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Original Article

DEVELOPMENT OF FUNDAMENTAL MOTOR SKILLS IN CHILDREN FROM DIFFERENT SCHOOL CONTEXTS

DESENVOLVIMENTO DE HABILIDADES MOTORAS FUNDAMENTAIS EM CRIANÇAS COM DIFERENTES CONTEXTOS ESCOLARES

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ABSTRACT
The purpose of this study was to verify the development of fundamental motor skills in elementary school children from different school environment. Fifteen children from a public school (CPub) and 15 children from a private school (CPri) were randomly chosen, from all those enrolled in the 5th grade. Children from the CPri attended, along the first four grades of elementary school, physical activities developed by a Physical Education teacher, whereas the activities for the CPub were administered by a teacher without any specific degree. All children were videotaped performing the *locomotion* and *object handling* subtests of the Test of Gross Motor Development, obtaining the raw score and the equivalent age. MANOVAs indicated lower raw scores and equivalent age for the CPub group when compared to the values of the CPri group. Finally, "t" tests indicated no difference between equivalent motor age and chronological age for the CPri group, but indicated lower equivalent motor age inferior to the chronological age for the CPub group, in the *object handling* subtest. These results point that the school context influences children's motor development.
Keywords: Physical Education. Elementary and High School. Human Development.

INTRODUCTION

Motor development is characterized by the occurrence of qualitative and quantitative changes in the motor repertoire along life. In this process, order and regularity in the acquisition of motor skills, observed in the motor repertoire of babies and children, in the first months and years of life, call the attention of many scholars of the area. Moreover, the observation of these two characteristics has strongly allowed the pioneers in the area of motor development suggesting that the course of motor development was determined by the maturation of the central nervous system (GESELL, 1933). From this perspective, the acquisition and enhancement of motor skills were explained as derived from processes genetically onset, inherent to the body and common to all representatives of the human species, and little influenced by the environment.

Recently, the explanation about the acquisition and enhancement of motor skills has radically changed, starting to be understood as a result of a dynamic process (THELEN, 1995; BARELA, 1999; THELEN, 2000; POLASTRI; BARELA, 2002). From this point-of-view, changes in motor development are regarded as successive states of stability, instability and changes of phases that allow the motor behavior changing from an attractive state to another attractive state (THELEN; SMITH, 1994), which, when visualized inside a broader context, delineate the developmental course.

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More important than this is that developmental changes may be triggered and influenced by factors of the body, of the environment and of the task (CLARK, 1994, 2007), implying an active involvement of the developing being with the environment into which he is inserted (THELEN, 1995; POLASTRI; BARELA, 2002). Is spite of assuming the influence of multiple factors, the dynamic view of motor development also assumes that some factors, those called parameters of control, may have a decisive influence, superposing the influence of other factors and promoting alterations in the developmental state (THELEN, 1989; CLARK, 1994; THELEN, 1995; BARELA, 1997). As influences in the environment and tasks, opportunity of structured practice and appropriate instruction are determinant factors (parameters of control – in the dynamic language) so that new motor skills may be acquired and, especially, enhanced throughout the developmental cycle, including, in this repertoire, fundamental motor skills, such as running, kicking, throwing, receiving and other. In this case, the opportunity for structured practice and the appropriate instruction are roles of Physical Education professionals (PELLEGRINI; BARELA, 1998) who work in schools. These professionals should provide activities with defined objectives and directed to the development of specific aspects of students. Besides, they should provide information about the motor skill to be performed and information about eventual alterations and/or corrections that the student needs to carry out so that the objective inherent to the class or motor action are achieved.

