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FUNDAMENTAL MOTOR SKILLS OF PUBLIC AND PRIVATE SCHOOL CHILDREN

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Resumo: O objetivo deste estudo foi classificar e comparar as habilidades motoras fundamentais de crianças de escolas públicas e privadas e verificar a compatibilidade das habilidades motoras fundamentais com a idade cronológica dos alunos. Os participantes foram 81 crianças saudáveis (10.6 ± 1.2 anos). O *Test of Gross Motor Development - edition* 2 foi usado para avaliar a habilidades motoras fundamentais. Os subtestes de habilidades motoras fundamentais foram comparados entre as escolas, usando o teste t para amostras independentes e o teste U de Mann Whitney. A idade cronológica foi comparada com a idade motora equivalente nos dois subtestes para cada escola separadamente, usando o teste estatístico de Wilcoxon. Alunos de escolas privadas obtiveram pontuação maior no subteste locomotor do que alunos de escolas públicas ($p = 0.032$), sem diferença no subteste controle de objetos ($p = 0.733$). O Quociente Motor Bruto indicou que os alunos de ambas as escolas apresentaram classificações de desempenho semelhantes classificadas como “muito ruim”, “ruim” e “abaixo da média”. Para os subtestes locomotor e controle de objetos, todos os escolares apresentaram idade motora equivalente menor que a cronológica. Alunos de ambas escolas apresentaram atraso no desenvolvimento motor, enquanto alunos de escolas privadas demonstraram maior eficiência nas habilidades motoras fundamentais de locomoção.

Palavras-chave: Atividade física; desempenho psicomotor; crescimento e desenvolvimento; habilidades motoras fundamentais; HMF; desenvolvimento infantil

Afiliação

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Fundamental motor skills of public and private school children

Abstract: The purpose of this study was to classify and compare the fundamental motor skills of children from public and private schools and verify the compatibility of fundamental motor skills with students' chronological age. Participants were 81 healthy children (10.6±1.2 years). The Test of Gross Motor Development - edition 2was used to evaluate fundamental motor skills. Fundamental motor skills subtests were compared among schools, using the independent samples t-test and Mann Whitney U-test. Chronological age was compared with equivalent motor age in the two subtests for each school separately, using the Wilcoxon statistical test. Private school students had a higher score on the locomotor subtest than public school students (p=.032), with no difference on the object control subtest (p=.733). The Gross Motor Quotient indicated that the students of both schools presented similar performance ratings classified as "very poor", "poor" and "below average". For the locomotor and object control subtests, all schoolchildren had equivalent motor ages lower than their chronological age. Students from both schools had a delay in motor development, while private school students demonstrated greater efficiency in locomotor fundamental motor skills.

Key words: Physical activity; psychomotor performance; growth and development; fundamental motor skills; FMS; child development

Introdução

Fundamental motor skills (FMS) are important for the overall physical development of children because they are essential for the performance of refined (coordinated and controlled) movements in daily, recreational and competitive activities throughout life[1, 2]. If children do not develop FMS at the desired stage (proficient), their effective participation in games, dance, sports, and social activities, as well as daily chores, could be compromised. Consequently, they are related to a child's daily physical activity (PA) participation and health[3, 4].

The lack of movement proficiency is a relevant factor that may cause children to be disinterested in PA and even in physical education (PE) classes[5]. Regular PA participation in childhood results in better motor development[4]. Thus, the greater the participation in PA, the greater the chances of the child to obtain improvements in the levels of FMS, which in turn may increase the performance levels of PA[6, 7]. More importantly, PA participation during childhood is necessary because it is during this phase that fundamental movements are developed[2, 3].

FMS are typically acquired and developed in children between the ages of two and seven and comprise three stages: initial, elementary-emergent and proficient. Every child is expected to reach the proficient level of fundamental movements by the age of seven[7-9]. They are understood as the serial organization of basic movements, combined with two or more movements, such as running, jumping, hitting, and throwing[2]. They are classified into skills of stabilization (balance-related), locomotive (running, galloping, hopping, leaping, jumping [horizontally], and sliding), and manipulative/object control (throwing, catching, kicking a ball)[7, 10].

