
EFFECT OF SCHOOL TYPE AND FAMILY INCOME ON MOTOR COMPETENCE CHANGES IN PRE-SCHOOL CHILDREN: A REPEATED CROSS SECTIONAL STUDY**EFEITO DO TIPO DE ESCOLA E RENDA FAMILIAR NAS MUDANÇAS DA COMPETÊNCIA MOTORA EM CRIANÇAS PRÉ-ESCOLARES: UM ESTUDO TRANSVERSAL REPETIDO**

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RESUMO

A competência motora (CM) é um atributo associado a comportamentos positivos de saúde; fatores contextuais, parecem desempenhar um papel importante para CM de crianças. O objetivo deste estudo foi comparar a CM de pré-escolares em dois diferentes anos e identificar o efeito de fatores contextuais (tipo de escola e renda). Duas amostras representativas de crianças (3 a 5 anos) da cidade do Recife foram avaliadas em dois momentos: no ano de 2010 (282 crianças; 151 meninos) e 2012 (270 crianças; 148 meninos). A avaliação da CM foi realizada com o Test of Gross Motor Development – 2. A análise dos dados utilizou a Anova Two-Way e a Ancova ajustada por tipo de escola (pública e particular) e renda familiar, foi adotado um $p < 0.05$. Foi identificada uma superioridade nas habilidades locomotoras, de controle de objetos e no quociente motor geral para as crianças analisadas em 2010 e o tipo de escola e renda aumentaram o tamanho do efeito das diferenças nas habilidades de controle de objetos e no quociente motor geral. Podemos concluir que houve uma diminuição na CM da população pré-escolar após dois anos e que as variáveis contextuais tipo de escola e renda são importantes para o desenvolvimento da CM.

Palavras-chave: Infância. Desempenho Psicomotor. Saúde.

ABSTRACT

Motor competence (MC) is an attribute associated with positive health behaviors; contextual factors, seems to play a important role for MC of children. The purpose of this study was to compare the MC of preschool children in two different years and to identify the effect of contextual factors (school type and family income). Two representative samples of children (3 to 5 years old) from Recife were assessed in two time periods: 2010 (n= 282 children, 151 boys) and 2012 (n=270 children, 148 boys). MC was assessed using the Test of Gross Motor Development - 2. Data analysis used the Anova Two-Way and the Ancova tests adjusted by type of school (public and private) and family income, a $p < 0.05$ was used. Locomotor skills, object control and overall motor quotient were superior for the children analyzed in 2010. Furthermore, the school type and income increased the effect size in the differences in object control skills and the general motor quotient. We can conclude that there was a decrease in MC of the preschool population after two years and that the contextual variables type of school and family income are important for the development of MC.

Keywords: Childhood. Psychomotor Performance. Health

Introduction

Motor competence (MC) is a general term that refers to proficiency or performance in skills for all motor actions involving coordination and control of the human body¹. Examples of activities that require MC are those involving locomotor skills (i.e. running, jumping), and object control skills (i.e. overhead throw or kicking). These skills are developed through childhood (considered the critical phase to develop MC) and play a significant role in supporting engagement in physical activity throughout life²⁻⁵.

Previous longitudinal studies have reported positive associations between MC and higher levels of physical activity in adults⁶; however, the literature also suggests that children are not reaching the recommended levels of physical activity⁷ or adequate levels of MC^{8,9}. In

some cases, studies reported declining rates in MC^{10,11}. Thus, identifying factors that contribute to skilled performance can promote valuable insights to improve performance and health through motor skills.

Historically, studies of motor behavior in children have focused on biological factors such as age, weight status and sex¹²⁻¹⁴. However, contextual factors, such as school type (public or private) and socioeconomic level, have been suggested as potential aspects that can significantly influence MC¹⁵⁻¹⁸. For example, Queiroz et al.¹⁶ compared the MC of pre-school children from two different contexts (school type). In this study, children from private schools performed better than those from public schools. In a meta-analysis, Barnett et al.¹⁷ identified that higher strata of socioeconomic level was a contextual factor considered consistent when correlated with MC. In addition, Venetsanou and Kambas¹⁵ in a systematic review identified that, in pre-school children, the school type and the socioeconomic level were factors associated with MC. Our hypothesis is that MC in children exposed to similar contextual aspects would have the same values within the two years of evaluations. Therefore, it is important to evaluate the effect of these two factors on the changes in MC.

The purpose of this study was twofold. First, we aimed to examine the MC trend in a sample of children collected at two assessment points in 2010 and 2012. Second, we aimed to verify whether there is an effect of the school type and/or family income on MC.