For a long time, some professionals considered that the activity of a physical education teacher, offering structured practice and appropriate information, should occur only when the child is around 10 years of age, with the introduction of specific motor skills to the sportive modalities; but the opinion that children acquire fundamental motor skills naturally, therefore without needing the action of a professional and a structured practice, does not meet the reality (GALLAHUE, 1982; GALLAHUE; DONNELLY, 2008). In general, children acquire fundamental motor skills through their own experience, but these fundamental motor skills are enhanced and, consequently, most children do not achieve a more efficient execution of movement within the environmental context named mature pattern (GALLAHUE, 1982; GALLAHUE; DONNELLY, 2008). In fact, children have the potential to present a mature pattern in fundamental motor skills when they are around six or seven years old, but this pattern will be achieved with a structured practice and appropriate instruction (GALLAHUE, 1982; GALLAHUE; DONNELLY, 2008). Although this has no empirical proof yet, if these fundamental motor skills are not developed in their entirety, the effective participation in plays, games, dances, recreational, sportive, circus and social activities, as well as the performance of daily activities, may be impaired.

The lack of full development of the motor potentialities, especially of fundamental motor skills, is being demonstrated both in the overall set of motor skills (BRAGA et al., 2009) and in specific motor skills, like running (FERRAZ, 1992). The lack of opportunity for a systematized and structured practice, with the purpose of providing diversified motor experiences and appropriate instructions, may be one of the reasons children do not achieve more elevated levels of motor development in the fundamental motor skills, staying beneath the expected level for the respective ages, as observed in several studies (FERRAZ, 1992; VALENTINI, 2002; BRAGA et al., 2009).

Considering that children have the potential to develop fundamental motor skills up to seven years old (GALLAHUE; DONNELLY, 2008), even before beginning Elementary School I, and that opportunity for a systematized and structured practice is crucial for the acquisition of an efficient performance of these skills, it is important to examine these questions empirically. Recently, a motor intervention program has caused improvement in the level of motor development of children aged six and seven years old (BRAGA et al., 2009).

The results of the study by Braga and colleagues (BRAGA et al., 2009) are promising and very important; indicating that structured intervention brings about alterations in motor

development, although such effects may be associated to the specificity of the intervention applied and a result of it. Possible longitudinal effects, derived from different teaching opportunities and realities, need to be examined. Thereby, this study aimed to compare the development of fundamental motor skills of children in early second phase of Elementary School I who were exposed to different contents, opportunities of motor practice and specific instruction in the first phase of Elementary School I.

METHOD

Participants

The sample was randomly selected and composed of thirty children from different teaching conditions and realities, belonging to the education network of the city of São Bernardo do Campo, state of São Paulo, Brazil. Fifteen children of both genders (seven girls and eight boys, aged 10.7 +0.3, 46.8+10.9 kg of body mass, 1.47 +0.6 m of height) who studied the first phase of Elementary School I (former 1st to 4th grade) in a public school, enrolled in the 5th grade of the same school, were drawn and composed the group of children from public school (CPub). Fifteen children of both genders (seven girls and eight boys, aged 10.3 +0.4 years old, 38.5 +8.0 kg of body mass, and 1.41 +0.7 m of height) who studied the first phase of Elementary School I (former 1st and 4th grade) in a private school, enrolled in the 5th grade of the same school, were drawn and composed the group of children from private school (CPri). The participation of the children was allowed if their legal guardians signed an informed consent form after being informed about the objectives of the present study, which was approved by the Institutional Ethics Committee (protocol 117/2009). Besides, no child presented or indicated any musculoskeletal condition that could compromise his/her participation in the study.

Although both schools, the public and the private one, are located in the central region of the city of São Bernardo do Campo, the experiences lived by the children in the respective schools, in the first four grades of Elementary School I, were very different. The children of the private school had Physical Education classes twice a week, lasting 50 minutes, taught by a Physical Education professional. The Physical Education program developed consisted of activities involving a systematized practice of fundamental motor skills and used as strategies repetitive exercises, recreational games, pre-adapted games and pre-sportive games. The children of the public school had the activities of motor experience called *body and movement*, also twice a week, with duration of 50 minutes, taught by the teacher responsible for the curricular content of the class. The activities developed, most of the time, involved recreational activities and games, without a specific direction of content and instruction.