Considering that schools may be the best venue for children to be physically active and develop FMS, it is necessary to understand how the school environment provides opportunities for children to engage in PE and PA and develop FMS[11]. The literature suggests that schools that provide better learning environments (smaller class sizes, more equipment, certified teachers, etc.) increase student learning[12]. One study in the school environment showed how it may impact children's motor development[13]. In Australia, the school environment in conjunction with the school's existing policies can influence

the performance of the FMS and increase the levels of PA of students during recess[14]. Another research carried out in the same country found that the provision of facilities (the sum of available facilities) and the availability of unfixed materials, such as loose equipment, balls, skipping rope, rackets, contribute to the practice of fundamental movements and increased levels of PA among students during recess[15]. These researchers believe that both the environment and the supply of these materials are necessary for the development of FMS and increased PA.

Students who had classes taught by a PE professional and in a spacious environment with several materials presented superior motor development in comparison to children who attended PE classes in schools with professionals who were not certified in PE and taught in adapted spaces[5, 13].

In Brazil, it is common to find schools where PE classes lack space and materials and have non-certified PE teachers. It is evident in the Brazilian literature that private institutions provide better conditions - such as proper space for classes, diversity and quantity of materials, small class size, and certified teachers - to increase students' development[16].

However, the literature on motor development is limited regarding the investigation and comparison of FMS of Brazilian children in different environmental contexts. Additionally, there is no evidence if the child who is in elementary school presents the FMS in the proficient stage. Consequently, it is important to evaluate the FMS of the students in different contexts and to identify the FMS development stages that children are in order to provide activities for the students who are in the proficient stage or to improve the FMS of those who have not yet reached the desired stage[1, 17, 18].

The purpose of this study was to classify and compare the FMS of schoolchildren from public and private schools, as well as to verify the compatibility of FMS with the chronological age of children. The following hypotheses were tested in this study: a) private school students have higher levels of fundamental motor skills in relation to those in the public school; b) private school students are at the expected level of fundamental motor skills' development.

Materials and methods

Participants

This cross-sectional study had a sample of 81 (36 boys and 45 girls) healthy schoolchildren aged = 10.6; SD = 1.2 years old, from one public (n = 43) and one private (n = 38) school in the Southeast region of Brazil. The choice of sample and schools was intentional, motivated mainly by accessibility.

Institutions

One public and one private elementary school located in a city with more than 200 thousand inhabitants participated in the study. The public school had a gymnasium with three courts and its students attended two weekly PE classes of 50 minutes each. The private school students had access to a gymnasium with two courts and three weekly classes lasting 50 minutes each. The public school had fewer equipment such as some soccer balls, baseball bats, and hula-hoops. The private school presented greater diversity and quantity of materials compared to the public school, including many soccer balls, basketballs, volleyballs, tennis balls, playground balls, vests, traffic cones, hula-hoops, and tennis tables.

Recruitment

One researcher met with the school board and PE teachers in both institutions to explain all procedures and obtain authorization to conduct the study. After approval, the researcher met the students in the classroom, invited them to participate, and explained the details and procedures that would be performed before and during the test application. After acceptance, two copies of the Free and Informed Consent Form (FICF) were given to interested students to obtain parental consent and signature. After the return of FICF, a consent form for the minors was given to the children with a simple explanation of the entire test procedure. After reading, all children agreed to participate in the study. The project was evaluated and approved by the Institution Research Ethics Committee

(CAAE: 3423/58745616.9.0000.5515).

To participate in the study, students should have the following inclusion criteria: a) ages between eight and 12 years, b) apparent health (no motor restrictions or physical disability), and c) no medical restrictions. The data were excluded from analysis if children: a) did not complete at least 80% of the predicted procedures and b) who were affected by illness or physical limitation during the survey.

Instrument for testing

The Test of Gross Motor Development - edition 2 (TGMD-2; Ulrich, 2000) was used to evaluate participants' FMS. The test is a standardized, inexpensive, and easy-to-apply test that allows the classification of FMS in overall gross motor skills - Gross Motor Quotient (GMQ) - and in its two subtests (locomotor and object control) by presenting seven classification ratings: very poor, poor, below average, average, above average, superior and very superior. The ratings are identified from the results obtained from the raw and standard scores.

