

The influence of school physical education on the development of children in early childhood education

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Abstract - Objective: To analyze the influence of school Physical Education (PE) on the development of children enrolled in Early Childhood Education (ECE). **Method:** Sixty children aged 4-5 years enrolled in four ECE institutions in Fortaleza, Ceará, participated in this observational and cross-sectional study. The children were divided into two groups: PE Group (30 children who receive PE pedagogical mediations with a PE teacher); and Control Group (30 children who do not have such mediations). The Movement Assessment Battery for Children 2 (MABC-2) and the Ages & Stages Questionnaires (ASQ-3) were used to assess child development. The performance of the groups was compared using the Student's T-test, and the relative frequency of children with motor difficulties or at risk of motor difficulties according to the MABC-2, and those who Require Referral for Evaluation (NE) or Need Additional Activities (AA) according to the ASQ-3 were presented. **Results:** The PE Group demonstrated superior performance compared to the Control Group in the components of Throwing and Catching, Balance, and the total score of the MABC-2. More children in the Control Group exhibited motor difficulties and were at risk of motor difficulties than in the PE Group. Also, the PE Group performed better than the Control Group in the dimensions of Gross Motor Coordination, Fine Motor Coordination, and Personal/Social skills. More children in the PE Group exhibited AA or NE in Communication, Fine Motor Coordination, and Problem-Solving than in the Control Group. **Conclusion:** The results suggest that PE influences the development of children in ECE.

Keywords: child development, physical education, early childhood education.

Introduction

Early Childhood Education (ECE) is defined as the initial stage of basic education, provided in daycare centers and preschools. These are described as non-domestic institutional environments that comprise public or private educational establishments, which educate and care for children aged 0 to 5 years during the daytime, either on a full-time or part-time basis. In Brazil, these institutions are regulated and inspected by educational system authorities and are subject to social oversight¹. It was only with the Brazilian Federal Constitution of 1988 that the State assumed responsibility for accommodating children in daycare centers and preschools. Later, with the enactment of the Law of Guidelines and Bases of National Education (LDB)

in 1996, ECE became an integral part of Basic Education, achieving the same status as Primary and Secondary Education².

According to LDB, Physical Education (PE), as part of the school's pedagogical project, is an integral component of the Basic Education curriculum³, despite this, the requirement to hire PE teachers in ECE remains at the discretion of educational institutions. In this ongoing process of structuring guarantees, it is up to these institutions to decide whether the classes will be taught by teachers with specific training in the field or not⁴. The lack of specific guidance in federal documents addressing Physical Education in Early Childhood Education (PEECE) raises questions about the necessity of specialized teacher training for this segment. This ambiguity allows multipurpose teachers to

deliver these contents, without requiring the presence of a PE specialist at the school⁵.

A significant portion of the arguments against the presence of licensed PE professionals at this stage of education revolves around concerns that ECE might adopt a “school-like” model. This model would be structured around disciplines with fragmented approaches, potentially compartmentalizing children's development and reinforcing divisions between different aspects of knowledge⁶. However, the presence of PEECE does not necessarily constitute a process of schooling. Its implementation is supported by pedagogical practices grounded in hypotheses emerging from academic research and, to some extent, articulated in the most recent guiding documents, such as the National Curriculum Guidelines for Early Childhood Education - DCNEI and the National Curriculum Basis for Early Childhood Education - BNCCEI⁷.

In the state of Ceará, Resolution No. 412 of 2006 establishes that PE, as part of the school's pedagogical project, is a mandatory curricular component throughout basic education, both for schools offering it and for children practicing it. Furthermore, the resolution states that Physical Education, in the form of recreation, will be conducted in ECE and the initial years of Elementary Education by a polyvalent teacher with a higher education degree, a teaching diploma at the secondary level, or a degree in Pedagogy⁸. Conversely, in the municipality of Fortaleza, Law n. 10,025 of 2013 ensures that the curricular content of the PE discipline in ECE, whether in public or private schools within the municipality, is to be delivered exclusively by PE teachers with a higher education degree in the field⁹.

PE constitutes a curricular component with a crucial role in ECE, as it provides diverse experiences that contribute to the motor, cognitive, emotional, and social development of the child¹⁰. By the age of five, children rapidly develop essential skills that will form the foundation for their future development¹¹. However, it is observed that in Brazil, particularly in poorer areas of the northeastern countryside, examples of PEECE being taught by qualified professionals in the field are rare¹⁰ and that are capable of properly exploring its pedagogical value. It can even be stated that motor stimulation at this stage often represents a space of freedom for the child to run and jump freely, without appropriate pedagogical guidance¹².