In addition to different physical activity programs, the schools in which the children were enrolled in the first phase of Elementary School I differed in terms of facilities and material available that they used in the respective Physical Education/physical activity programs. Whereas the children of the private school performed the activities in an indoor multi-sports court, with appropriate floor and ventilation, the children from the public school used a covered/indoor court with cemented floor. Besides, the children of the private school used adequate number of several types of ball, mattresses, sticks, which allowed for experiences much superior to those lived by the children of the public school. Thus, besides the differentiated action regarding the proposal of activities and their application, the children also had differentiated conditions as for the physical structure and material available, along the four initial grades of Elementary School.

Instrument

The instrument to assess motor development used in the present study was the Test of Gross Motor Development, second version (TGMD-2), proposed by Ulrich (2000), which has been used for the assessment of the development, especially of the fundamental motor skills in children aged between three and ten years old. The TGMD-2 assesses twelve skills: six in the Locomotion subtest (running, galloping, jumping on one foot, jumping over, jumping horizontally and displacing laterally) and six in the Object handling subtest (kicking back, bouncing, kicking, throwing over and throwing under). The normative sample of the TGMD-2 was composed from 1,208 people of ten North-American states.

According to Ulrich (2000), the TGMD-2 can be used to identify children who present difficulties in mastering fundamental motor skills in relation to their peers, to assist in the planning of an instructional program for the development of fundamental motor skills, to assess the progress of children in the development of fundamental motor skills, and to serve as instrument in studies involving assessment of motor development. Recently, Cools and colleagues (COOLS et al., 2008), in an analysis of several motor tests, have suggested that the TGMD-2 present acceptable validity, objectivity and reproducibility for the assessment proposed, can be easily applied and comprehends the analysis of fundamental motor skills.

In a general way, the TGMD-2 allows verifying whether the child can perform the tasks that involve the major fundamental motor skills and the performance in which children coordinate their limbs (upper and lower) and the trunk during the execution of the motor task, instead of only assessing the final performance. Each skill of the locomotion and object handling subtest has from three to five behavioral components that are presented as performance criteria (ULRICH, 2000). If the execution analyzed presents the performance criterion, it receives one score. In the end, the scores of two trials are summed, comprising all motors skills, which indicate the level of execution of the skills in the respective subtest, called “raw scores”. There is also the possibility of obtaining the equivalent motor age, considering the raw score obtained by each child in the respective subtest in relation to the normative data.

In Brazil, Valentini and colleagues (VALENTINI et al., 2008) validated the TGMD-2 for the population of Rio Grande do Sul, Brazil, using a translation in Portuguese. Although it is not translated and does not have normative data for the Brazilian population, the TGMD-2 has been used to assess several aspects of the motor development of Brazilian children in several situations (BRAGA et al., 2009; BRAUNER; VALENTINI, 2009). Similarly, the TGMD-2 has also been used in studies conducted in other countries (PANG; FONG, 2009).

Procedures

The collection of data from the children occurred in the facilities of the court in the respective schools, in the beginning of the school year of the 5th grade of Elementary School I (end of March, early April). Initially, the date of birth and information on manual and pedal dominance, body mass and height were obtained. Then, the children were videotaped performing the motor skills of the locomotion and object handling subtests of the TGMD-2, as suggested (ULRICH, 2000). For such a purpose, a digital camera (Sony DCR-HC96) was positioned on one of the half of the court in such a way that it was possible to record the children performing the skills of running, galloping, jumping on one foot, jumping over, jumping horizontally and displacing laterally (*locomotion* subtest). Another camera (Sony DCR-HC96) was positioned on the other half of the court, enabling the recording of the children performing the skills of kicking back, bouncing, kicking, throwing over, throwing under (*object handling* subtest). In all cases, the identity of the children was preserved; they were identified through a number defined before the recording.

