

An Empirical Study of Preschool Children's Physical Games from the Perspective of Gross Motor Development

Mengjia You¹, Xinyi Liu¹, Wenming Jiang¹, Zulakbal bin Abd Karim^{1*}

¹Faculty of Sport Science and Coaching, Sultan Idris Education University, 35900 Tanjong Malim, Malaysia.

Abstract. In recent years, the country has attached more importance to children's physical education, and relevant policy documents also emphasize the importance of children's physical activities. Children are the key period for the development of gross movements. The development of gross movements not only affects the physical quality of children, but also is closely related to their cognitive, emotional and social development. Research points out that 3-6 years old is the critical period for young children to develop gross movements. Different in age, so the focus of children's development of rough movements is not the same, in which children 5-6 years old is the fastest development of children's gross movements, mainly to develop the development of running, jumping and balance ability. At this stage, targeted intervention for children will produce good results. This paper uses literature research, testing, experiment, and mathematical statistics. Among them, the present paper mainly adopts the experimental method. In this paper, children aged 5-6 years old in Chengdu Aidi Kindergarten were selected as the experiment object, among which 20 children (10 from each male and female) were randomly selected as the experimental group. After 8 weeks of experimental intervention in the experimental group, the following conclusions were drawn. After 8 weeks of sports game experiment in the experimental group, the children's gross movement skills were improved to different degrees. The research results are as follows: 1. Children's "running", "standing long jump" and "side slip" are less improved after intervention, and need intervention and attention in the future gross movement training. 2. Children have less improvement after the intervention of "overhand throw" and "one-handed racket" in the operational skills, and should be intervened and paid attention to in the future rough movement training. 3. Compared with traditional physical education teaching activities, sports game activity teaching can better improve children's interest in participating in sports activities. The sports games in this study have played this effect, compared with the previous teaching, greatly improved the enthusiasm of children, and achieved the ideal effect. Therefore, professional sports games can make children better improve the development of gross movement skills in the happy activities, and improve their personal physical quality.

Keywords: Toddlers, Gross Motor, Sport game.

*Corresponding Author, E-mail: zulakbal@fsskj.upsi.edu.my

1 Introduction

From the perspective of gross motor development in early childhood, the critical period for gross motor development has a positive impact on children's perception, cognitive abilities, physical and mental health, and social adaptation. Gross motor skills refer to the movement of the trunk and large muscle groups, such as running, jumping, and throwing. In real-life education, using scientific teaching methods to help children improve their gross motor skills has gradually become an important issue in early childhood education (Willoughby & Hudson, 2023).

Physical games need to meet the needs of children's gross motor development, both arousing their interest and maintaining their educational purpose. Compared with ordinary physical activities, physical games can better help children improve their motivation to participate in physical activities, providing interest-driven action and encouraging them to actively participate in physical game exercises (Zou et al., 2024). However, in reality, most kindergartens still use traditional methods in their daily physical education curriculum, and these activities lack effective organization (Logan et al., 2011). Furthermore, there is limited research on using well-organized physical game classrooms to improve children's gross motor skills, especially in terms of curriculum intervention and evaluation systems. Therefore, this study designed an 8-week intervention program to help children improve their gross motor skills in running, jumping, and throwing. This method is based on previous research that has shown that engaging and

innovative physical activities can effectively promote the development of early motor skills (Yu, 2015; Waseniuset al., 2018; Dobell et al., 2023).

2 Method

This study conducted an empirical investigation on gross motor skill development among senior class children (aged 5–6 years) at Chengdu Aidi Kindergarten. The research participants were all physically healthy children with normal development, excluding those with major illnesses or physical disabilities. All parents or guardians of pediatric subjects gave consent for participation in the study. A total of 20 subjects were included in this study, with equal numbers of male (10) and female (10) subjects. A gross motor-skill-based physical game intervention experimental study was utilized by the experimental group to examine the effects of this physical game intervention on gross motor skill development in young children. The gross motor-skill-based physical game intervention experimental intervention occurred for a period of 8 weeks from March 22 through May 17, 2025. In the experimental group, physical game based on gross motor skills were delivered on Mondays, Wednesdays, and Fridays, for 40 minute sessions over a time period of 8 weeks, organized and conducted by the researcher. The children's gross motor skill levels were tested before and after the experiment, and the test data were statistically analyzed. The Test of Gross Motor Development, Third Edition (TGMD-3) was used to assess the children's gross motor skills, covering two categories of skills: locomotor skills and manipulative skills, totaling 13 movements. The tests were completed by the researcher in accordance with the test procedures and scoring standards of TGMD-3. The pre-experiment test was conducted on March

22, 2025, and the post-experiment test on May 17, 2025, both at the outdoor activity site of Aidi Kindergarten under the same environmental conditions to ensure the comparability of test results. SPSS software was used for statistical analysis of the data. The experimental data were expressed as mean \pm standard deviation. Paired samples t-test was employed to analyze the changes in children's gross motor skill levels before and after the experiment, with the significance level set at $p < 0.05$. Meanwhile, Cohen's d was calculated to evaluate the practical effect size of the physical game intervention.