The first subtest (locomotor) rates the skills of running, galloping, hopping, leaping, jumping (horizontally), and sliding. The second subtest (object control) rates the skills of striking a stationary ball, stationary dribbling, catching, kicking, overhand throwing, and underhand rolling. The test is used to: a) identify whether children are following the same age pattern in the development of FMS, b) plan physical exercise programs, c) evaluate the progress of FMS individually, and d) serve as an assessment tool in FMS research[19].

The TGMD-2 uses a scoring system as a reference and evaluates 12 FMS in children aged three to 10 years. It also has a scoring system (score assignment) for each expected performance criterion. There are 3 to 5 criteria for each FMS. The score "1" is assigned for each criterion present and "0" when the criterion is not met. Three trials are offered (the first made for familiarization with the movement, without being scored) for each FMS, enabling scores from 0 to 2 for each performance criterion. Scoring occurs for the second and third attempts. The maximum score of the TGMD-2 is 96 points, ranging from 0 to 48 points for each subtest. Appropriate TGMD-2 results were found in Brazilian

children (n = 3124) for content, construct validity, and reliability with several indicators with values above 0.80[20, 21].

Procedures

The TGMD-2 test was prepared according to the specifications outlined for the evaluation of FMS (Ulrich, 2000). The test was applied in the morning and afternoon periods at the schools' gymnasiums. The site was well lit and ventilated, contributing to the good application of the test. For the elaboration of the stations, it was necessary the materials: video camera, cones, balls (plastic, soccer, basketball, tennis), and baseball bat.

As soon as the students arrived at the test site, the researcher made sure that all children were wearing appropriate clothes for the test (shorts, t-shirt, and sneakers). For the application of the test, the children were randomly divided into groups of five; for each, the movements (or FMS) were explained, detailed, and demonstrated according to test sequences at proficient level. Without questions in the group, each child performed the test sequence individually (≅ 15 minutes per student). The children were called follow to the row call and absent students had their names moved to the end of the list. Data collection was held on Tuesdays, Wednesdays, and Thursdays in the morning and afternoon during PE classes. Testing was performed in 24 days during 2 months. All students performed the TGMD-2 test and none had difficulty during the test.

The children were filmed individually and the camera was in a position perpendicular to the participant, positioned by the preferred side of execution (left or right) with a distance of approximately 10 feet from the child. The entire test was recorded so that the evaluation of the movement pattern could be performed later with greater accuracy. The videos were recorded in full HD resolution (1920 x 1980) at 30 frames per second (fps).

Video review

The 81 videos of the children participating in the study were analyzed and each child filmed presented the execution of the twelve FMS, as determined by the manual. The images obtained from filming were analyzed separately by two evaluators previously

trained. The evaluators assessed the footage and scored on the TGMD-2 recording sheet, according to the performance criteria of each child: 1 point if the child performed the criterion proficiently and 0 if it did not reach the criterion. All videos were excluded after the calculation of results.

Statistical analysis

Descriptive analysis (minimum and maximum values, mean and standard deviation) was used for all study variables and the Kolmogorov-Smirnov test was used to check for data normality. FMS subtests were compared among students in the public and private schools, using the independent samples t-test (using Levene test to identify homogeneity, confirmed in all comparisons performed) for the variables that presented a normal distribution. For the variables whose normality curve was not present, the non-parametric Mann Whitney U-test was used. The comparisons between the public and private schools where repeated controlling the effect of chronological age with Analysis of Covariance (ANCOVA). Chronological age was compared with equivalent motor age in the two subtests for each school separately, using the Wilcoxon statistical test. All analyzes were performed using the Statistical Package for the Social Sciences (SPSS 23.0) software with a pre-established level of significance ($\alpha = 5\%$).

Results

The descriptive data from the sample's FMS (locomotor and object control) and comparisons are presented in Table 1. Only the raw Locomotor score variable of public and private students presented a normal distribution. The normality curve was not present for the variables of raw score of object control and motor age equivalent of locomotor and object control. Private school students had a higher raw locomotor score when compared to public school students (p=.032). After controlling chronological age effect in this comparison, the differences became non-significant ($F_{(1.78)}$=0.124; p=0.726), with adjusted means of the raw locomotor score of 32.2±0.7 for public schools and 32.6±0.7 to private school. However, there were no differences between the groups for the raw object control score (p=.733), even after controlling for chronological age effect. The

mean values of the raw scores of each subtest can be seen in Table 1.