The children were instructed according to what was suggested in the TGMD-2 and executed three repetitions of every motor skill mentioned above. The first execution, as suggested by Ulrich (2000), aimed to verify whether the child had understood the task, and the other two repetitions were considered for analysis. If the child had not understood the task, it was explained again and repeated by the child.

The recording of the motor skills of each of the subtests lasted approximately five minutes for each child, which totaled about ten minutes of test. The explanations were provided by two teachers responsible for the study, one of which provided information on the *locomotion* subtest and the other one provided all children with information on the *object handling* subtest.

Data analysis

After the recording, the images of the children performing the motor skills of both subtests were analyzed in the Laboratory for Movement Analysis, by three dully prepared raters. For this analysis, an assessment form similar to the proposed in the TGMD-2 was prepared, and the two trials made by the children were scored according to the development criteria (ULRICH, 2000). To do so, when the performance criterion was identified in the movement executed by the child, it received "one score", and when the performance criterion was not identified in the movement, it received "zero score". This assessment was carried out by the three of the examiners, separately. After the individual analysis, the individual assessments were checked; the agreement of at least two of the raters for the respective skills analyzed was necessary. In the rare cases when there was disagreement among the three raters, the assessment of the skills in question was carried out again.

The assessment based on the development criteria occurred for the skills of both subtests; considering the two repetitions of the child, the total value possible for the *locomotion* and *object handling* subtests was 48. This scoring represents the raw score of the performance of the child in the respective subtest; the higher the raw score, the better the performance of the movement executed by the child.

Using the raw scores, the equivalent motor age of each child was obtained, based on the normative data of the TGMD-2 (ULRICH, 2000). In this case, the equivalent motor age reflects the hypothetical motor age, based on the performance criteria that the child presented. In the same way as the raw scores, the equivalent motor age was calculated for the *locomotion* and *object handling* subtests was calculated.

Statistical analysis

Two multivariate analyses (MANOVAs) were used to verify eventual differences between the children of both schools (group factor). The first MANOVA had as dependent variables the raw scores and the equivalent motor age, considering the *locomotion* subtest and the second MANOVA has as dependent variables the raw scores and equivalent motor age, considering the *object handling* subtest.

Four "t" tests were carried out to verify whether the equivalent motor age was different from the chronological age for the *locomotion* subtest and for the *object handling* subtest of the children from both schools. In these tests, the equivalent motor age obtained was compared to the mean of the chronological age of the respective group.

When necessary, univariate analyses were conducted. All analyses were carried out through the statistical software SPSS (SPSS, version 10), maintaining the level of significance at 0.05.

RESULTS

All of the children were capable of executing the motor skills of both motor subtests. Figure 1 displays the raw scores of the *locomotion* and *object handling* subtests for the children of both groups. The MANOVA revealed difference between groups ("Wilks" Lambda=0.664, F(2.27)=6.821, p<0.005). The univariated tests revealed difference between groups for the raw scores of the *locomotion* subtest (F(1.28)=6.713, p<0.05) and for the raw scores of the *object handling* subtest (F(1.28)=13.83, p<0.005); in both cases the raw scores of the CPub group were inferior to the raw scores of the CPri

