The Relationship Between Physical Activity Levels and Motor Skill Development in Preschool Children: A Systematic Review

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Abstract

Physical activity (PA) is recognized as fundamental for the holistic development of preschool-age children, influencing not only physical health but also cognitive and socio-emotional domains. This article presents a comprehensive synthesis of recent literature exploring the intricate relationship between PA levels and motor skills development in preschool children. Drawing upon a systematic review methodology, this analysis collates findings from 12 selected articles published from 2010 onwards, encompassing both empirical studies and literature reviews.

The reviewed literature underscores the significance of PA in shaping motor skill acquisition during the formative preschool years (typically 3 to 6 years old). Across various study designs, a consistent pattern emerges, linking higher levels of PA with enhanced motor skill proficiency. Specifically, activities of moderate to vigorous intensity demonstrate the most pronounced positive impact on motor skills development, emphasizing the importance of engaging children in energetic play and movement-rich environments.

However, despite the recognized benefits, discrepancies persist between recommended PA guidelines and actual engagement levels among preschoolers. Studies consistently report suboptimal PA levels in this demographic, raising concerns about the adequacy of current interventions and the need for targeted strategies to promote active lifestyles from an early age.

Gender disparities in PA participation and motor skill development further complicate the landscape. While boys generally exhibit higher levels of PA and motor skill proficiency compared to girls, nuanced factors underlying these differences warrant exploration. Environmental and parental influences emerge as significant determinants of PA engagement, highlighting the need for multifaceted interventions that address socio-economic, cultural, and familial contexts.

Moreover, the impact of PA on motor skills extends beyond immediate developmental outcomes, with implications for long-term health and well-being. Low levels of motor skill proficiency during the preschool years have been linked to persisting difficulties in adolescence and adulthood, emphasizing the critical window of opportunity for intervention.

In conclusion, this synthesis underscores the pivotal role of PA in fostering motor skills and lays the groundwork for future research and intervention efforts aimed at optimizing developmental outcomes in preschool-age children. By addressing existing gaps in knowledge and practice, stakeholders can collectively work towards creating supportive environments that prioritize PA promotion and motor skill development, laying a robust foundation for lifelong health and flourishing.

Keywords: Physical activity, Preschool children, Motor skills, Gender differences, Early intervention.

1. Introduction

According to the World Health Organization (WHO, 2020), physical activity is defined as any bodily movement performed by skeletal muscles that results in energy expenditure. Physical activity encompasses any movement performed during leisure time or the route taken to commute to work. According to (Chaput et al., 2014), physical inactivity as well as sedentary behaviors are a significant concern for public health and are closely linked to serious health consequences. Guidelines for the amount and intensity of physical activity that should be performed by different age groups for maximum health benefits vary. Recommendations regarding the quantity and intensity of physical activity (PA) appropriate for preschool-age groups, in addition to the time and type of physical activity, also include time for sedentary behaviors as well as sleep time. A combination of these three parameters constitutes behaviors over 24 hours for preschool children.

The World Health Organization recommends that children under the age of 5 should accumulate at least 180 minutes of total physical activity, including 60 minutes of moderate to vigorous physical activity daily. (WHO, 2020). Similarly, according to this recommendation, the time spent sitting or in front of screens should not exceed 60 minutes, and the recommended amount of quality sleep time is 10-13 hours. According to authors (Ciliff et al., 2017) in the new Australian recommendations for Movement in preschool age groups, a healthy 24 hours should include ≥ 180 minutes per day of physical activity, including 60 minutes of energetic play, ≤ 1 hour of sedentary screen time, as well as 10-13 hours of quality sleep. Similarly, guidelines from the Canadian Society of Exercise Physiology (CSEP) regarding sedentary behavior, as quoted by authors (Tremblay et al., 2012), emphasize that for healthy growth and development, caregivers should minimize passive time during waking hours, which includes sitting for more than one hour continuously for (infants <1 year), (children 1-2 years), and preschoolers (3-4 years). Screen time for children under two years is not recommended, while for children 2-4 years it should be limited to less than one hour per day, the less the better.