Chronological age was evaluated in two ways. First, the chronological age of the public and private school students was compared. The results presented statistical differences with a value of $p<.05$. The private school students were older than public school ones (Table 1). The second way was an intra-group comparison, between the chronological age and motor age equivalent. That is, the average chronological age of school students (public and private) was compared with their own average motor age equivalent of locomotor and object control. Results showed that the equivalent motor age of the children of both schools was lower than their chronological age in the subtests. The differences are indicated by the † for public school and indicated by the $^{\#}$ for private school. These results indicated that the motor development of these students was not compatible with their chronological age.

Table 1. Descriptive data, normality test and comparisons of FMS of public and private school students.

Variables	Public (n = 43)				Private (n = 38)				*p* T test	*p* Z test
	Min	Max	Mean±SD	Norm (*p*)	Min	Max	Mean±SD	Norm (*p*)		
Raw locomotor score	25.0	40.0	31.5±3.29	.200	26.0	41.0	33.3±3.94	.200	.032*	-
Raw object control score	18.0	43.0	31.5±6.34	.194	22.0	45.0	32.5±4.93	.041	-	.733
GMQ (subtest sum)	58.0	85.0	68.32±6.90	.066	55.0	85.0	68.97±7.22	.110	.681	-
Chronological age (years)	7.8	12.0	9.8±0.99	.114	10.1	12.5	11.6±0.74	.001	-	<.001*
Equivalent motor age-locomotor	4.0	7.0	5.2±0.63	.003	4.0	7.0	5.6±0.74	.020	-	<.001#†
Equivalent motor age-object control	3.9	8.6	6.0±1.09	.110	4.3	10.6	6.2±1.01	.017	-	<.001#†

Note: FMS = fundamental motor skills; *p<.05 vs public school; †p<.05 vs chronological age of public school; #p<.05 vs chronological age of private school; GMQ = Gross Motor Quotient; SD = standard deviation; Min = minimum; Max = maximum; Norm = normality.

According to the evaluations of Figure 1, referring to locomotor, and Figure 2, regarding object control, it was observed that both public and private school students presented a performance in FMS classified between "very poor" and "average".

Figure 1. Frequency of the classification of the performance of the FMS of locomotor of public and private school students.