3 Result

Impact of Physical Games on Children's Locomotor Skill Levels

The pre-experiment test results of locomotor skills (Table 1) showed that among the locomotor skills, the children scored relatively low in "standing long jump" and "side shuffle," while achieving the highest score in "running," indicating developmental differences in some locomotor skills among the children.

Table 1 Pre-test Levels of Children's Locomotor Skills (N = 20)

Variable	N	Min	Max	Mean	SD	Median
Running	20	1.500	5.500	4.075	0.950	4.500
Gallop	20	2.500	5.500	3.950	0.686	4.000
Slide	20	1.500	4.500	3.650	0.829	3.750
Leap	20	3.000	5.000	3.950	0.583	3.750
Horizontal jump	20	2.000	4.500	3.575	0.712	3.500
Hop	20	2.500	5.000	3.900	0.641	4.000

The post-experiment test results of locomotor skills (Table 2) revealed that the average scores of all locomotor skills of the children increased significantly after the intervention, with particularly prominent improvements in "standing long jump" and "side shuffle."

Table 2 Post-test Levels of Children’s Locomotor Skills (N = 20)

Variable	N	Min	Max	Mean	SD	Median
Running	20	3.500	7.500	5.400	1.083	5.500
Gallop	20	5.000	7.500	6.025	0.573	6.000
Slide	20	4.500	7.000	5.575	0.799	5.500
Leap	20	4.500	6.000	5.575	0.467	5.500
Horizontal jump	20	4.500	6.500	5.475	0.499	5.500
Hop	20	5.000	6.500	5.725	0.550	5.500

The comparison results of locomotor skills before and after the experiment (Table 3) indicated that six locomotor skills running, forward slide, side shuffle, forward hop, standing long jump, and single-leg hop exhibited significant improvements before and after the experiment ($p < 0.01$). These results demonstrated that physical game intervention had a significant promoting effect on the development of children’s locomotor skills. Effect size analysis showed that the overall intervention effect on locomotor skills was at a moderate to large level (Cohen’s $d = 0.6-1.2$), indicating that the intervention had a strong practical effect.

Table 3 t-Test Analysis of Children’s Locomotor Skills Before and After the Experiment

	Pre-test (n = 20)	Post-test (n = 20)	t	p
Running	4.08±0.95	5.40±1.08	-4.113	<0.01
Gallop	3.95±0.69	6.03±0.57	-10.379	<0.01
Slide	3.65±0.83	5.58±0.80	-7.477	<0.01
Leap	3.95±0.58	5.58±0.47	-9.735	<0.01
Horizontal jump	3.58±0.71	5.47±0.50	-9.769	<0.01
Hop	3.90±0.64	5.72±0.55	-9.669	<0.01

* $p < 0.05$ ** $p < 0.01$

Impact of Physical Games on Children’s Manipulative Skill Levels

The pre-experiment test results of manipulative skills (Table 4) showed that the scores of three manipulative skills "underhand throw," "overhand throw," and "catching" were relatively low, indicating certain deficiencies in the children's related manipulative skills.

Table 4 Pre-test Levels of Children's Object Control Skills (N = 20)

Variable	N	Min	Max	Mean	SD	Median
Overhand throw	20	1.500	5.500	3.900	0.940	4.000
Underhand throw	20	1.500	4.500	3.650	0.829	3.750
Catching	20	2.500	5.000	3.825	0.613	3.500
One-hand dribble	20	2.000	4.500	3.575	0.712	3.500
One-hand strike	20	2.500	5.000	3.900	0.641	4.000
Two-hand strike	20	1.500	4.500	3.650	0.829	3.750
Kick	20	2.500	5.500	3.950	0.686	4.000

The post-experiment test results of manipulative skills (Table 5) showed that the scores of the above three skills improved after the intervention, and the overall level of manipulative skills was significantly enhanced.