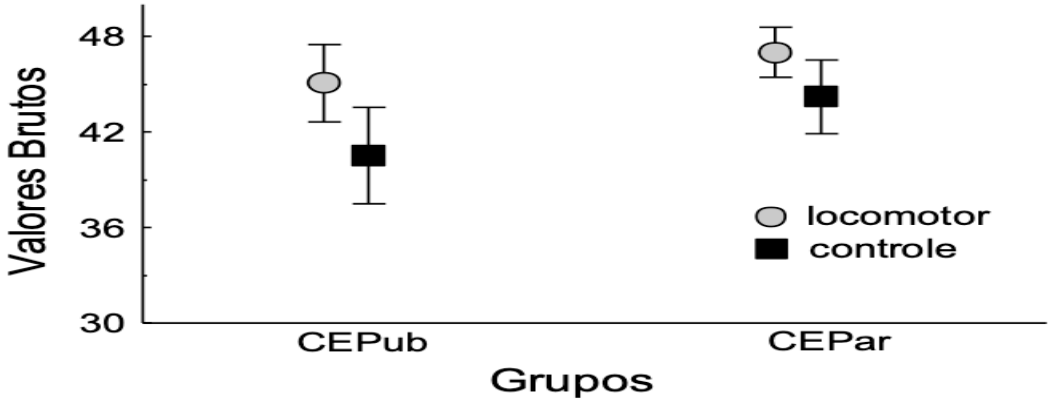

Figure 1 - Mean and standard deviation of the raw scores of the group of children from public school (CPub) and of the group of children from private school (CPri) referring to the *locomotion* (locomotion) and object handling (handling) subtests.

Figure 2 presents the equivalent motor age of the *locomotion* and *object handling* subtests for the children of both groups. The MANOVA revealed difference between groups ("Wilks" Lambda=0.590, F(2.27)=9,38, p<0.005). The univariated tests revealed difference between groups only for the equivalent motor age of the *object handling* subtest, F(1.28)=19.44, p<0.001; the motor age of the CPub group was lower than the equivalent motor age of the CPri group.

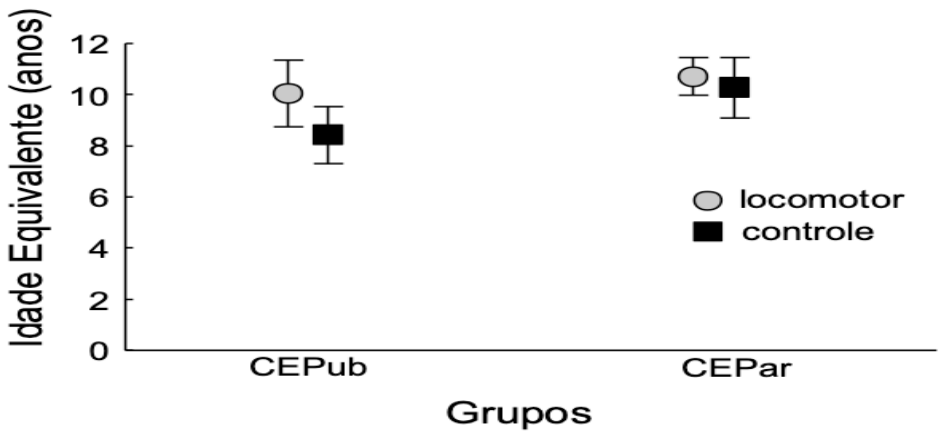

Figure 2 - Mean and standard deviation of the equivalent motor ages of the group of children from the public school (CPub) and of the group of children from the private school (CPri), referring to the *locomotion* (locomotion) and *object handling* (handling) subtests.

The CPub group presented equivalent motor age inferior to that of the CPri group and proved being below the chronological age in the execution of skills that composed the *object handling* subtest. The "t" test revealed that the equivalent motor age referring to the *object handling* subtest of the CPub group is inferior to the chronological age of the respective children, (14)=7.96, p<0.001. Differently, "t" tests did not reveal any differences between the equivalent motor age and the chronological age for the *locomotion* subtest for the CPub group (t(14)=1.99, p>0.05) and for the CPri group (t(14)=2.00, p>0.05), and for the *object handling* subtest of the CPri group (t(8)=0.15, p>0,05).

