

The effect of physical activity for the development of motor skill in children aged 3-12 years old: a narrative review

Tjokorda Istri Agung Rosanthi Pradnyani^{1*}, Indah Pramita², Ni Wayan Tianing³

¹Bachelor of Physiotherapy and Physiotherapy Profession Study Program, Faculty of Medicine, Universitas Udayana, Indonesia;

²Physiotherapy Department, Faculty of Medicine, Universitas Udayana, Indonesia;

³Biochemistry Department, Faculty of Medicine, Universitas Udayana, Indonesia;

ABSTRACT

Background: Physical activity is vital in growth and development, maturation of motor and physiological functions, and cognitive abilities in the pediatric population. In children, sufficient physical activity is reported to help develop motor skills. This is because to have a good quality of movement, abilities obtained through habits in physical activity are needed. This study aimed to determine the effect of physical activity on the development of motor skills in children aged 3-12 years.

Methods: The type of research was a literature review based on the review process of research articles that discuss the effect of physical activity on the development of motor skills in children aged 3-12 years. The search for articles was done from the Google Scholar and PubMed databases.

Results: Based on the five selected journals in this literature review, significant positive results were obtained between physical activity and the development of motor skills in children aged 3-12 years old. The specifications of the motor skills that develop in children vary depending on the form, type, and settings of the physical activity.

Conclusion: Physical activity seemed to affect the development of children's motor skills. The development of motor skills in children occurs gradually, along with physical development and stimulation of activities that spur better skills.

Keywords: children, fine motor skills, gross motor skills, physical activity

Received: January 14, 2024. **Accepted:** March 12, 2024.

Type: Review article; Doi: 10.62004/kpc.v3i1.30

***Corresponding Author:** Tjokorda Istri Agung Rosanthi Pradnyani; Bachelor of Physiotherapy and Physiotherapy Profession Study Program, Faculty of Medicine, Universitas Udayana, Indonesia;
Email: tjokordarosa@gmail.com

Introduction

Physical activity is movement or action produced by skeletal muscles that requires energy expenditure (burning calories) through exercise, sports, or other active movements that require energy.^{1,2} Being physically active is the basis for early development in children, which has short-term and long-term health impacts.³ Populations that are not physically active have higher risk factors for diseases such as cardiovascular disease, metabolic disorders, cancer risk, obesity/overweight, musculoskeletal disorders, and premature mortality.⁴ Meanwhile, physically active populations have better physical or cardiorespiratory fitness, development of motor skills, bone tissue density, muscle and joint strength, and minimal emotional disorder symptoms.⁵⁻⁷

Physical activity also improves children's cognitive and non-cognitive abilities, such as behaviour and emotional

intelligence.⁸ Physical activity enhances memory by increasing neurotrophins such as brain-derived neurotrophic factor (BDNF).⁹ Physical activity also impacts chemical processes in individuals, such as the production of endorphins, serotonin, and other stress-relieving hormones in the brain.¹⁰ The use of the musculoskeletal system in physical activity has a vital role in growth and development, maturation of motor and physiological functions, and cognitive abilities in the pediatric population.^{11,12}

In childhood, sufficient physical activity is reported to help the development of motor skills. This is because good movement quality requires abilities obtained through habits of physical activity. The repetition of a movement or the movement pattern in creating a motor habit varies for each individual, depending on age, previous movement experience, motivation, concentration, procedures, and the

complexity of the movement to be learned. Therefore, honing motor skills is carried out continuously over the long term and is a process that takes many years.¹³

Motor skills are a series of movements combined to produce smooth, coordinated, efficient actions to master specific movement abilities. Motor skills are divided into two physical categories: gross motor skills (GMS) and fine motor skills (FMS). GMS is a person's ability to move the body and extremities by involving large muscles. GMS was then further categorized into locomotor, manipulative, and non-manipulative skills. Meanwhile, fine motor skills are a person's skills in creating smooth and precise movements by involving small muscles such as the muscles of the wrist and fingers.⁸

The development of motor skills occurs gradually according to age, and each stage has unique characteristics.^{14,15} Although it occurs slowly according to the child's age, physical and cognitive maturity are also factors that greatly impact the development of motor skills. If a child is mature enough and able to learn new motor skills but does not receive appropriate physical activity stimulation, his development will be hampered. Meanwhile, if the child is not yet mature enough or the stimulation of physical activity is not age-appropriate, then the process of learning motor skills may not be successful.¹⁶

Behavioural learning theory in the motor learning process involves understanding events in the surrounding environment. In this theory, a child's stimulus and response to situations in the surrounding environment exists. Meanwhile, according to Piaget, cognitive theory concerns structuring and adapting to the environment so that cognitive development can be viewed from typical experiences, which means that children have images in their memory.¹⁷ According to expert Singer (2018), three main factors must be considered in the motor learning process: the learning process, the child's process of processing stimulation so that automation occurs in carrying out movements, and the child's personality.¹⁸ This study aims to determine the effect of physical activity on the development of motor skills in children aged 3-12 years.

