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ACTIVE PLAY INTERVENTIONS ON MOTOR SKILLS OF PRESCHOOLERS: A SYSTEMATIC REVIEW

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Abstract: Active play can contribute to the reduction of sedentary time and generate potential benefits for the performance of fundamental motor skills in children. Thus, the aim of this systematic review was to provide a synthesis of evidence on the contributions of active play to fundamental motor skills in children aged 2 to 5 years typically developed, as well as to verify the differences between the intervention protocols used in the studies. The studies were identified by searching the PubMed, Web of Science and Lilacs databases. Clinical trials available in English, conducted in typically developing children, were included, and studies with the theme of electronic games were excluded. Two independent researchers examined the studies and conducted data extraction. Eight articles were included in the systematic review; three identified that children who experienced interventions with free active play had better performance in handling and balance skills. Four studies identified that children who practiced guided active play had better performance in locomotion, manipulation and balance skills, one study found no significant difference. We concluded that the practice of active play, especially guided active play, positively contributes to the fundamental motor skills of children aged 3 to 5 years typically developed.

Key words: Children; Fundamental Motor Skill; Preschool; Motor Performance; Active Play

Afiliação

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INTERVENÇÕES COM BRINCAR ATIVO NAS HABILIDADES MOTORAS DE PRÉ-ESCOLARES: UMA REVISÃO SISTEMÁTICA

Resumo: Brincadeiras ativas podem contribuir para redução do tempo sedentário e gerar potenciais benefícios para o desempenho das habilidades motoras fundamentais em crianças. Assim, o objetivo desta revisão sistemática foi fornecer uma síntese das evidências sobre as contribuições do brincar ativo para a habilidades motoras fundamentais em crianças de 2 a 5 anos tipicamente desenvolvidas, bem como verificar as diferenças entre os protocolos de intervenção utilizados nos estudos. Os estudos foram identificados por meio de busca nas bases de dados PubMed, Web of Science e Lilacs. Foram incluídos os ensaios clínicos disponíveis em inglês, realizados em crianças com desenvolvimento típico, e excluídos os estudos com a temática de jogos eletrônicos. Dois pesquisadores independentes examinaram os estudos e conduziram a extração de dados. Oito artigos foram incluídos na revisão sistemática; três identificaram que as crianças que vivenciaram intervenções com brincadeira ativa livre tiveram melhor desempenho nas habilidades de manuseio e equilíbrio. Quatro estudos identificaram que crianças que praticavam brincadeiras ativas orientadas tinham melhor desempenho nas habilidades de locomoção, manipulação e equilíbrio, um estudo não encontrou diferença significativa. Concluímos que a prática da brincadeira ativa, especialmente a orientada, contribui positivamente para o desempenho das habilidades motoras fundamentais de crianças de 3 a 5 anos tipicamente desenvolvidas.

Palavras-chave: Crianças; Habilidade Motora Fundamental; Pré-escola; Desempenho Motor; Brincar ativo

Introduction

Childhood is a phase marked by important body acquisitions and the expansion of physical, cognitive, affective and social skills [1]. The first years of life, from birth to 5 years of age, correspond to the period of increasing brain plasticity and adaptation to environmental stimuli, being considered critical for motor and cognitive development [1–4]. Different sensory and motor stimuli undergone during this period promote varied adaptive responses to different experiences that will be the basis for learning the motor skills that will compose the child's motor repertoire [5].

The fundamental movement phase includes children from 2 to 5 years old. In this phase children begin to develop movement control and Fundamental Motor Skill (FMS) in response to the stimuli provided by the environment and the tasks experienced. FMS forms the basis for the development of specialized motor skills, these skills are improved and combined to perform more complex movements of every day or sports activities [6,7]. FMS included basic skills such as locomotion movement (e.g. running, jumping, rolling), manipulative or object control (e.g. throwing, kicking, catching) and body control or balance (e.g. balancing on one foot, rolling) skills [8].