The literature in the field highlights that participation in PE classes offers benefits for the enhancement of cognitive functions and academic performance of children¹³. It is believed that this positive impact is because a child's cognitive development is shaped by motor experiences, as motor functions, such as movement, are interconnected with intellec-

tual development, including memory, attention, reasoning, and affectivity, encompassing emotions and feelings. Thus, for skills such as reading and writing to be properly developed, it is essential that the skills related to these practices are well mastered¹⁴.

It is important to emphasize that ECE is an environment with fundamental meanings and significance for the stimulating process. It is a social space where children have essential opportunities for this formative task. However, this perspective requires reflection on which type of ECE is being referred to: one that fosters the development of independence and the holistic growth of the child, or one where historical constraint remains focused on the intensified value of cognitive stimulation at the expense of motor and affective development?¹²

Therefore, it is necessary for PE to be fully integrated into ECE so that professionals in the field can develop the content of the body movement culture through activities that support the development, learning, and growth of the children. PEECE is not merely movement for the sake of movement, but guided movement, aimed at achieving objectives that address the limitations and challenges faced by children. It seeks to foster the development of a responsible individual, endowed with creativity and critical thinking about themselves, others, and the society to which they belong¹⁰.

Furthermore, it is essential that the academic coordination team be able to recognize and advocate for the inclusion of movement as part of the process in ECE, ensuring that proper stimulation is provided in alignment with the pedagogical project at this level of education. It is important to understand that the time dedicated to PE will not negatively impact the performance in other areas of education; on the contrary, it will undoubtedly qualify and enhance a comprehensive learning experience for the children¹². Therefore, considering the importance of investigating the potential motor, cognitive, and social benefits associated with the presence of PEECE and the drawbacks resulting from their absence, this study aimed to analyze the influence of these pedagogical mediations on the holistic development of children aged 4 to 5 years.

Method

Study design

This was an observational, cross-sectional, descriptive, and analytical study of a quantitative nature. The research was approved by the Ethics and Research Committee of the Federal University of Ceará (CAAE: 73500523.9.0000.5054).

Participants

The study was conducted in four public Early Childhood Education institutions, all located in the city of Fortaleza, in the state of Ceará. The study included children of both genders, aged 4 to 5 years. The sample consisted of 60 children, divided into two groups: 30 in the Physical Education (PE) Group, consisting of those who have Physical Education taught by qualified Physical Education teachers, and 30 in the Control Group, consisting of those who do not have such pedagogical mediations. Children who participated in extracurricular sports activities or who had a diagnosed disability or disorder affecting motor and/or cognitive performance were excluded. All guardians provided consent for the children's participation through the signing of the informed consent form, and the children themselves assented to their participation through the minor assent form.

Instruments

The Movement Assessment Battery for Children 2 (MABC-2)¹⁵ for the age range of 3 to 6 years was used to assess the motor development of the participating children. This battery consists of eight tasks divided into three motor components: Manual Dexterity (3 tasks), Throwing and Catching (2 tasks), and Static and Dynamic Balance (3 tasks). The Ages & Stages Questionnaires (ASQ-3)¹⁶ for the assessment of children at 48, 54, and 60 months was used to evaluate the development of five dimensions: Communication, Gross Motor Coordination, Fine Motor Coordination, Problem-Solving, and Personal/Social. Development in each of these dimensions is assessed based on responses to six items.

Procedures

Initially, contact was made with the schools to present the project, the procedures, the objectives, and the timeline for the study. Simultaneously, a Letter of Introduction signed by the supervising professor of this study was provided, reinforcing the study's objectives as well as its ethical and professional nature.

Subsequently, the assessments were conducted over two days, with the MABC-2 administered on the first day and the ASQ-3 on the second day. Both assessments were conducted individually at the children's schools during the period they were there, after obtaining consent to participate. The evaluation process took approximately 40 min on the first day and 20 min on the second day.

Data analysis

The performance that each child achieved in each task was transformed into a standardized score,

according to the MABC-2 Manual, ranging from 1 to 17 (higher scores indicate better performance). The score for each motor component was calculated by summing up the standardized scores of the tasks related to that component. The total score on the MABC-2 was obtained by summing the scores of the motor components and converting it into a percentile (Table 1).