Methods

The type of research was a literature review based on the review process of research articles that discuss the influence of physical activity on children's motor skills. Article searches were carried out through Google Scholar and PubMed databases. The keywords used in the Google Scholar database searched for children's fine motor skills, gross motor skills, and physical activity. The inclusion criteria used include literature published in the last 10 years, the research sample was children aged 3-12 years old, and variables from the research include children's fine motor skills, gross motor skills, and physical activity. Meanwhile, the exclusion criteria used included abstracts and a thesis. The articles gathered were then examined and synthesized to address the research questions.

Results

Based on the search, five pieces of literature were found, with a range of publications from the last ten years that can describe the physical activity for developing motor skills in children aged 3-12 years old, written in Table 1. Roth et al. stated in the intervention group, a higher increase was found in the proportion of daily time spent on moderate-to-vigorous physical activity (MVPA) compared to the control group. Then, the intervention group affected a statistically significant increase in the composite motor skills score. Children in the intervention group showed better motor skills than the control group.¹⁴

Research conducted by Prasetya et al. started practising the traditional game "belahi tumbak" to improve gross motor skills in the 4 x 5-meter back-and-forth running agility test. The conventional "engkek-engkek" match has an impact on increasing gross motor skills, vertical jumps, and leg power; the game of rounders affects running speed.¹⁵ Annuar H. et al. stated the research results say that montage activities influence children's fine motor skills. Every aspect of fine motor skills assessed has improved.¹⁹ Zeng et al. stated of the ten studies that examined physical activity's effect on preschool children's motor skills, eight (80%) reported a significant impact of physical activity-based interventions toward improving motor skills (fundamental motor skills and motor abilities).³

In research conducted by Febriana, A. et al., the results were collected through observational study data in the form of a percentage of fine motor skills before the action of 25%. During the implementation of cycle II, it increased to 90%. McDonough et al. 2020 stated that of the 25 RCTs, 7 (28%) studies tested the effect of exergaming-based physical activity intervention on children's motor skills, and the remaining 18 (72%) studies tested the impact of traditional physical activity on children's motor skills. 20 (80%) reported statistical significance of improvement pre- and post-intervention. By specification, 5 (71%) of 7 studies that tested the effects of exergaming-based physical activity interventions observed significant intervention effects. Furthermore, 15 (83%) of the 18 studies examining the impact of traditional physical activity observed effective intervention results on children's motor skills development.²⁰

The research conducted by Dapp et al. stated that post-hoc analyses show no significant differences between physical activity groups at T1 (structured and unstructured physical activity measures). However, post-hoc comparisons for T2 (gross and fine motor skills measured at T1) showed that gross motor scores in structured and combined physical activity participants showed better motor skill proficiency compared to unstructured physical activity participants. The effects of structured physical activity are organized, planned, and guided. The effects of unstructured physical activity are non-formal, playful, and spontaneous.²¹

Table 1. Results of articles following the physical activity for the development of motor skills in children