Play is an important part of childhood. However, children are increasing the time they spend involved in sedentary behavior [9,10]. Active play, understood as playful activities that involve motor skills [11,12] and that demand an increase in energy expenditure above the resting level [11], can contribute to the reduction of sedentary time. Greater involvement in active play is important for children's motor and cognitive performance [13], an essential tool for children's integral development.

Active play can be able to generate potential benefits for children´s FMS [14]. In a study, children aged 5-6 years present an increase in locomotor performance, object control and gross motor performance when compared to the control group after eight weeks of active play intervention [14]. The practitioners of the guided active play group performed better when compared to the group that performed free active play and the control group [14]. Thus, it seems that the different intervention protocols with active play can influence the FMH in a different way.

Active play can contribute to the improvement of FMS performance and to the composition of the child's motor repertoire [14,15]. Given the diversity of actions that active play offers, there is also a diversity among the interventions described in the literature. Therefore, the objective of this systematic review is to provide a synthesis of evidence on the contributions

of active play to FMS performance in children aged 2 to 5 years typically developed, as well as to verify the differences between the intervention protocols used in the studies.

Methods

This systematic review followed the procedures indicated by the Preferred Report for Systematic Analysis and Meta-Analysis (PRISMA) [16]. The protocol for this systematic review has been described and registered in advance with PROSPERO (International Prospective Register of Systematic Reviews) (Registration Number: CRD42019120282).

Search strategy

The studies were identified by searching the PubMed, Web of Science and Lilacs databases; the searches were completed in September 2020. The following descriptors were searched for the three databases: "*Play"*; "*Child"*; "*Motor Skill*s" and "*Preschool"*, according to Medical Subject Headings (MeSH) and *Descritores em Ciência da Saúde* (DeCS), where the terms have the same description on both platforms. The descriptors were searched in the title, abstract, index term or topic fields. Using the boolean operator "*AND*", the crossings were performed: "*Play* AND *Child*"; "*Play* AND *Motor Skills*" and "*Play* AND *Preschool*". To refine the search, we used filters available in the databases: Pubmed: Clinical trial, Free full text and English; Web of Science: Open Access, English and Article; for Lilacs: '*Texto completo disponíve*l', '*Ensaio clínico controlado*' and '*Inglês*'.

Selection Strategy

In the first stage of the systematic review, two examiners (F.L.S. and D.S.C.) independently searched the articles in the PubMed, Web of Science and Lilacs databases, applied the filters and analyzed the titles and abstracts of the articles. Duplicates were identified and removed from the articles retrieved through the searches. In the next step, the same examiners evaluated all full-text articles according to the eligibility criteria. All disagreements were discussed between the two examiners and in case of no agreement, a third examiner (I.L.P.) was consulted.

Eligibility criteria

According to the eligibility criteria, the following were included: clinical trials in English, performed with typically developing girls and boys aged 2 to 5 years, who performed

intervention with active play. There was no year of publication limitation for the inclusion of studies. Studies that did not meet the criteria for population eligibility, intervention, type of study and outcome were excluded (Table 1).

Table 1 - Eligibility criteria adopted for this study.

	Inclusion criteria	**Exclusion criteria**
Population	Children from 2 to 5 years of age of both sexes, typically developed	Children under the age of 2 and over 5 years old or with atypical development
intervention	Active play, regardless of type	Electronic games
Outcomes	Primary outcomes: Fundamental Motor Skill (locomotion, balance or manipulation skills) Secondary outcomes: intervention protocols	None
Publication parameters	Clinical trials published in English, regardless of year of publication	Other types of studies not published in English

Data extraction and study risk assessment of bias

After the initial screening, the eligible articles were downloaded and the study identification data (authors and year of publication) extracted, objective, study method (motor skills test used in the study, description of active play, duration and frequency of interventions), participant characteristics (age and number of participants) and outcomes. The examiners completed a standardized data extraction worksheet independently.