The amount of physical activity that preschool-age children should accumulate according to (Tremblay et al., 2012) is recommended to be 180 minutes of PA of any intensity throughout the day, aiming for 60 minutes of movement/energetic play around the age of 5 years old. According to (Tremblay et al., 2017) in formulating new recommendations from the Canadian Society of Exercise Physiology, optimal health is framed by balancing approaches to movement throughout the day, hence the creation of Canadian Guidelines for Movement during 24 hours for early age (0-4 years), where the allocation of physical activity, sedentary behavior, and sleep intersect.

Motor skills are considered the foundation of motor development, upon which complex motor responses are built, according to (Gallahue et al., 2011) as cited by authors (Marín & López, 2020). Preschool years are marked by significant changes in the acquisition and execution of locomotor and object manipulation skills by children, according to (Williams et al., 2008). However, the level of proficiency exhibited by this age group is weak, as confirmed in the findings by (Marín & López, 2020). Motor skills, in the context of early childhood development, encompass the variety of physical skills and capacities that young children acquire and improve during their formative years. These skills include both major and fine motor skills. Major motor skills involve the coordination and control of large muscle groups, enabling children to perform activities such as running, jumping, climbing, and maintaining balance. Meanwhile, fine motor skills involve the coordination and control of small muscle groups, particularly in the hands and fingers, enabling tasks such as object manipulation, drawing, writing, and handling small objects that facilitate the refinement of hand-eye coordination as well as manipulative abilities, essential for independently carrying out daily tasks or personal care. The development of motor skills in early childhood is crucial for the physical, cognitive, and socio-emotional development of children, laying the foundation for their future growth and well-being.

A good level of motor development in the preschool period, according to (Marín & López, 2020), positively influences a range of skills such as perceptual, cognitive, psychological, affective, social, and also affects the academic achievements of children. Motor skills have a considerable impact on the social development of preschool-age children. Participation in physical activities that require the use of motor skills encourages interaction and cooperation with their peers, fostering the development of social skills such as cooperation, communication, and group work. Through games and group activities, children learn to negotiate, share, and take turns, developing fundamental social skills that form the basis for positive relationships and effective communication. Moreover, mastering motor skills gives children a sense of self-confidence and competence, encouraging them to explore their physical abilities and actively engage in social interactions and group dynamics. According to (Figueroa & An, 2016), their study sheds light on the relationship between motor skill competence and physical activity in preschool-age groups. According to them, there is a connection between motor skills and physical activity, the pattern and trend of which depend on gender, intensity of physical activity, type of motor skills, as well as the timing of physical activity (during the week or weekends). Physical activity performed at different intensities, according to (Haugland et al., 2023), is positively associated with the development of basic motor skills as well as physical fitness (Haugland et al., 2023; Utesch et al., 2019), and promoting physical activity, especially moderate and vigorous intensity activities from an early age, has a positive impact on children's physical development.

It has also been observed that children with weaker motor skills often exhibit lower levels of physical activity, play less in playgrounds, and spend less time interacting with their peers. Basic motor skills (such as throwing, catching, jumping, running, etc.) are crucial for acquiring more complex skills later in life, such as in sports, recreational activities, etc., and therefore, improving basic motor skills during the preschool years may lead to greater participation in physical activities (Figueroa & An, 2016) as mastery of motor skills, both in acquisition and execution, facilitates participation in physical activities (Williams et al., 2018).

Weak motor skills manifested during the preschool period continue to be evident later in life. According to the longitudinal study by (Haugen and Johansen, 2018) as cited in (O'Neill et al., 2014), in their 10-year study, studying children from ages 5-6 to 15-16, researchers showed that weak motor skills do not recover and these children continue to exhibit the same difficulties and deficiencies compared to their peers.

2. Methodology

The methodology used for conducting this literature review included a systematic and comprehensive approach to identifying, selecting, and analyzing important articles addressing the impact of levels of physical activity on the motor skills of preschool children. Specific criteria for inclusion and exclusion of articles considered were established for this review. Inclusion criteria were set regarding the age of participants. Studies focusing on preschool-age children (generally 3 to 6 years old) were included in the review, as well as studies published from 2010 onwards. Selected articles were required to directly investigate the relationship between physical activity levels and motor skills in preschool children, either through experimental studies, observational research, or systematic reviews and meta-analyses. Articles published in English and available in full text were considered for inclusion. Exclusion criteria included studies focusing on older children or adults, studies focusing exclusively on children with developmental disorders or disabilities, and studies published in languages other than English. Additionally, articles focusing on interventions or therapies for improving motor skills without a direct emphasis on physical activity were excluded.