For the ASQ-3, the scores in each dimension (Communication, Gross Motor Coordination, Fine Motor Coordination, Problem-Solving, and Personal/Social) were summed, and these results were compared with the cutoff score that the child could achieve. This information is recorded in a specific section of the questionnaire designated for compiling the results. After comparing the total scores and the cutoff points in each of the five areas, it was possible to determine the child's developmental status, which can be classified as: typical development (TD) when the score is well above the cutoff point; requires additional activities (AA) when it is close to the cutoff point; or requires referral for further evaluation (RE) (conducted by a professional) when it is below the cutoff point (Table 2).

After data treatment, the data were analyzed descriptively using absolute and relative frequencies for categorical variables and mean and standard deviation for numerical variables. The normality of the data was assessed using the Shapiro-Wilk test.

Subsequently, the Student's t-test was used to compare the children's age between the groups, the children's performance between the groups regarding the scores in the Manual Dexterity, Throwing and Catching, Balance components, and the total score on the MABC-2, as well as the Communication, Gross Motor Coordination, Fine Motor Coordination, Problem-Solving, and Personal/Social domains of the ASQ-3. For the Balance component of the MABC-2, the Mann-Whitney U test was also used (for non-parametric data). Additionally, Pearson's correlation test was used between the motor component data of the MABC-2 and the domains of the ASQ-3. In all analyses, the significance level adopted was $p < 0.05$. The software The Jamovi Project (2022) version 2.3 was used for all analyses.

Table 1 - Final classification in the MABC-2 according to percentiles.

Classification of the MABC-2 total score	
Typical motor development	≥ 16 th percentile
Risk of motor difficulties	$6^{\text{th}} \geq 15$ th percentiles
Motor difficulties	≤ 5 th percentile

Source: adapted from Henderson et al.¹⁵.

Table 2 - Cutoff scores for each dimension across different ages in the ASQ-3 questionnaire.

Questionnaire	Dimension	Cut-off point
48 months	communication	30.72
	gross motor coordination	32.78
	fine motor coordination	15.81
	problem-solving	31.30
	personal/social	26.60
54 months	communication	31.85
	gross motor coordination	35.18
	fine motor coordination	17.32
	problem-solving	28.12
	personal/social	32.33
60 months	communication	33.19
	gross motor coordination	31.28
	fine motor coordination	26.54
	problem-solving	29.99
	personal/social	39.07

Source: adapted from Filgueiras et al.¹⁶.

Results

Regarding the sample, 53.3% of the children in the Control Group and 33.3% of the children in the PE Group were female. As for the children's age, the result of the student's T-test showed that the PE Group had a higher mean age in months (62.6 ± 3.0) compared to the Control Group (53.7 ± 3.8 ; $p < 0.001$).

Regarding motor assessment, the results showed that the children in the PE Group performed better in the Throwing and Catching, Balance components, and the total MABC-2 score compared to the children in the Control Group (Table 3).

Table 4 presents the classification of the children's motor development in both groups, obtained through the total performance on the MABC-2.

Regarding the assessments with the ASQ-3, the results showed that the children in the PE Group performed better in the domains of Gross Motor Coordination, Fine Motor Coordination, and Personal/Social

Table 3 - Mean and standard deviation (SD) of the scores obtained by each group in the motor assessment using the MABC-2.

Component	control group (mean $\pm$ SD)	PE group (mean $\pm$ SD)	p-value
Manual dexterity	7.07 ± 2.29	7.77 ± 2.78	0.291
Throwing and catching	7.77 ± 1.94	9.90 ± 2.99	0.002
Balance	6.20 ± 1.88	8.87 ± 3.28	< 0.001
MABC-2 Total	58.2 ± 11.3	69.9 ± 12.9	< 0.001

Table 4 - Relative frequency of participants in both groups according to the classification obtained in the MABC-2.

Classification			
Group	Motor difficulties	Risk of motor difficulties	Typical motor development
Control Group	36.7%	50%	13.3%
PE Group	16.7%	16.7%	66.6%

compared to the children in the Control Group (Table 5).

Table 6 presents the classification obtained by the children in both groups in the ASQ-3 assessment.

The Pearson correlation results indicated that the scores in Manual Dexterity, Throwing and Catching, and Balance were correlated with the total MABC-2 score ($R = 0.730$, $p < 0.001$; $R = 0.684$, $p < 0.001$; and $R = 0.759$, $p < 0.001$, respectively). Regarding the ASQ-3, the dimensions that showed a significant correlation with the total MABC-2 score were Gross Motor Coordination ($R = 0.568$, $p < 0.001$), Fine Motor Coordination ($R = 0.542$, $p < 0.001$), and Personal/Social ($R = 0.461$, $p < 0.001$).