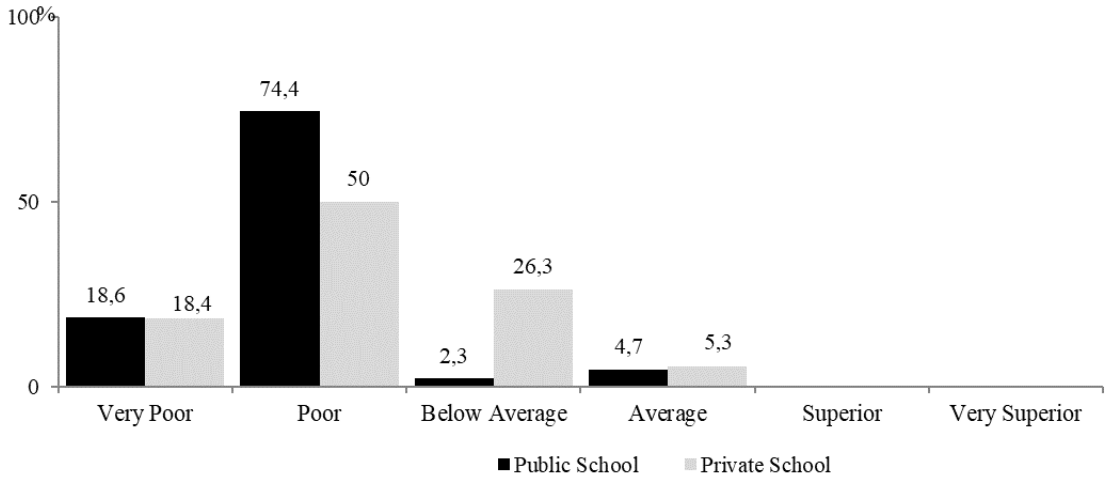
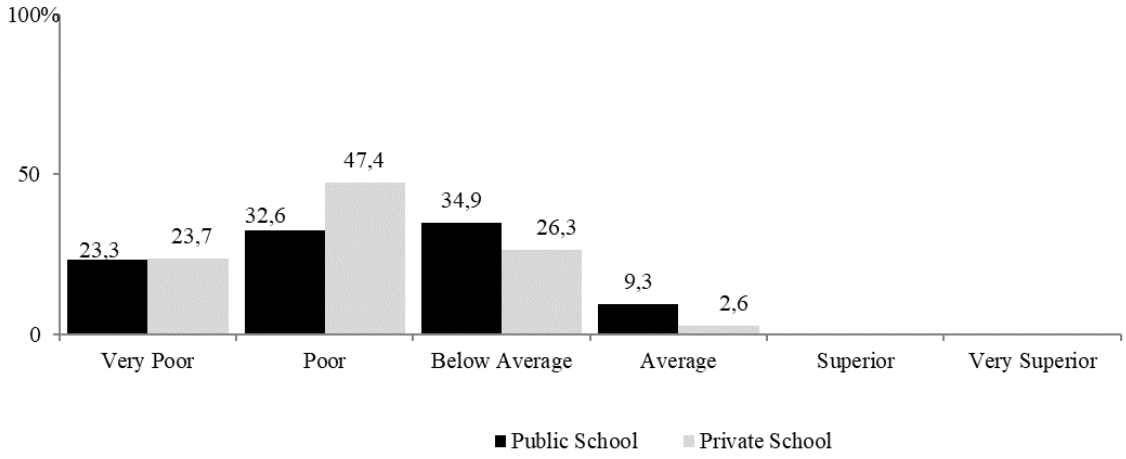


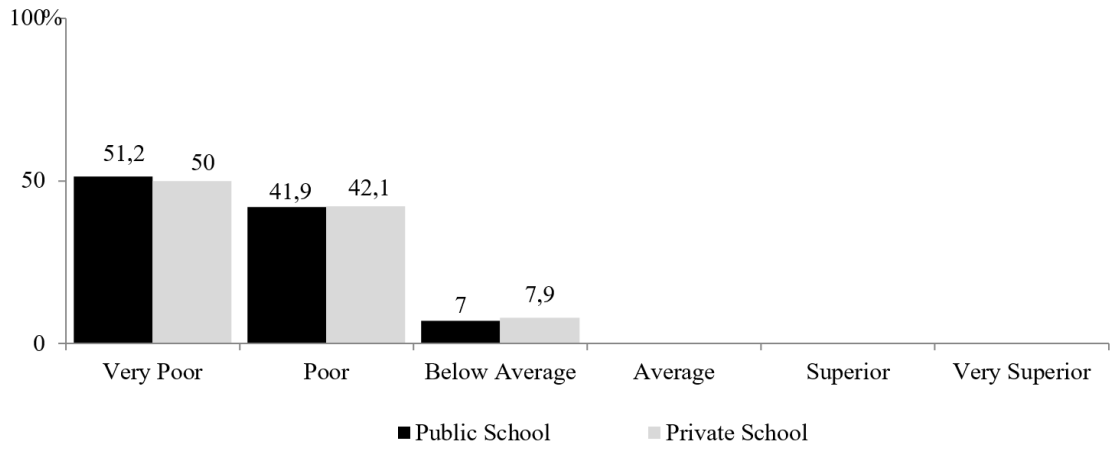
Figure 2. Frequency of the classification of the performance of object control FMS of public and private school students.



The results presented in Figure 1 demonstrate that approximately 95% of the students of both schools were “below average” in locomotor FMS. Figure 2 shows that approximately 90% of public-school students and 97.4% of private-school students did not reach the "average" rating for object control FMS. It should be noted that students were far below expected as they should be in the "Superior" and "Very Superior" ratings.