The initial search was conducted using electronic databases, including PubMed, PsycINFO, Scopus, and Google Scholar, using relevant keywords and search terms such as "physical activity," "motor skills," "preschool children," "young children," "exercise," and "movement." Additional articles were identified through manual searches of the reference lists of selected articles and relevant systematic reviews and meta-analyses. The search process was conducted iteratively until saturation was reached, meaning that no new relevant articles were found. The identified articles were then screened based on the established inclusion and exclusion criteria, and duplicates were removed. Following the initial screening, the full texts of selected articles were assessed for eligibility and relevance. Finally, data extraction and synthesis were performed to summarize the key findings of the selected articles and draw conclusions regarding the impact of physical activity levels on motor skills in preschool children.

3. Results

After careful review of the articles accepted for analyzing physical activity and its impact on motor skills, only 12 of the articles met the criteria for this analysis (Table 1). The articles were reviewed taking into consideration the authors, the type of study, the tests used, the study results, as well as limitations or recommendations. The reviewed articles ranged from 2012 the earliest to 2021 the latest. From the synthesis of these articles, it emerged that 9 of them were concrete studies (mixed-method studies, observational studies, or longitudinal studies), while the other 3

were literature reviews. The literature reviews were systematic reviews and had different approaches to reviewing articles, such as the PRISMA approach (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), the GRADE approach (Grading of Recommendations Assessment, Development, and Evaluation). The literature review articles included in this literature review report similar results regarding the impact of physical activity on the motor skills of preschool children. Specifically, (Coelho & Tolocka, 2020) reports low levels of physical activity in preschool ages and discrepancies between recommendations regarding the amount of physical activity this age group should engage in. According to (Figueroa & An, 2016), in 11 analyzed studies, the amount of physical activity and the level of motor skills depend on the intensity of the physical activity in which children engage, the day on which physical activity takes place, as well as the content of the physical activity, and further, they recommend more in-depth studies on the relationship between physical activity and motor skills. The association between physical activity and motor skills is also confirmed by the results of (Martínez-Bello & Estevan, 2021) in their systematic review, and this association is more precisely determined by longitudinal analyses. The influence of the type of physical activity on children's motor skills is significant according to (Livonen et al., 2013), where activities with moderate and vigorous intensity have the most positive impact, while the amount of physical activity is decisive in the level of motor skills according to (Martins et al., 2020), who report that only 2% of the sample included in the study met the recommendations for the amount of physical activity during 24 hours, and that based on the performance in the test (TGMD-2), ball manipulation skills were determinative in the amount of physical activity of children. The level of motor skill development is not only dependent on the intensity of physical activity but also, according to the authors (Lemos et al., 2012), the development of major motor skills of children is also influenced by who directs children's physical activity, as the results of their study showed that children's motor skills improved significantly as a result of physical activity directed by a specialist compared to recreational activities directed by regular teachers, while according to (Sutapa et al., 2021), when aiming to improve basic motor skills, organized activities are more effective as they encourage children to exercise certain muscle groups. By enhancing children's motor skills, their engagement in physical activity increases. Low levels of motor skills were also found in their study by (Lemos et al., 2012; Bürgi et al., 2011, and Olesen et al., 2014).

These findings are consistent with the results of (Marín & López, 2020), where in a sample of 80 children, the motor skills of children resulted in low levels for both genders, where the main cause reported was the low amount of physical activity that children engage in during the week in kindergarten, and where the development of the physical activity session by specialists is recommended for a better impact on children's motor skills. Low levels of physical activity during the week were also found in their study by (Olesen et al., 2014 and Foweather et al., 2015). According to (Foweather et al., 2015), motor skill acquisition is essential in promoting an active life throughout life, while (Olesen et al., 2014) emphasize that it is important to study further factors that influence low levels of physical activity in kindergartens.

In a cross-sectional study by (Barros et al., 2012), parents reported low levels of physical activity in preschool children through questionnaires, and the factors were both environmental and parental related to the socio-economic status of the parents. Public awareness of the importance of physical activity in this age group is important.