Regarding the children's performance in the MABC-2 components and the ASQ-3 dimensions, 15 children showed no difficulties, 18 exhibited difficulties in both, and 8 had more than one difficulty in both assessments. In the MABC-2, the main difficulties were in the Manual Dexterity and Balance tasks, where 14 children performed poorly in both. In the ASQ-3, the

Table 5 - Mean and standard deviation of the scores obtained by each group in the domains assessed by the ASQ-3.

Dimension	control group (mean $\pm$ SD)	PE group (mean $\pm$ SD)	p-value
Communication	38.5 ± 17.7	31.3 ± 11.1	0.066
Gross motor coordination	34.8 ± 10.4	44 ± 8.14	< 0.001
Fine motor coordination	28.3 ± 10.9	39 ± 8.85	< 0.001
Problem-solving	40.8 ± 11.7	38 ± 11.1	0.340
Personal/social	38.7 ± 11.4	47 ± 9.06	< 0.001

Table 6 - Relative frequency of participants in both groups according to the classification in the ASQ-3.

Dimension	control group		PE group	
	AA	NE	AA	NE
Communication	16.7%	33.3%	26.7%	56.6%
Gross motor coordination	53.3%	10%	33.3%	6.7%
Fine motor coordination	26.7%	50%	33.4%	10%
Problem-solving	10%	20%	53.4%	13.3%
Personal/social	40%	23.3%	36.6%	13.4%

Legend: (AA) Needs Additional Activities; (NE) Needs Referral for Further Evaluation.

difficulties were primarily observed in the Communication dimension, where 18 children faced challenges.

Table 7 presents the main difficulties identified in each group (PE and Control) in the assessments.

Discussion

This study aimed to analyze the influence of PE on the holistic development of children in ECE. According to the results, children who have regular PEECE pedagogical mediation showed superior motor and personal-social development compared to children who do not participate in such classes at school. This is because motor skills are the result of opportunities to experience appropriate and systematic activities. Only practice and instruction can lead children, as they progress through school years, to more notable levels of motor skills¹⁷. Thus, PEECE enhances children's motor development due to the guided motor activities, primarily led by a PE teacher, which are performed by the children with the aim of developing and learning future movements¹⁸.

Similar results were found by Ferraz and Flores¹⁹. The study aimed to investigate the impact of a PEECE program, focusing on the development of basic motor skills and the learning of concepts related to physical education. A quasi-experimental method was used with two groups of 4-year-old children in a school from the Municipal ECE Network in São Paulo. The experimental group participated in 50-min PE pedagogical mediations twice a week, while the control group did not have this experience. Both groups were eval-

uated before and after the program. The results indicated that the group that participated in PE showed superior performance in basic motor skills, particularly in throwing skills, as well as better results in learning about what PE is, compared to the control group.

Another finding of the present study was that a large portion of the children in the PE Group were classified as having "Typical Motor Development" on the MABC-2, while those in the Control Group were classified as "At Risk of Motor Difficulties". Melo et al. (2019)²⁰ obtained results corroborate these findings. In the study, the motor development of a group of 10 children who participated in 20 PEECE pedagogical mediations was analyzed in comparison to another group of 10 children who did not participate in such activities. The results showed that none of the participants in the group of children who did not attend PEECE achieved a coordination level above normal, with some even showing difficulties in this area in the post-test. In contrast, the group that received the PEECE showed a significant improvement in post-test results, confirming the benefits of physical education for motor coordination.

Briet and Polastri²¹ reinforce the positive impact of PE on children's motor development. They analyzed the gross motor development of 19 children between the ages of three and five from an ECE unit who participated in a Developmental Physical Education Program. Using the Test of Gross Motor Development (TGMD-2) to assess motor performance, the researchers aimed to identify the Gross Motor Quotient and the motor age of the participants. The results showed that all the children achieved predominant motor development, with 68.42% reaching average or above-average global standards.

The results obtained with the ASQ-3 in the present study showed that the group of children who had PEECE performed better in terms of gross and fine motor coordination and in personal/social aspects compared to children who did not have these pedagogical mediations. This finding is significant, considering that current literature lacks similar studies. PE is a subject that can contribute to the holistic development of children through playful and enjoyable tasks, especially when such activities are led and structured by a teacher who is properly qualified in the field to work in

Table 7 - Main difficulties by group.