Authors	Titles	Methods	Results
Roth et al. 2015	Effect of a Physical Activity Intervention in Preschool Children	Preschool age children ($\pm 4-6$ years) Method: cluster-randomized controlled trial Sample: 709 were randomized to the intervention group (368 children in 21 clusters); (341 children in 20 clusters). Measuring instrument: accelerometer	In the intervention group vs. the control group, a higher increase was found in the proportion of daily time spent. Then, the intervention group affected a statistically significant increase in the composite motor skills score. Children in the intervention group showed better motor skills than the control group.
Zeng, et al. 2017	Effect of Physical Activity on Motor Skill and Cognitive Development in Early Childhood: A Systematic Review	Preschool age children ($\pm 4-6$ years) Method: systematic review. Various RCT studies assess the effects of physical activity or exercise-based interventions. Number of literature reviewed: 15 studies Data were extracted independently by three reviewers (NZ, MA, and ZG).	Of the ten studies that examined physical activity's effect on preschool children's motor skills, eight (80%) reported a significant impact of physical activity-based interventions toward improving motor skills (fundamental motor skills and motor abilities).
Febriana, A., et al. 2018	Meningkatkan Motorik Halus Anak Melalui Kegiatan Menganyam pada Anak Kelompok B Usia 5-6 Tahun	Children aged 5-6 years Method: observational study Descriptive analysis There are two cycles in this research, namely, Cycle I and Cycle II. Each cycle consists of planning, implementation, observation, and reflection.	The results of this research were collected through observational study data in the form of a percentage of fine motor skills before the action of 25%. During the implementation of cycle II, it increased to 90%.
McDonough et al. 2020	Effect of Physical Activity on Children's Motor Skill Development: A Systematic Review of Randomized Controlled Trials	Children aged 6-12 years. Method: a systematic review Number of literature reviewed: 25 RCT studies.	Of the 25 RCTs, 7 (28%) studies tested the effect of exergaming-based physical activity intervention on children's motor skills, and the remaining 18 (72%) studies tested the impact of traditional physical activity on children's motor skills. 20 (80%) reported statistical significance of improvement pre- and post-intervention. By specification, 5 (71%) of 7 studies that tested the effects of exergaming-based physical activity interventions observed significant intervention effects. Furthermore, 15 (83%) of the 18 studies examining the impact of traditional physical activity observed effective intervention results on children's motor skills development.
Prasetya, et al. 2019	Pengaruh Permainan Tradisional terhadap Peningkatan Kemampuan Motorik Kasar pada Siswa Putra Sekolah Dasar Negeri 166/III Cut Mutia Kerinci	Elementary school children aged 9-10 years. Method: experimental study The population and sample are 12 fourth-grade students in elementary school. The intervention provided is playing the traditional games of engkek-engkek, belahi tumbak, and rounders.	Practising the traditional game belahi tumbak improves gross motor skills in the 4 x 5 meter back-and-forth running agility test. The conventional engkek-engkek match has an impact on increasing gross motor skills, vertical jumps, and leg power; the game of rounders affects running speed.

MVPA, moderate-to-vigorous physical activity; RCTs, randomized control trial

Table 1. -Continued

Authors	Titles	Methods	Results
Annuar, H., et al.2021	Pengaruh Kegiatan Montase terhadap Kemampuan Motorik Halus Anak	Children aged 5-6 years Method: quasi-experimental with a one-group pretest-posttest design model. Fine motor aspects observed: 1) strength of the fingers; 2) sticking speed; 3) accuracy of sticking.	The research results say that montage activities influence children's fine motor skills. Every aspect of fine motor skills assessed has improved.
C. Dapp, et al. 2021	Physical Activity and Motor Skill in Children: A Differential Approach	Kindergarten-age children (6.42 years) and second grade (7.78 years). Data was obtained through a longitudinal study investigating children's physical activity and motor development.	Post-hoc analyses show no significant differences between physical activity groups at T1 (structured and unstructured physical activity measures). However, post-hoc comparisons for T2 (gross and fine motor skills measured at T1) showed that gross motor scores in structured and combined physical activity participants showed better motor skill proficiency compared to unstructured physical activity participants. The effects of structured physical activity are organized, planned, and guided. The effects of unstructured physical activity are non-formal, playful, and spontaneous.

MVPA, moderate-to-vigorous physical activity; RCTs, randomized control trial

Discussion

The habitual level of physical activity of the right type and intensity is stated to contribute to the development of the tissues that make up the musculoskeletal system, improved cardiovascular health, and also neuromuscular awareness, such as coordination and control of movement.²¹ This gradual and complex development can also improve children's motor skills. Continuous multidimensional physical activity with MVPA intensity, according to the recommendations of the Physical Activity Guideline for Americans, namely 60 minutes per day, positively affected children's motor development after the intervention.²⁰

The results of this research align with a field experimental study conducted by Prasetia, 2019 which tested that physical activity in the form of traditional games could influence the increase in gross motor skills in children. However, this study also found that the motor skills that develop differ depending on the type of game. For example, the game of rounders improves locomotor motor skills, namely running, "belahi tumpak" affects increasing agility, and running back and forth, and "engkek-engkek" impacts the explosive power of Vertical jump of the legs.²² These results are also supported by a journal systematic review and network meta-analysis by Hassan et al., 2022 that aerobic physical activity is the most effective program in improving overall object control and gross motor skills coupled with modifications to the time, content, and goals of the intervention in helping children develop motor skills. In addition, exergaming programs are considered the most effective physical activity in improving locomotor skills.¹⁹