Primary outcomes of research included the effects of active play on FMS performance, and the secondary outcomes included differences between the active play intervention protocols used in the studies.

The risk assessment of bias in the studies was independently performed by two reviewers using the Modified Health Care Research and Quality Agency (AHRQ) instrument [17], reported in table 2. It was observed that the studies did not describe in detail how their interventions with active play occurred. The studies were evaluated using a list of items divided into nine evaluation criteria: study question, study population, randomization, intervention, outcome measures, statistical analysis, results, discussion and financing or sponsorship [17].

The level of agreement between reviewers was assessed using the Kappa statistical test, the results revealing a substantial level of agreement interobserver [18] (k= 0,673; p <0,001; agreement= 87,6%) using the Statistical Package for Social Sciences - SPSS version 20 for

Windows (IBM SPSS Software, Armonk, NY, USA).

Table 2 shows the evaluation of the articles according to the points highlighted [17]. After evaluating the quality criteria, we observed that some studies showed methodological deficits, since: six studies were not randomized [19–24] and five did not describe in detail the intervention protocol used [19,22,23,25,26].

Table 2 - Characterization of the studies according to the evaluation criteria highlighted by West et al.[17]

Reference	Study question	Study population	Randomization	Intervention	Outcome measures	Statistical analysis	Results	Discussion	Financing or sponsorship
Reilly *et al.*, 2006	●	◑	●	◑	●	●	◑	●	●
Stagnitti *et al*, 2011	●	◑	○	◑	●	●	●	●	●
Yin *et al.*, 2012	●	◑	○	●	●	●	●	●	●
Zhou *et al.*, 2014	●	●	○	●	◑	●	●	●	●
Tortella *et al.*, 2016	●	●	○	◑	◑	●	●	◑	●
Bedard *et al.*, 2017	●	●	○	◑	●	●	●	●	●
Foulkes *et al*, 2017.	●	●	●	◑	●	●	●	●	○
Bedard *et al.*, 2018	●	●	○	●	●	●	●	●	●

Note: ● = Yes ◑ = Partial ○ = No

Results

The search for articles allowed us to identify 58.217 articles in PUBMED, 1.371 articles in Lilacs and 5.602 in Web of Science. After applying the filters in the databases, there remained 2.315 articles. After an analysis of titles and abstracts from all databases, there remained 48 articles for reading the full text. 2.307 articles do not meet the eligibility criteria. At the end, eight articles were identified for inclusion in this systematic review; see the flow diagram (figure 1).