DISCUSSION

The objective of this study was to compare the development of fundamental motor skills of children in the beginning of the second phase of Elementary School I who were exposed to different contents, opportunities of motor practice and specific instruction in the first phase of Elementary School I. The results indicated differences in the development of motor skills among the children who had different contents, opportunities and instruction for the motor practice. Although no systematized assessment of the classes and of the conditions of the school was carried out, the children who studied the first grades of Elementary School I with Physical Education classes taught by a professional of the area presented motor development superior to that observed in children who studied the same grades in schools that had motor activity offered by the teacher responsible for the class. In addition, the equivalent motor age of the children from the private school was not different from the chronological age for the locomotion skills ad for the skills involving object handling. On the other hand, the children who studied the first grades of Elementary School I in the public school presented motor development equivalent to the chronological age only for the locomotion skills, and shower motor development inferior to the chronological age for the skills involving object handling.

The direct comparison of the level of motor development between the group of children from the private and the public schools indicate that different education conditions, in the initial grades of Elementary School I, seem to promote different motor developments between the children. It is worth stressing that the major objective of this observation is not to indicate that the private system of education is better than the public one, but that the activity of a Physical Education professional who, based on contents, opportunities for motor experiences, appropriate instruction and better conditions of infrastructure and of materials and equipment, produce different effects on the motor development of children. In this case, the school context, having as a central aspect the activity of the teachers, also has an important role in the delineation of the developmental course of the child.

The results observed in the present study corroborate the observation of delay in the development of motor skills verified in previous studies (BRAGA et al., 2009; BRAUNER; VALENTINI, 2009). In the present study, delay was observed in the development of object handing skills in children from the public school that did not have the chance to experience content developed by a Physical Education professional. This delay in relation to the chronological age was around two years, and can be considered crucial for the future developmental course of these children.

It is important to highlight that the children who had an environment apparently more favorable, as the one that possibly the children of the private school had, present levels of development of fundamental motor skills correspondent to their chronological age. This observation is important for several factors, for instance, the fact that the opportunity for a systematized and structured practice brings about the full development of the potential of the

children, as previously observed in specific intervention programs (BRAGA et al., 2009; BRAUNER; VALENTINI, 2009). In the case of the present study, a better motor development did not result from a specific intervention program, but from the offering of appropriate opportunities during the developmental course and in the most sensitive period for the development of fundamental motor skills (GALLAHUE, 1982; CLARK, 2007; GALLAHUE; DONNELLY, 2008). Children from the private school, among other aspects, had more adequate opportunities, such as specific content, appropriate instruction, adequate place, access and availability of material and equipment, which favored their full motor development. These children would not need to engage in intervention activities, because they had opportunity and, consequently, used their potential for the development of fundamental motor skills.

On the other hand, children who do not have a propitious environment and systematized and structured opportunity for the development of motor skills can be impaired in motor terms. This was, presumably, the case of the children from the public school, who presented equivalent motor age inferior to the chronological one, regarding the skills that involve object handling. Thereby, only the biological factors do not provide nor guarantee the full development, even in the case of the fundamental motor skills.

The understanding that the development of fundamental motor skills occurs naturally, as suggested by some scholars, ruled by neuro-maturational principles EGESELL, 1933), has been pointed as a big mistake (CLARK, 2007) that permeated the proposals of the School Physical Education. The results of the present study corroborate the importance of the opportunity and a structured and systematized practice so that even the fundamental motor skills are fully developed. Moreover, the results suggest that the fundamental motor skills are naturally acquired, as children explore their motor potentialities, but these skills are not naturally enhanced and does not allow children achieving greater efficacy and adapting their execution to the demands of the context. Along the first decade of life, children have the potential to perform fundamental motor skills with aplomb and adaptability to the demands of the context (GALLAHUE; DONNELLY, 2008), but they need environmental stimuli in the form of instruction and appropriate practice so that this potential is totally turned into motor actions performed by the children in line with the needs of the context. In this case, the conditions of the school and the action of the teacher as a promoter of structured and organized activities and provider of appropriate instruction and agreeable with a defined objective acts then as a parameter of control (THELEN, 1989), in such a way that, in spite of the countless factors that could alter the course of the development, they begin to promote developmental changes (PELLEGRINI; BARELA, 1998).