Figure 3 indicates that students from both schools presented GMQ (sum of subtests) performance from "very poor" to "below average". The results showed that, when evaluated in a general way, the students of both schools were below the expected. None of the students reached the "average" rating of GMQ. More specifically, ≅50% of the children were rated "very poor", ≅ 40% of the students were rated "poor" and ≅7% were rated “below average”.

Figure 3. Frequency of the classification of FMS of the GMQ of public and private school students.



The results demonstrate that the equivalent motor age of the children justifies the results of the "average" rating for the subtests and "below average" for the GMQ.

Discussion

It was possible to identify that children from both public and private schools were below the levels expected for FMS. However, there was a significant difference between the institutions in the raw score of the locomotor subtest. Although both schools presented deficits, the private-school students presented better scores compared to the public-school students. The improvement of locomotion FMS is fundamental for children since locomotor activities are related to conditions of physical fitness, cardiorespiratory endurance, muscular endurance, and muscular power[22]. It is evident in the PE literature that physical fitness brings countless benefits to people's health. In particular, it suggests that the PE teacher is developing classes that tend to focus a little more on the development of FMS than the public school, although the private school is still far from what is expected.

Three major factors may have contributed to the better performance (founded in locomotor skills) of students in the private school. First, the average chronological age of private school students was higher than the public school students by one year and eight months. This indicates that these students had almost two extra years to participate in physical activities than the other group. Second, private school students participated in three weekly PE classes while the other students had only two classes. Third, PA practices outside the school context may have further facilitated the development of locomotor FMS as it is evident in the literature that activities outside the school environment tend to benefit children to improve their FMS levels[16]. Although PA and sports participation were not evaluated (a limitation of this study),

private school students may have had more access to extra-curricular activities due to their social-economic status. A study with a similar design to ours but with younger children (3 to 6.5 yr) found the same results, where children from private schools performed better on locomotor skills than those from public schools, but with no difference for object control skills between schools[16].

In the object control subtest, it was also verified that students from both institutions demonstrated deficits in FMS. There was no significant statistical difference between the two groups in this subtest. FMS deficiency impairs the child in motor and psycho-social development, due to several activities, (e.g., games and sports activities), that use implements (object control), such as bats, rackets, balls, darts, Frisbees, ropes, hula hoops, etc. Thus, children with low manipulative FMS have a higher probability of not participating in games and sports activities, and as a result, reducing their practice of PA and social interactions.

According to Gallahue et al.[2], manipulative activities are essential for daily life, recreational and sports activities requiring greater stimulation and psychomotor attention during PE classes since object control is related to children's hand-eye coordination and studies have shown that children tend to not develop object control at the same quickness of that locomotor FMS[3, 5, 16]. Object control are more complex, as the subject, in addition to controlling the body (movement) must additionally manipulate the object[2]. PE teachers must encourage students in FMS to control objects since most of the practical and sports activities use equipment's.

The results of this study are more worrisome when the Gross Motor Quotient (GMQ) is discussed. Students from both institutions presented ratings of "very poor", "poor" and "below average" in FMS. This finding shows that, in general, all children have motor deficits. Given this context, it was evident how much the children have motor delay regardless of the type of school. These results are in agreement with the literature on motor development[7, 23, 24]. This finding did not confirm the first hypothesis that "private school students have higher levels of FMS compared to public school students".

The motor deficit can have serious consequences for children's health, both in the physical and affective-social aspects. A child with less than expected motor development may be more likely not to be interested in day-to-day practical activities, such as playing some sports or other activities that require physical skills. Thus, lack of ability can discourage children from being physically active and consequently can, among several problems, decrease control of specific movements, participation in sports activities, socialization with their peers, and increase body weight[3]. Lack of PA (hypokinesia) may develop health problems, such as

metabolic syndrome and diabetes diseases, resulting from a sedentary lifestyle[10, 25], which already manifest themselves in children and adolescents[26].

PA participation is a way for a child to reach the proficient level of FMS[27]. The more PA the child performs in his or her daily life, the greater the chances of developing FMS. Thus, the PE teacher needs to create activities that raise the level of PA of these students, as this is an effective way to enhance the motor repertoire of the child. This may to create a positive vicious circle, where a higher level of PA will allow an increase in levels of FMS that in return may stimulate an increase in the level of PA.