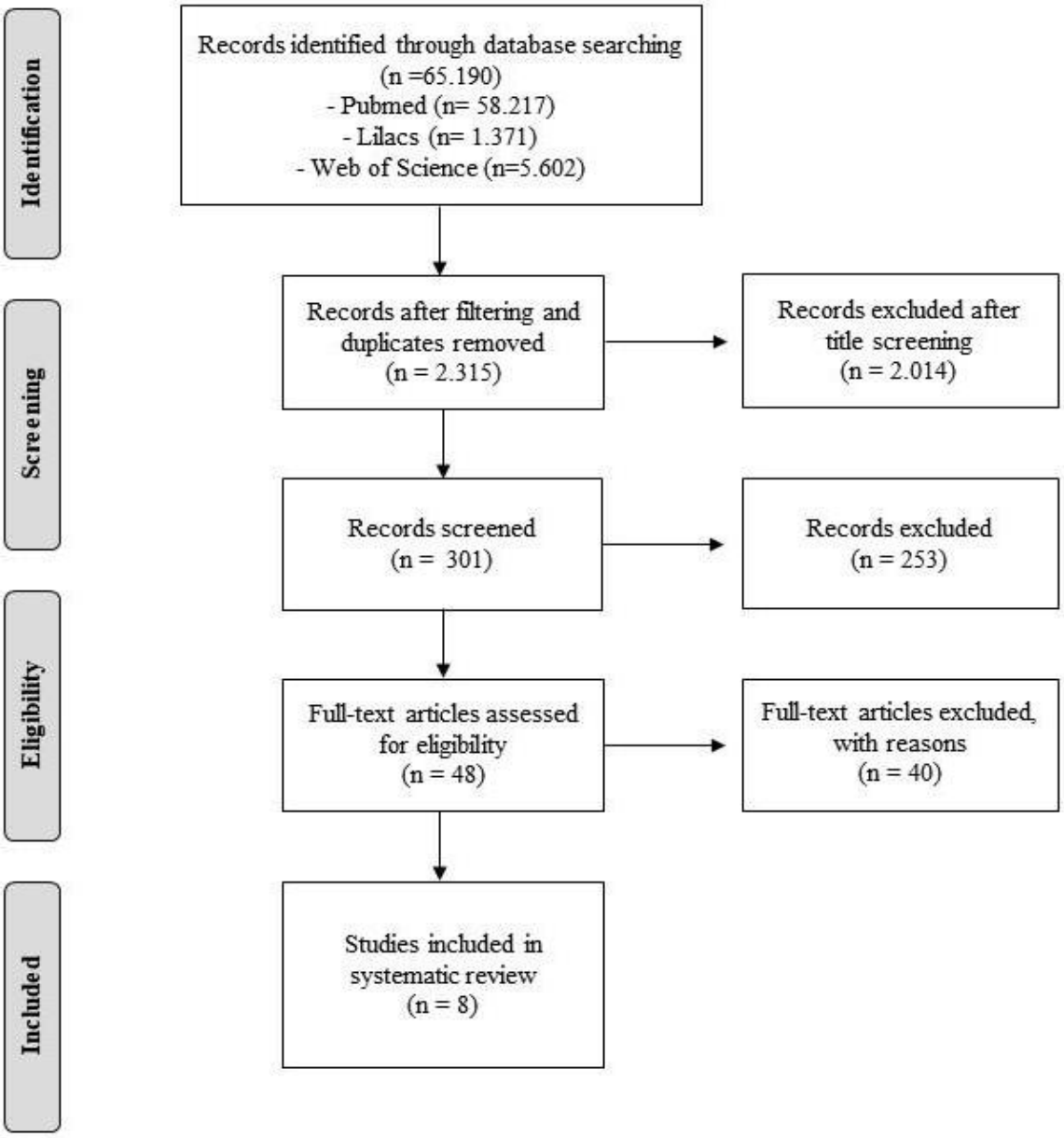

Figure 1 - PRISMA flow diagram of systematic selection of studies.

Study characteristics

The summary of the studies included in the systematic review and their most relevant features are described in table 3. The eight studies included in the systematic review were published between 2006 and 2018. The sample size ranged from 9 to 545 children participating in the studies, aged 3 to 5 years. Of the 1.481 children included in the eight studies, 582 were girls and 646 were boys; only one study did not describe the number of girls and boys selected for intervention [20]. The eight studies included interventions with active play, related to FMS [19–26]. These studies are not clear enough about how the children performed the activities included in the intervention protocols [19–26].

Table 3 - Performance of children's motor skills according to active play interventions.

Author / year	Participants	Type of active play	Intervention	Duration / Frequency	Motor skills test	Motor skills assessed	Results
Reilly *et al.*, 2006	545 children with an average age of 4.2 years	Guided active play	Nursery physical activity program (aiming to increase physical activity and fundamental motor skills); Active play or home play	3 sessions of 30 minutes per week for 24 weeks	Motion rating battery	Jumps; balance; skipping (steady running) and ball exercises, which make up the overall motor skills score	For fundamental motor skills, girls performed better than boys There was a positive effect for fundamental motor skills
Stagnitti *et al*, 2011	26 children with an average age of 3.11 years	Guided active play	PLAY Program included: classic outdoor play (example: quoits, skittles, hula hoops)	5 sessions per week for 22 weeks	PDMS-2 (Peabody Developmental Motor Scales-2)	Locomotion, object manipulation and balance	↑ Locomotion skills ↑ Object manipulation skills ↑Gross Motor Quotient Not significant effect: - Stationary skills
Yin *et al.*, 2012	253 children with average age of 4.1 years	Guided active play	Gross motor skills program with outdoor play (used: activity cards (lesson plans to increase physical activity levels and teach motor skills), gross motor skills equipment, CDs and DVDs (with dance moves) (30 to 45 min.); Additional Physical Activities between the playgrounds (15 to 20 min.)	60 minutes a day. On 9 modules for 18 weeks	LAP-3 (Learning Achievement Profile Version 3)	–	↑ Motor Skills Development ↑ Game assets