Besides, the delay in the development of fundamental motor skills may affect the developmental course, creating an insurmountable barrier for many of the children, called proficiency barrier (CLARK, 2007; GALLAHUE; DONNELLY, 2008). Children who present low level of development of fundamental motor skills may even have an interest in performing recreational and/or sportive activities, but these children will face huge difficulties to perform the motor skills required and adaptable to the demands of the context. When this happens, these children have a great risk for giving up effectively engaging in plays, games, dances, recreational, sportive, circus and social activities and, consequently, they fail overcoming this barrier of motor proficiency (CLARK, 2007), abandoning the practice of such activities, an usual fact in the context of school physical education.

It is interesting to note that the results of the present study indicate that such impairment in the development of fundamental motor skills occurs in a more pronounced way in those skills that involve object handling. These skills are even more required and necessary for recreational activities, therefore they can be even more crucial to difficult

the engagement in recreational and/or sportive activities. This result indicates that, for the locomotion activities, the experiences lived by the children would be already sufficient for their full development. Although developmental delay has been observed for the locomotion skills at younger ages (BRAGA et al., 2009; BRAUNER; VALENTINI, 2009), this does not seem to be the case of children in the end of the first decade of life, as pointed in the results of the present study.

The present study presents some limitations that need to be recognized and mentioned, and are described below.

The first of them is that the design employed is the quasi-experimental type, whereas the desirable one is a study with actual experimental design. By the way, it is worth reporting that efforts are being made towards the conduction of a study with such design.

The second limitation is that the activities provided to and performed by the children from both schools were not thoroughly controlled, not even accompanied/monitored, and can be described only in a generalized way, as in the present study. The same happened with the extracurricular activities, which were controlled only by information provided by the parents.

The third limitation is that the anthropometric characteristics of the children of the groups are slightly different, in such a way that the children of the public school are slightly older, higher and heavier that the children from the private one. Although the similarity between the groups in relation to these variables is desirable, there is no indication that such differences have interfered with the results observed in the present study.

Finally, the use of the TGMD-2, test of motor development assessment proposed and normatized for the American reality, can be questioned. Regarding this possible limitation, we can minimize eventual undesirable influences for two reasons. The first one is that the TGMD-2 is a test directed to the fundamental motor skills that should be carried out with aplomb by all children, regardless of the sociocultural context, because they form the basis for the acquisition of other motor skills (CLARK, 1994, 2007; COOLS et al., 2008; GALLAHUE; DONNELLY, 2008); and the second one is that the children of the present study who had a school context presumably more favorable for the full development did not differ as for the equivalent motor age obtained from the normative data of the TGMD-2 (ULRICH, 2000); therefore, the Brazilian children who had better opportunities in the school context presented development of fundamental motor skills similar to that of the American children used for the referential norms of the test.

In spite of the various limitations of this study, it was possible to demonstrate that different conditions of school context, experienced throughout the first grades of Elementary School I, seem to interfere and provide children with different levels of motor development. Children who experienced opportunity and practice of Physical Education in a structure way , taught by a specific professional in the area in the first grades of Elementary School I presented motor development superior to that of their peers who did not have such opportunity of practice. Besides, these conditions of differentiated practice and instruction cooperated so that these children did not present any motor delay. On the other hand, children who did not have the same opportunities presented development of motor skills related to object handling inferior to the expected for their age. Thus, it may not only be suggested that the environment interferes with the motor development of children, but also that Physical Education in the initial years of Elementary School I has an important role to guarantee the expected motor development for children in the end of the first decade of life.

REFERENCES

BARELA, J. A. Perspectiva dos sistemas dinâmicos: teoria e aplicação no estudo de desenvolvimento motor. In: PELLEGRINI, A. M. (Ed.). **Coletânea de estudos**: comportamento motor. São Paulo: Movimento, 1997. p.11-28.