Assessment	control group		PE group	
	difficulty	number of children (n)	difficulty	number of children (n)
MABC	manual dexterity	9	manual dexterity	5
	balance	9		
ASQ-3	gross motor coordination	14	communication	17

ECE. This provides children with opportunities to interact with objects, other children, and situations that serve as valuable learning experiences for their lives in society¹⁰.

In childhood, a child develops a wide range of motor skills, which allows them to have a comprehensive control of their body in different postures (static and dynamic), move around the environment in various ways (walking, running, jumping, etc.), and manipulate objects and tools (catching a ball, throwing a stone, kicking, writing, etc.). These fundamental skills are essential for carrying out daily routines at home and school, as well as for engaging in playful activities, which are characteristic of childhood²². Therefore, cognitive learning stimuli in the school, social, and family environments must occur simultaneously with regular physical activities in children's daily routines, so that they can integrate these experiences to enhance the cognitive development and learning process that children are undergoing at this stage of life²³.

Another study that supports the results found in this research is that of Costa et al.²⁴ which analyzed the impact of structured PE on the psychomotor development of children in daycare centers. With a sample of 324 children aged three to five years (154 boys and 170 girls) across nine kindergarten pedagogical mediations in Porto, Portugal, the study divided the participants into two groups: an experimental group, which participated in a 24-week Physical Education program, and a control group. The psychomotor tests were conducted before and after the intervention. The results showed that, although both groups improved their psychomotor profiles, the experimental group had a statistically greater growth in all ages and variations observed, highlighting the importance of structured PE in the psychomotor development of children.

Although, among these reference studies, child development falls under an evaluative perspective of motor skills, therefore, a view restricted to motor performance, a gap that the present study seeks to fill by including possible associations of motor assessments with the assessment of personal and social skills, which also justifies the use of ASQ-3 as a differential in the present study.

The results of the Pearson correlation showed significant associations between the motor skills assessed by the MABC-2 and the ASQ-3. Significant correlations were also observed between the ASQ-3 and the total score of the MABC-2, indicating that motor development is related to the development of social and personal competencies in childhood. Martins et al.²⁵ emphasize that movement contributes to the development of all other areas of the individual, high-

lighting the importance of providing stimuli and keeping children active.

Therefore, participatory PE in the school context, with well-prepared lessons and clearly defined objectives, considering the developmental characteristics of each phase the children are in, truly becomes indispensable²⁶. Thus, if the teacher merely allows children to play freely by jumping, for example, they will gain motor experiences and likely a sense of their own ability. However, this will be a poor experience of the action of jumping, as it will remain merely an experience. This act can be referred to as *laissez-faire*, letting them do it without reflection on the action taken. It is poor from the reflective motor and neurological perspective, as the understanding of what happens is not investigated¹².

These results allow us not only to have a broad view of child development, but also to see PE from an emancipatory perspective since ECE. Even if the child experiences movements that he or she is already familiar with, within the Physical Education class he or she will also be able to learn about the contextualization of the historical and cultural consensus that gave rise to it²⁷.

As limitations of this study include the small number of participants, which restricts the generalization of the results. The PE Group consisted of children older than those in the Control Group, which may have influenced the results, as maturation associated with age could have contributed to the superior performance observed in the PE Group. Additionally, there was no control over the activities, content, and pedagogical strategies adopted in the PEECE of the institutions in the sample. Therefore, for future studies, it is suggested that the sample be composed of a larger number of participants, enabling better generalization of the results. Furthermore, it is recommended that the comparison groups be homogeneous in terms of age, to reduce the influence of maturation on the results and ensure that the observed differences are primarily attributed to the PE.

Conclusion

It is concluded, therefore, that school physical education plays a fundamental role in the motor development and personal and social skills of children in ECE. The differences observed between the groups in this study reinforce the positive impact of these classes on holistic development during early childhood, highlighting the need for their recognition and strengthening in the curricula of educational institutions at this level of education.

AI use statement

No AI was used in this research.

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Author contributions (CRediT)

Jonas da Silva Bezerra: conceptualisation, investigation: methodology, data curation, writing - original draft, writing - review and editing, visualisation. **Lorena Gomes Gadelha:** methodology, data curation, writing - original draft, writing - review and editing. **Carla Thais de Sousa:** data curation, writing - original draft, writing - review and editing, visualisation. **Marcela de Castro Ferracioli Gama:** conceptualisation, investigation: methodology, data curation, writing - original draft, writing - review and editing, visualisation.

Data availability statement

We declare, for all due purposes, that the research data is available in the body of the document.

Conflict of interest statement

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report.

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