Zhou *et al.*, 2014	357 children aged 3 to 5 years	Guided active play	Outdoor play (play activities, using equipment based on gross motor skills development needs); Exercise routine (choreographed movements) (10 min.)	For 3 year olds: 60 minutes (30 min. in the morning and 30 min. in the afternoon) For children 4 and 5 years old: 90 minutes (60 min. in the morning and 30 min. in the afternoon). Daily for 12 months	People's Physical Fitness Measurement Standards battery test (measuring children's ability to perform fundamental movement skills)	Agility and speed, jumping, tennis ball throwing, sitting and reaching, dynamic balance, crawling and running	↑ 20 meters agility run ↑ Largo wide jump for distance ↑ Tennis Ball Throw ↑ Sit and Reach ↑ Balance Bar March ↑ 30 meter race and 20 meter displacement
Tortella *et al.*, 2016	110 children 5 years old	Free active play	Walk from the bus stop to the playground (10 to 15 min.); Structured activities (usage guidance): Activities with handling skills (rope ladder, suspension bar, gymnastic rings, climbing net, monkey bars) (10 min.); Activities with stability skills (rocker, log balancing, elastic beam balancing, platform balancing) (10 min.); Activities with mobility skills (each child goes up and down various climbing points and slopes in the mobility area and organized as a circuit) (10 min.); Free play (30 min.)	1 session of 60-minutes per week for 10 weeks	Motor Competence Test; Children's Movement Assessment Battery; Physical Fitness Test	Thick motor skills: balance on one leg (right and left), balance on the beam, balance on the platforms, heel riding and placing medicine ball Fine motor skills: post coins (right and left hand) and brick tower	Thick motor skills ↑ Medicine ball throwing; ↑ Balance on the left leg; ↑ Balance in the beam; ↑ Balance on the platforms. Not significant effect: - Balance on the right leg; -Heel walk Fine motor skills Not significant effect: - Posting coins from (right and left hand); - Brick tower construction

Bedard *et al.*, 2017	19 children from 3 to 4 years old	Free active play	Fundamental motor skills direct guidance / instruction; Unstructured exploratory free play (equipment available: playground balls)	1 session of 60-minutes per week for 10 consecutive weeks	PDMS-2 (Peabody Developmental Motor Scales-2)	Locomotion, object manipulation and balance	↑ Gross motor skills ↑ Object handling skills Improvements in stationary and locomotor domain scores were not significantly different between groups
Foulkes *et al*, 2017	162 children with an average age of 4.64 years	Guided active play	Active Play Program (warming up; dance; jumping gym; games; cool down)	60 minutes sessions per week for 6 weeks	TGMD-2 (Test of Gross Motor Development-2)	Locomotor skills (run, broad jump, leap, hop, gallop, and slide) and Object manipulation skills (overarm throw, stationary strike, kick, catch, underhand roll and stationary dribble)	There were no significant effects of the intervention on the scores total object manipulation skills or locomotor between the baseline and the posttest or baseline and follow-up after 6 months of the intervention
Bedard *et al.*, 2018	9 children from 3 to 4 years old	Free active play	Direct movement skill guidance / teaching (warm-up, two skill instruction blocks and an obstacle course) (30 min.); Unstructured exploratory free play (equipment available: balls, bows, rockers, building blocks, etc.) (15 min.)	1 session of 60-minutes per week for 10 consecutive weeks	PDMS-2 (Peabody Developmental Motor Scales-2)	Locomotion, object manipulation and balance	↑ Gross motor skills Earnings were maintained over a 5 weeks follow-up period