PE teachers are essential professionals to promote PA to improve students' FMS. Teachers have to carefully choose physical activities that help students improve their FMS. In this context, proposing games, plays, or sports activities related to the student's local culture may be attractive. Familiarity with the activity may increase the child's motivation and the chances of effective participation in PE classes. Activities related to other cultures should also be proposed, as long as the teacher stimulates the student's curiosity and creates means for participation. In short, students can perfect FMS through a variety of activities.

Fundamentally, teachers apply motor tests to identify students' levels of FMS. This knowledge will allow teachers to propose activities that help maintain or improve the FMS through different stimuli[2.] Another essential point is that PE teachers discuss with students the importance of reaching the proficient level of the movement and encourage them to participate in PA since it will help in the improvement of FMS. In addition, for the teacher doing his/her work in the gymnasium, he or she must aware the students of the significance of being active to develop and maintain the FMS in the proficient stages.

Corroborating with this idea, Morgan et al. [9] and Bardid et al.[24] indicated that the more active children are, the less likely they are to develop diseases of metabolic traits and consequently, the more likely they are to achieve or maintain the proficient stage. The proficient stage should be reached in childhood and should be maintained through adulthood. Only with constant PA participation resulting from stimuli, and preferably with the guidance of a PE professional, children are able to be active and to improve FMS at the ideal ages[9, 24].

Since the literature suggests that children should have FMS at proficient levels by the age of seven years[2, 9, 28], it was expected that the students in this study would have high FMS ratings according to age (chronological and motor equivalent) because the average chronological age of participants was 9.8 years among public school students and 11.6 years for private school students.

However, the intra-group analysis showed that students from both schools had the equivalent motor age delayed approximately two years for each subtest. Given this information, our second hypothesis was refuted that "private school students would have the equivalent motor age compatible with their chronological age."

PE classes with teaching strategies, guided play activities, and various instructional experiences greatly influence the motor development process[17]. It is possible to observe how fundamental the presence of PE teachers in the school environment is since this professional was prepared to elaborate programs of physical activities for children during the process of motor development. This process occurs from early childhood when patterns of sequential motor development are established. Thus, when the teacher knows the processes of motor development, it is possible to elaborate a diversified and creative teaching environment that can help children to develop the FMS in a balanced way and consequently, improve their equivalent motor age.

The games, space available to the students during the PE class, recess, and the different experiences of instruction also influence this process[27]. The schools participating in this study had gymnasiums with adequate flooring and the necessary accessories and equipment needed for classes. However, the public school had only balls, bats, and hula-hoops. The private school had more quantity and variety of equipment. Consequently, the teacher of the private school had more options in using different materials in classes, and an additional class period when compared with the teacher of the public school.

Given this context, the findings from this study contradict the literature. The private school provided spaces, different materials, reduced class sizes, and an additional weekly class period, yet students' results were not satisfactory as students were not developing FMS. Perhaps both public and private school teachers were not focused on developing the FMS of these children.

Another relevant issue that should be debated is that the PE teacher must advise school administrators so that they do not inhibit children from playing (e.g., running, playing tag, and soccer) during school free time. Free time, including recess, is a fundamental moment that the child can replicate what was learned in PE, but in an unstructured way, and thus, further improve FMS besides increasing the practice of physical activity.

Lack of space and recreational materials may also be a reason why children do not practice and improve their class-learned activities and consequently, not improve their FMS more effectively. Thus, in an attempt to improve children to achieve and maintain the proficient

stage of FMS, the PE teacher needs to be attentive, know, observe and evaluate the FMS presented by the children and to stimulate them so that they create the habit to move about and, consequently, to practice physical activities throughout their lives.

Conclusion

Public and private school students presented motor development below expected. Overall, private school students did not have higher ratings of FMS than public school students, and even though these students were older, had availability of spaces, diversities of materials, and one extra PE class per week. Locomotor score were higher for private than public school, even knowing that private school students did not reach an expected classification. For the locomotor and object control subtests, all schoolchildren had equivalent motor ages lower than their chronological age.

Thus, it is necessary to advise PE teachers to be attentive to the levels of FMS presented by young students, since FMS influences the practice of physical activity and may impact the lifestyle of these individuals.

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Disclosure statement

Nothing to declare.

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