Children who get the appropriate dose, frequency, intensity, and type of physical activity will get more stimulus to master specific motor skills better. Related to these results, further research is needed regarding the dose of physical activity that influences the development of children's motor skills. The success of physical activity interventions to improve children's motor skills is influenced by the dose and the basis or location where the treatment is given. Physical activity at home or child care shows different results than school activities. School-based physical activity interventions are a strong predictor because children spend more time at school, have a structured schedule, and are well documented by the school, so they have a positive relationship to higher levels of daily physical activity at MVPA.³

Longitudinal research by Dapp et al. in 2021 examined, more specifically, the setting of physical activity (structured and unstructured) and the type of motor skills (gross and fine). Children involved in structured and combined (structured and unstructured) physical activity showed much better gross motor skills than children in the amorphous physical activity group. In addition, a significantly progressive increase in gross motor skills was only found in children involved in structured physical activity. These results are all the more striking because the reported duration of unstructured physical activity was twice as high as that of

structured physical activity. A similar thing also appears in fine motor output. Each category did not strongly produce positive results related to fine motor skills except for the structured physical activity group, although not significantly. A possible explanation for this result is that the movements were less directly trained or less planned during the delivery of physical activity.²¹

Wijianto, 2022 also explained that fine motor skills must be stimulated with thorough preparation and knowing the child's basic motor skill level to create an appropriate motor development program. Fine motor development can not only be trained with fine movements such as writing. Still, it can also be supported by providing guidance and explanations about skills, explicitly presenting skill phases, focusing children's attention, providing direction and opportunities for practice, and motivating children to be actively involved. In the development activities carried out.¹⁷

Physical activities involving the activation of small muscles, such as wrists and fingers, were studied by Febriana, A. et al. in 2018 and Annuar, H. et al. in 2021. Febriana's research observed increased fine motor skills in children aged 5-6 years with weaving activities.²⁰ Weaving is an activity that involves the small muscles in the hands by creating woven patterns that intertwine alternately to produce a work. This research found that weaving improved fine motor skills before the action, cycle I, and cycle II. These results align with research from Az-Zahra, P. et al. in 2022, who found that weaving activities are needed as a fun stimulus for children to train their fine motor skills.²²

The effect of physical activity in the form of montage activities to stimulate fine motor skills was also studied by Annuar H. et al. in 2021, where in their experimental research, a significant effect was obtained before and after treatment. It was presented in more detail on each aspect, namely the finger strength aspect, which showed an increase from 14.28% to 28.57% of children categorized as developing according to expectations. Regarding the accuracy of sticking, there was an increase from no children being in the category of developing as expected to 11 children (52.38%) developing as expected. Then, there was an increase in finger strength from 10 children (47.62%) in the underdeveloped category to no children in the underdeveloped category. The appropriate discussion for this is because montage activities involve specific movements and require precision and attention from children to complete the task so that, over time, they can master fine motor skills.¹⁹

Based on several studies above, physical activity is stated to have a significant favourable influence on the development of children's motor skills. Even though the impact of physical activity on children was found to be more stimulative in gross motor skills compared to fine motor skills, this can happen because gross and fine motor skills should be stimulated with different types of activities so that the potential changes will also be various. Generally, gross motor skills display broader and more energetic movements than

fine motor skills, requiring greater control and precision. The limitations of this study were not explained regarding the dosage and regulation of physical activity. Future studies must also be conducted to understand its effect in more detail.

Conclusion

Motor development in children is greatly influenced by the stimulation obtained through physical activity. However, some state that not all forms, types, and settings of physical activity have the same effectiveness in developing motor skills. Children with low physical activity tend to experience delays in developing motor skills and movement quality. So, stimulation is needed through physical activity carried out gradually and repeatedly to contribute to the child's growth and development.

Ethical consideration

The researchers carried out a literature review on the subject. The study did not require ethical approval because it only reviewed existing data and did not include human beings or acquire new data.

Funding

This study received no grants from any institution.

Conflict of interest

This study has no conflicts of interest.

Author contributions

TIARP creates study designs, collects data, processes the data, and writes publications. IP and NWT are responsible for data gathering and manuscript revision.