Active play

The Active play performed in the interventions of the included studies varied in type, frequency and duration. Of the eight studies included, three [22–24] performed interventions with free active play and five with guided active play [19–21,25,26]. The three studies that performed interventions with active free play were associated with FMH-oriented activities [22–24]. Of the studies with guided active play, two [19,26] performed interventions only with guided active play and three [0,21,25] with guided active play associated with physical activities.

The Bedard et al.[23,24] and Tortella et al.[22] studies evaluated the effects of a 60 minutes intervention per week during 10 weeks with free active play. Their observations related to stability of motor skills (balance on left and right leg; heel walking; balance on beam; balance on platforms), handling (medicine ball throwing) and fine motor skills (right and left hand gripping coins; brick tower construction).

The other five studies [19–21,25,26] investigated the effects of guided active play on the performance of HMF in children, although variation in duration and frequency was observed in interventions. The study conducted by Reilly et al.,[25] performed 3 sessions of 30 minutes per week for 24 weeks 19; the one conducted by Yin et al.,[20] performed daily 60-minute interventions for 18 weeks; The study by Zhou et al.,[21] decided to stipulate the intervention time according to the child's age, 60 minutes divided equally between morning and afternoon for children aged 3 years and 90 minutes (60 minutes in the morning and 30 minutes in the afternoon) for children aged 4 and 5 for 12 months; In the study by Foulkes et al.,[26], interventions consisted of 60-minute sessions per week for 6 weeks; while in the study by Staginitti et al.,[19] there were 5 sessions per week for 22 weeks, this study did not specify the duration of the sessions.

Five studies described the materials and equipment used in their interventions [20–24]. Studies conducted by Bedard et al.[23,24] provide balls, bows, rockers and building blocks for use during free active play. The study by Yin et al.,[20] conducted guided active play, using activity cards with lesson plans on how to increase physical activity levels and teach motor skills, gross motor skills equipment, CDs and DVD (with dance moves). In the study of Tortella et al., [22] various kinds of playground equipment was used for children to use in their motor activities, for practice in walking skills, the following were used: climbing and slopes for children to go up and down from various points, organized in a circuit; for handling skills: rope ladder, suspension bar, gymnastic rings, climbing net, and jack bars; and for stability skills: rocker, log balancing, elastic beam balancing, and platform balancing were used. The study by Zhou et

al.,[21] described that outdoor games, recreational activities and equipment based on the development of motor skills were performed, but did not provide details about the equipment used in the intervention.

Motor skills Assessed

All studies included in this review assessed FMS using different skill tests described in table 3. Motor skills can be classified into locomotion, balance and manipulation skills, grouped according to the purpose of the skill [6,7]. Six studies assessed simultaneously locomotion, balance and manipulation motor skills [19,21–25]. Of these skills, one study did not evaluate only the balance skills [26] and only one study did not specifically describe the motor skills evaluated [20].

Effects of active play on motor skill performance

In the analysis of the results, it was found that children who experienced interventions with free active play performed better on gross motor skills [22–24], manipulation skills [22,23] and balance on left leg, beam and platforms. However, no significant effect was observed on some stability and mobility abilities [23], such as balance on the right leg, heel walking and fine motor skills, brick tower assembly and left and right hand seizure of coins [22].

Children who practiced guided active play demonstrated better performance of motor skills [19–21,25]. Was identified an improvement in the performance of girls' FMS in relation to those of boys [25], an increase in locomotion skills performance, manipulation [19–21,25], balance [20,21,25] and consequently an increase in the practice of active play [20]. In the study of Stagnitti et al.[19] results only did not demonstrate significant improvement in balance skills when compared to baseline. Foulkes et al.[26] did not find significant improvement in locomotion and object manipulation skills after intervention with guided active play.