Table 5 Post-test Levels of Children's Object Control Skills (N = 20)

Variable	N	Min	Max	Mean	SD	Median
Overhand throw	20	3.500	7.500	5.400	1.083	5.500
Underhand throw	20	4.500	7.000	5.575	0.799	5.500
Catching	20	4.500	6.000	5.650	0.401	5.500
One-hand dribble	20	4.500	6.000	5.450	0.456	5.500
One-hand strike	20	5.000	6.500	5.725	0.550	5.500
Two-hand strike	20	4.500	6.000	5.350	0.564	5.500
Kick	20	5.000	7.500	6.025	0.573	6.000

Table 6 t-Test Analysis of Children's Object Control Skills Before and After the Experiment

	Pre-test (n = 20)	Post-test (n = 20)	t	p
Overhand throw	3.90±0.94	5.40±1.08	-4.676	<0.01

Underhand throw	3.65±0.83	5.58±0.80	-7.477	<0.01
Catching	3.95±0.58	5.65±0.40	-10.752	<0.01
One-hand dribble	3.58±0.71	5.45±0.46	-9.916	<0.01
One-hand strike	3.90±0.64	5.72±0.55	-9.669	<0.01
Two-hand strike	3.65±0.83	5.35±0.56	-7.583	<0.01
Kick	3.95±0.69	6.03±0.57	-10.379	<0.01

* p<0.05 ** p<0.01

The comparison results of manipulative skills before and after the experiment (Table 6) indicated that seven manipulative gross motor skills overhand throw, underhand throw, catching, single-hand dribbling, single-hand striking, two-hand striking, and kicking a stationary ball exhibited significant differences before and after the experiment ($p<0.01$). Among them, the scores of overhand throw ($t=-4.676$), underhand throw ($t=-7.477$), catching ($t=-10.752$), single-hand dribbling ($t=-9.916$), single-hand striking ($t=-9.669$), two-hand striking ($t=-7.583$), and kicking a stationary ball ($t=-10.379$) after the experiment were significantly higher than those before the experiment.

In summary, the interesting physical game intervention can significantly improve children's manipulative gross motor skill levels and has an obvious promoting effect on the overall development of children's gross motor skills.

4 Discussion and Conclusion

The survey revealed that Aidi Kindergarten did not systematically set up physical game courses, and physical teaching still mainly relied on traditional calisthenics activities, which to a certain extent reflected the school's insufficient attention to the development of children's gross motor

skills (Guerra et al., 2019). Although calisthenics activities are conducive to the development of coordination and balance, they are highly repetitive and tend to overlook equipment-based sports training. The test results showed that the children's scores in manipulative skills were lower than those in locomotor skills, indicating that the children were still inadequate in terms of proficiency in equipment operation and gross motor skill training (Gubbels et al., 2012). By putting more emphasis on building gross motor skills and having physical game activities regularly, kindergartens will help foster a love of sports in kids and promote the overall development of their gross motor skills, health, and emotional well-being (Bedard, 2024).

The teacher's role in developing children's physical development and building motor skills is critical (Allen et al., 2017). There was no full-time PE teacher at Aidi Kindergarten and therefore no systematic or professional guidance about physical activity at Aidi Kindergarten as it was all done by head teachers. This led to the children's low quality of movement completion in some manipulative skills, such as the overall low scores in items like "two-hand striking." The fact that the scores of manipulative skills were lower than those of locomotor skills also reflected the lack of targeted physical training in the teaching process. Teachers with professional capabilities can design targeted physical games to promote the development of children's basic motor skills such as running, jumping, throwing, and catching, and further support their social and emotional development (Ning et al., 2022). Therefore, introducing professional physical education teachers or strengthening on-the-job training to improve teachers' professional level is of great significance for promoting the development of children's gross motor skills.

Sports equipment and activity venue conditions are also important factors affecting the development of children's gross motor skills (Moliner& Ruiz, 2011). The existing equipment of

Aidi Kindergarten mainly includes slides, footballs, and basketballs, lacking targeted training equipment, which is not conducive to children's diverse sports experiences (Wen et al., 2023). By rationally planning activity spaces, dividing different functional areas, and introducing equipment such as agility ladders, mini hurdles, balance beams, and sandbags, the forms of physical activities can be enriched, and the development of children's gross motor skills can be promoted. The tennis balls used in the experiment also improved the children's gross motor skills to a certain extent, indicating that the configuration of diverse equipment has a positive effect on children's motor development (Kriemler et al., 2009).

In summary, school-level factors such as kindergarten physical education curriculum settings, teachers' professional support, and venue and equipment conditions have an important impact on the development of children's gross motor skills (Liao et al., 2014). Strengthening the construction of physical game courses, improving teachers' professional level, and optimizing the sports environment can provide a good guarantee for the continuous development of children's gross motor skills. Due to the adoption of a single-group pre-test-post-test experimental design without a control group, the research results still have certain limitations in causal inference, which need to be further verified in subsequent studies.