_____. Aquisição de habilidades motoras: do inexperiente ao habilidoso. **Motriz**, Rio Claro, v. 5, n. 1, p. 53-57, 1999.

BRAGA, R. K. et al. A influência de um programa de intervenção motora no desempenho das habilidades locomotoras de crianças com idade entre 6 e 7 anos. **Revista da Educação Física/UEM**, Maringá, v. 20, n. 2, p. 171-181, 2009.

BRAUNER, L. M.; VALENTINI, N. C. Análise do desempenho motor de crianças participantes de um programa de atividades físicas. **Revista da Educação Física/UEM**, Maringá, v. 20, n. 2, p. 205-216, 2009.

CLARK, J. E. Motor development. **Encyclopedia of human behavior**, [S.l.], v. 3, no. 1, p. 245-255, 1994.

_____. On the problem of motor skill development. **Journal of Physical Education, Recreation and Dance**, Reston, v. 78, no.5, p. 39-45, 2007.

COOLS, W. et al. Movement skill assessment of typically developing preschool children: a review of seven movement skill assessment tools. **Journal of Sports Science and Medicine**, Bursa, v. 8, p. 154-168, 2008.

FERRAZ, O. L. Desenvolvimento do padrão fundamental de movimento correr em crianças: um estudo semi-longitudinal. **Revista Paulista de Educação Física**, São Paulo, v. 6, n. 1, p. 26-34, 1992.

GALLAHUE, D. L. **Understanding Motor Development in Children**. Boston: John Wiley, 1982.
GALLAHUE, D. L.; DONNELLY, F. C. **Educação Física desenvolvimentista para todas as crianças**. São Paulo: Phorte, 2008.

GESELL, A. Maturing and the patterning of behavior. In: MURCHISON, C. (Ed.). **A handbook of child psychology**. New York: Russell & Russell, 1933. p. 209 235.

PANG, A. W. Y.; FONG, D. T. P. Fundamental motor skill proficiency of Hong Kong children aged 6-9 years. **Research in Sports Medicine**, Philadelphia, v. 17, p. 125-144, 2009.

PELLEGRINI, A. M.; BARELA, J. A. O que o professor deve saber sobre o desenvolvimento motor de seus alunos. In: MICOTTI, M. C. D. O. (Ed.). **Alfabetização**: assunto para pais e mestres. Rio Claro: Instituto de Biociências, 1998. p. 69-80.

POLASTRI, P. F.; BARELA, J. A. Percepção - ação no desenvolvimento motor de crianças portadoras de Síndrome de Down. **Revista da SOBAMA**, São Paulo, v. 7, n. 1, p. 1-8, 2002.

THELEN, E. Evolving and dissolving synergies in the development of leg coordination. In: S. A. Wallace (Ed.). **Perspectives on the coordination of movement**. Northholland: Elsevier Science, 1989. p. 259-281.

_____. Motor development: a new synthesis. **American Psychologist**, Washington, DC, v. 50, no. 2, p. 79-95, 1995.

_____. Grounded in the world: developmental origins of the embodied mind. **Infancy**, [S.l.], v. 1, no. 1, p. 3-28, 2000.

THELEN, E.; SMITH, L. B. **A dynamic systems approach to the development of cognition and action**. Cambridge: MIT Press. 1994.

ULRICH, D. A. **Test of gross motor development-2**. Austin: TX: PRO-ED, 2000.

VALENTINI, N. C. Percepções de compet~encia e desenvolvimento motor de meninos e meninas: um estudo transversal. **Movimento**, Porto Alegre, v. 8, n. 2, p. 51 62, 2002.

VALENTINI, N. C. et al. Teste de desenvolvimento motor grosso: validade e consistência interna para uma população gaúcha. **Revista Brasileira de Cineantropometria & Desempenho Humano**, Florianópolis, v. 10, n. 4, p. 399-404, 20

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