Discussion

The studies identified in this systematic review indicate that guided active play contributes to the best performance of FMS in children aged 3 to 5 years, typically developed. These findings corroborate the hypothesis that active play, especially the guided, through a wide variety of movements contribute to the development of FMS in children.

In the results of this study, children who experienced free active play showed improved performance of gross motor skills, manipulation, and stability, such as balance on the left leg,

beam, and platforms. Interventions with free active play associated with FMS-oriented activities, lasting 60 minutes a week for 10 weeks, seem to have been sufficient to improve these skills [22–24]. In line with these findings, a study [27] found that participants in a free play motor skills program showed significant improvement in ball motor skills and of locomotion, the results also indicate that the participants who performed only free play also had improvement in motor skills with ball and locomotion. Although improvements in FMS were observed in both groups, the group that participated in the program with motor skills associated with play presented better performance in FMS [27].

The free active play associated with FMS-oriented activities showed an improvement in FMS performance. These results can be justified by the fact that the activities performed during these interventions were specifically focused on an orientation towards FMS, which consequently provide the improvement of some specific motor skills due to training for them. It was also found that these interventions did not show significant effect on fine motor skills, locomotion and some kinds of balance, such as right leg balance and heel walking. For activities that were developed to improve locomotion skills, climbing points and slopes were used for the children to go up and down [22]. The planned activities and the materials used may not have been effective in improving the children's locomotor skills.

On the other hand, the time dedicated to the experience of activities involving balance and locomotion skills may have been insufficient to improve their performance, explaining the non-significant results found. The absence of significant effects on fine motor skills can be explained by the activities developed in the intervention, specifically aimed at improving gross motor skills. This result suggests that the transfer of learning from gross motor skills to fine motor skills was nil, because the experiences of free play intervention and FMS-oriented activities did not affect the performance of fine motor skills [22,28].

Of the five studies that performed interventions with guided active play [19–21,25,26], four reported that children who experienced these interventions showed improvement in the performance of mobility skills, manipulation [19–21,25] and balance [20,21,25]; that is, these interventions were able to improve the participants' FMS performance. Although the weekly frequency and duration varies between these studies, it is observed that these are important variables to obtain a better effect of the studies. The interventions in these studies [19–21,25] were carried out daily or 3 to 5 times a week, thus increasing the weekly frequency of interventions, allowing participants more opportunities to experience guided active play and physical activity. Increased frequency of interventions can positively influence children's FMS performance.

This is true also for the use of specific equipment for the development of motor skills, as reported in two studies with guided active play and PA [20,21].

Only the study conducted by Foulkes et al.[26] did not find significant results for the locomotion and object manipulation skills of children who experienced guided active play. The duration and frequency of the intervention may justify the divergence of the results of this study, indicating that the 60 minutes sessions per week for a period of only 6 weeks [26], was insufficient to cause a significant improvement in locomotion and object manipulation skills in the participants.

The results of this systematic review suggest that guided active play can improve the performance of mobility, manipulation and balance skills in children aged 3 to 5 years. The findings partially agree with the study that highlights the efficiency of the game aimed at improving FMS in children aged 3 to 5 years [15]. It is noteworthy that a better performance of motor skills is associated with longer PA in children aged 3 and 4 years [29].

We also emphasize that future studies should seek to standardize the protocols of invention with active play, in order to create clearer parameters for comparing the results. In addition to considering the duration and frequency of interventions, as these are important variables that can influence the effects of interventions.

Conclusion

The practice of active play, especially guided active play, positively contributes to the FMS of children from 3 to 5 years old typically developed, we also verified the existing differences between the intervention protocols with active play used in the studies. Classes and planned interventions with active play to develop and improve the performance of FMS in preschools can help children to build an active and healthy behavior. The results found in this systematic review may assist health and education professionals in implementing interventions and programs that have the greatest impact on motor skill development.

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