In contrast to (Marín & López, 2020) where both boys and girls engage in low levels of physical activity, in the studies of (Viegas et al., 2021; Foweather et al., 2015), it was found that girls are more passive than boys and are likely to exhibit weaker motor skills than boys. And according to (Foweather et al., 2015), the level of motor skills determines both the type and the amount of physical activity.

Table 1. Review of Literature on Physical Activity and Its Impact on Motor Skills

Reference	Study Type	Tests Used and Sample	Results	Limitations and Recommendations
(Marín & López 2020)	Study	TGMD-2 / 80 participants	Low performance level in motor skills with no difference between genders. Differences in motor skills such as object manipulation and locomotor skills.	Low amount of physical activity in kindergarten during the week. Physical activity should be guided by specialists.
Livonen et al. 2013	Study	Measurement of physical activity and motor skills for 5 days	Motor skills are significantly influenced by moderate to vigorous physical activity.	Future studies should focus on larger samples.
Coelho & Tolocka 2020	Systematic review PRISMA approach	Varies from 63-631	Decline in physical activity levels in preschool ages.	Inconsistency between recommendations. Increasing physical activity levels is an urgent issue.
Barros et al. 2012	Cross-sectional study	Parent interview / 265 participants	Low levels of physical activity in preschool age. Environmental and parental factors.	Lack of a questionnaire or objective measurements. Public awareness on the importance of physical activity in this age group is needed.
Figueroa & An 2016	Literature review PRISMA approach	11 studies analyzed	Physical activity and motor skills depending on the intensity, type of motor skill, and the day the physical activity is	In-depth studies focusing on the dependency between physical activity and motor skills are needed.
Martínez-Bello & Estevan 2021	Systematic review	Not reported	The dependency between physical activity and motor skills exists from preschool age.	Longitudinal analyses of the relationship between physical activity and motor skills.
Olesen et al. 2014	Cross-sectional study	MABC-2 and Körperkoordination Test für Kinder (KTK) / 607 children / 43 kindergartens. Parent questionnaire.	Poor motor coordination performance. Low levels of physical activity during weekdays. Variations between kindergartens.	Further studies to investigate deeper the factors within kindergartens that influence these behaviors.
Lemos et al. 2012	Study	TGMD-2 / 50 participants	Slow motor development for both groups before intervention.	Children guided by a specialist showed better development in motor skills at the end of the intervention.
Martins et al. 2020	Study	Physical activity (Actigraph WGT3-X), Parent questionnaire, TGMD-2	2% meet the physical activity recommendations over 24 hours. Ball manipulation skills determine the amount of physical activity in	Strengthening children's motor skills increases their engagement in physical activity.
Viegas et al. 2021	Cross-sectional study	166 participants. Common physical activity, cognitive skills (CS) were assessed.	Girls with low levels of physical activity and cognitive skills are more likely to show low motor skills.	Physical activity, cognitive skills, and the child's gender may predict motor skills development in children.
Foweather et al. 2015	Cross-sectional observational study	99 children. Study protocol: motor skills and physical activity assessed with accelerometer.	Boys are more active than girls. Weekdays are more passive. Motor skills influence the type and amount of physical activity.	Acquisition of motor skills is important for promoting an active life throughout the week.
Bürgi et al. 2011	Cross-sectional longitudinal analysis	217 children. Physical activity (assessed with accelerometer)	Physical activity is a determinant of changes in children's motor skill levels in both measurements.	Physical activity improves children's motor skills.

1. Recommendations for Scoring, Analysis, Development, and Evaluation
2. Preferred Reporting Items for Systematic Reviews and Meta-Analyses

4. Conclusions

This review emphsizes the clear connection between physical activity and the development of motor skills in preschool-aged children. The findings demonstrate that engaging in moderate to vigorous physical activity is a key driver in improving motor abilities such as balance, coordination, and object manipulation. Importantly, these motor skills are foundational not just for physical development, but also for cognitive and social growth during early childhood.

Despite the well-established benefits of physical activity, many preschoolers do not engage in the recommended levels of physical activity, which can hinder their motor skill development. Factors such as insufficient structured physical activity in educational settings and socio-economic influences, particularly parental involvement, are significant determinants of how active children are.

Gender differences were also observed, with boys generally exhibiting higher activity levels and better motor skill outcomes compared to girls. This disparity suggests the need for interventions that cater specifically to the different needs and behaviors of boys and girls to ensure balanced motor development for all children.

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