test of Gross Motor Development–3. *Journal of Motor Learning & Development*, 11, 209–223.
- Marinšek, M., Štopfer, N., & Kovač, M. (2023). Analiza izvedbe temeljnih lokomotornih spretnosti v zgodnjem otroštvu. *Vzgojiteljica: Revija za dobro prakso v vrtcih*, 25(2), 8–12.
- Singer, R. N. (1977). To Err or Not to Err: A Question for the Instruction of Psychomotor Skills. *Review of Educational Research*, 47(3), 479–498
- Stodden, D., Goodway, J. D., Langendorfer, S., Robertson, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest*, 60(2), 290-306.
- Pavlič, N., Kovač, M., & Marinšek, M. (2022). Spremembe v gibalnih spretnostih ravnanja z žogo učencev in učenk od 1. do 5. razreda osnovne šole. In M. Kovač, M. Plavčak, & L. Dobovičnik (Eds.), *Zbornik 35. strokovnega in znanstvenega posveta športnih pedagogov Slovenije*. (pp. 98–110). Prebold: Zveza društev športnih pedagogov Slovenije.
- Robinson, L. E., & Goodway, J. D. (2009). Instructional climates in preschool children who are at-risk. Part I: Object-control skill development. *Research Quarterly for Exercise and Sport*, 80(3), 533-542.
- Wick, K., Leeger-Aschmann, C. S., Monn, N., Radtke, T., Ott, L. V., Rebholz, C. E., ... & Gerber, M. (2017). Interventions to promote fundamental movement skills in childcare and kindergarten: A systematic review and meta-analysis. *Sports Medicine*, 47(10), 2045-2068.
- Zhang, D., Soh, K. G., Chan, Y. M., & Zaremohzzabieh, Z. (2024). Effect of intervention programs to promote fundamental motor skills among typically developing children: A systematic review and meta-analysis. *Children and Youth Services Review*, 156, 107320. <https://doi.org/10.1016/j.childyouth.2023.107320>