References

1. Siscovick DS, Laporte RE, Newman J. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research synopsis. *Public Health Rep.* 1985; 100(2): 195–202.
2. Putra IPYP, Widnyana M, Kamayoga IDGA, Saraswati NLPKG, Eka AAG. The relationship between physical activity and increased learning concentration among Senior High School 3 Denpasar students. *Physical Therapy Journal of Indonesia.* 2021; 2(2): 41–5.
3. Zeng N, Ayyub M, Sun H, Wen X, Xiang P, Gao Z. Effects of physical activity on motor skills and cognitive development in early childhood: A Systematic Review. Wang HX, editor. *Biomed Res In.* 2017; 2017: 1–13.
4. Park JH, Moon JH, Kim HJ, Kong MH, Oh YH. Sedentary Lifestyle: Overview of updated evidence of potential health risks. *Korean J Fam Med.* 2020; 41(6): 365–73.
5. Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, et al. The physical activity guidelines for Americans. *JAMA - Journal of the American Medical Association.* 2018; 320(19): 2020–8.
6. Kohl HW. *Educating the Student Body: Taking Physical Activity and Physical Education to School.* Eds. 2013.
7. Rahayu NI, Monica AD, Jajat J, Sul-toni K. Hubungan physical activity dengan fine motor skills pada anak usia 4 tahun. *Jurnal Keolahragaan.* 2021; 9(1): 118–27.
8. Felfe C, Lechner M, Steinmayr A. Sports and child development. *PLoS One.* 2016; 11(5): 1–23.
9. Permatadewi PB, Nugraha MHS, Saraswati NLPKG, Putra IPYP. Association between nutritional status and physical activity level towards short-term memory ability in elementary school students. *Physical Therapy Journal of Indonesia.* 2023; 4(1): 95–101.

10. Malm C, Jakobsson J, Isaksson A. Physical activity and sports—real health benefits: A review with insight into the public health of Sweden. *Sports.* 2019; 7: 1–28.
11. Bukvić Z, Cirovic D, Nikolić D. The importance of physical activity for developing motor skills in younger school-age children. *Medicinski podmladak.* 2021; 72: 34–9.
12. Sriwahyuniati F. *Belajar motorik. Pertama.* UNY Press; 2017. 1–113.
13. Rohisfi E, Neviyarni N. Analisis belajar keterampilan motorik. *Edukatif: Jurnal Ilmu Pendidikan.* 2021; 3(1): 27–34.
14. Roth K, Kriemler S, Lehmachner W, Ruf Kc, Graf C, Hebestreit H. Effects of a physical activity intervention in preschool children. *Med Sci Sports Exerc.* 2015; 47(12): 2542–51.
15. Prasetya SA. Kemampuan motorik kasar pada siswa putra Sekolah Dasar Negeri 166/III Cut Mutia Kerinci. *Jurnal Stamina.* 2019; 2(6): 65–78.
16. Hassan MA, Liu W, McDonough DJ, Su X, Gao Z. Comparative effectiveness of physical activity intervention programs on motor skills in children and adolescents: A Systematic Review and Network Meta-Analysis. *Int J Environ Res Public Health.* 2022; 19(19): 1–12.
17. Wijianto W, Saktiyarini K. Relationship of in 3-4 Years Old Children. *Gaster Jurnal Kesehatan.* 2022; 20(2): 207–15.
18. McDonough DJ, Liu W, Gao Z. Effects of physical activity on children's motor skill development: A Systematic Review of Randomized Controlled Trials. Ekwunife OI, editor. *Biomed Res Int.* 2020; 2020: 1–14.
19. Annuar H, Nirmala B, Samarto N. Pengaruh kegiatan montase terhadap kemampuan motorik halus anak. *Jurnal Kreatif Online (JKO).* 2021; 9(3): 23–31.
20. Febriana A, Kusumaningtyas LE. Meningkatkan motorik halus anak melalui kegiatan menganyam pada anak kelompok B usia 5-6 tahun. *Jurnal Audi.* 2018; 2(2): 70–5.
21. Dapp LC, Gashaj V, Roebbers CM. Physical activity and motor skills in children: A differentiated approach. *Psychol Sport Exerc.* 2021; 54: 1–8.
22. Az-Zahra P, Fauzi T, Andriani D. Pengaruh kegiatan menganyam terhadap kemampuan motorik halus. *PAUD Lectura: Journal of Early Childhood Education.* 2022; 5(3): 1–11.



This work is licensed under a Creative Commons Attribution 4.0 International License.