Conclusions

The research results showed that after 8 weeks of interesting physical game intervention, the gross motor skill level of 5–6-year-old children in Aidi Kindergarten was significantly improved, rising from the previously below-average level to the average level. Physical game intervention had an obvious promoting effect on both children's locomotor skills (such as forward slide and side shuffle) and manipulative skills (such as underhand throw and kicking

a stationary ball). The data before and after the experiment showed significant differences, verifying the positive effect of physical games in promoting the development of children's gross motor skills.

Based on the above results, physical games have high application value in kindergarten physical education teaching. By combining interesting physical games with regular physical education teaching, and supporting them with appropriate sports equipment and family support, a good practical environment can be provided for the development of children's gross motor skills, thereby further enhancing children's enthusiasm for participating in physical activities and their motor development level.

References

Allen, K. A., Bredero, B., Van Damme, T., & others. (2017). Test of Gross Motor Development–3 (TGMD-3) with the use of visual supports for children with autism spectrum disorder: Validity and reliability. *Journal of Autism and Developmental Disorders*, 47(3), 813–833.

<https://doi.org/10.1007/s10803-016-2993-4>

Bedard, C., Dowling, S. K., Timmons, B. W., & Ferro, M. A. (2024). A matched-pair analysis of gross motor skills of 3- to 5-year-old children with and without a chronic physical illness. *Pediatric Exercise Science*, 36, 1–6. <https://doi.org/10.1123/PES.2023-0069>

Dobell, A. P., Faghy, M. A., Pringle, A., & Roscoe, C. M. P. (2023). Improving fundamental movement skills during early childhood: An intervention mapping approach. *Children*, 10(6), 1004. <https://doi.org/10.3390/children10061004>

Gubbels, J. S., Van Kann, D. H., & Jansen, M. W. (2012). Play equipment, physical activity opportunities, and children's activity levels at childcare. *Journal of Environmental and Public Health*, 2012, 326-520.

Guerra, L. A., Dos Santos, L. R. A., Pereira, P. E., Lauria, V. T., De Lima, C., Evangelista, A. L., ... & Teixeira, C. V. L. S. (2019). A low-cost and time-efficient calisthenics strength training program improves fitness performance of children. *Journal of physical education and sport*, 19, 58-62.

Kriemler, S., Zahner, L., Meyer, U., & Puder, J. J. (2009). A school-based physical activity program increases fitness and decreases adiposity in primary school children (KISS): A cluster-randomized trial. *Swiss Medical Weekly*, 139(21–22), 4S–4S.

Liao, T., Zheng, W., & Li, D. (2014). Correlation study between core stability, functional movement, and physical fitness performance in adolescents. *Journal of Chengdu Sport University*, 40(5), 37–43.

Logan, S. W., Fowe, K. S., Myer, C., et al. (2011). The relationship between motor skill proficiency and body mass index in preschool children. *Research Quarterly for Exercise and Sport*, 82(3), 442–448.

Moliner, D., & Ruiz, J. (2011). Associations of muscular and cardiorespiratory fitness with total and central body fat in adolescents: The HELENA Study. *British Journal of Sports Medicine*, 45(10), 1–8.

Ning, K., Wang, T., Wan, B., et al. (2022). Mechanisms of influence of fundamental motor skills on physical activity in preschool children: Local interpretation of the mediating effect of perceived motor competence. *Sport and Science*, 43(4), 105–114.

Wasenius, N. S., Grattan, K. P., Harvey, A. L. J., et al. (2018). The effect of a physical activity intervention on preschoolers' fundamental motor skills—A cluster RCT. *Journal of Science and Medicine in Sport*, 21(7), 714-719.

Willoughby, M. T., & Hudson, K. (2023). Contributions of motor skill development and physical activity to the ontogeny of executive function skills in early childhood. *Developmental Review*, 70, 101108. <https://doi.org/10.1016/j.dr.2023.101108>

Fitness, Performance & Health Journal, Year, Vol., 1-4

Wen, X., & Cai, L. (2023). Analysis of influencing factors and models of international preschool physical fitness: Based on bibliometrics. *Journal of Capital University of Physical Education and Sports*, 35(2), 208–222.

Yu, B. (2015). The effect of Gentile's motor skill classification on learning motor skills for junior high school students: A case of two-handed chest pass. *Sports*, (2), 123–124.

Zou, R., Wang, K., Li, D., Liu, Y., Zhang, T., & Wei, X. (2024). Study on the relationship and related factors between physical fitness and health behavior of preschool children in southwest China. *BMC Public Health*, 24(1), 1759.