Methods

Study Design, Population and Participants

This repeated cross-sectional study included a population-based sample from Recife – Brazil. The sample was from the longitudinal study “*Estudo Longitudinal de Observação da Saúde e Bem-estar da Criança em Idade Pré-Escolar*” (ELOS-Pre), which included 28 public (n=7) and private (n=21) schools from Recife’s administrative political regions clusters (n=6). Two representative samples of 3 to 5-year-old children from the 2010 (n= 282) and 2012 (n= 270) from the longitudinal ELOS-Pre database were used as the final sample (n=552 children, 299 boys). This study was approved by a local research ethics committee (CEP 097/10; CAAE - 0096.0.097.000-10). Written consent was obtained from legal guardians of all participants.

Study Procedures and Assessment

Motor competence was assessed using the Test of Gross Motor Development-2 – TGMD-2¹⁹. The TGMD-2 is consistently used in research involving MC in children², and it has adequate validity and reliability for the Brazilian population²⁰. The test evaluates 6 locomotor skills (run, gallop, hop, leap, horizontal jump, slide) and 6 object control skills (striking a stationary ball, stationary dribble, kick, catch, overhand throw, and underhand roll). The assessment can typically be completed within 20-30 minutes per child. Performance is then rated according to a process-oriented checklist¹⁹. Details related to test application can be observed elsewhere¹⁹.

The TGMD-2 was administered by two trained raters. The participants were asked to perform two attempts of each motor skill. Each attempt was recorded in the sagittal plane, using a digital video camera (Cyber-Shot DSC-H20, 10.1 megapixels).

Data reduction

The participant’s video performances were analyzed in slow motion using Media Player Classic, a free download software. The motor skills were assessed based on 3 to 5 qualitative criteria (i.e. assessment criteria for running: “brief period where both feet are off

the ground”), and assigned a score of 1 (one) to performances that meet the specific motor skill criteria and a score of 0 (zero) to performances that did not meet the criteria.

Videos were decoded by another two trained researchers (intra-rater reliability for locomotor skills ICC = 0.97, CI = 0.95-0.98; object control skills ICC = 0.95, CI = 0.92-0.97). Potential rate disagreements were re-evaluated, and a final score attributed. Raw scores from the 12 motor skills were converted to standard scores to adjust an individual’s motor performance based on age and gender¹⁹. Data analysis used standard scores of locomotor skill (ranged 0-24 points), object control (ranged 0-24 points), and the general motor quotient (equal to the sum of locomotor and objective control scores; ranged 0-48 points).

Data Analyses

Data normality was assessed through the Kolmogorov-Smirnov test and histogram analysis. To identify possible changes between years (primary objective), an ANOVA Two-Way (Year*Sex) was carried out and adjusted by covariates (ANCOVA). Socioeconomic status (family income) and school type (public or private) were used as covariates (secondary objective). The Effect Size was calculated and classified as proposed by Cohen²¹: small effect ($0.20 \leq d < 0.50$), moderate effect ($0.50 \leq d < 0.80$) and large effect ($d \geq 0.80$). All data analyses were performed through the SPSS 17.0 software at the level of significance fixed at $p < 0.05$.

Results

Table 1 reports participants’ descriptive characteristics and inferential analysis. In 2010, 36.2% of the sample was classified as low family income, 34% as middle family income, and 29.8% as high family income. In terms of school type, 44.7% of sample was from public school and 55.3% was from private school. In 2012, 38.9% of the sample was classified as low family income, 24.4% as middle family income, and 36.7% as high family income. Regarding the school type, 55.2% of the children were from public school and 44.8% were from private school. Initial analysis indicated that there was no interaction between years of assessment (2010 and 2012) and sex. Thus, sex stratification was not included in the next analyses.

Table 1. Age, body mass index (BMI) and standard motor competence in locomotor skills, object control skills and general motor quotient (GMQ) in the years 2010 and 2012 of preschoolers. Recife-PE

	2010 (n = 282)	2012 (n = 270)	Analysis of variance				
			F	p	ES	F _(year*sex)	p
Age (months)	57.6 (8.9)	52.6 (6.7)	18.5	<0.001	-	1.2	0.276
BMI (kg/m ²)	16.1 (2.4)	16.2 (2.2)	0.9	0.432	-	0.02	0.894
Locomotor score	10.2 (1.9)	9.1 (2.5)	10.2	<0.001	0.27	0.5	0.473
Object control score	9.6 (2.2)	9.1 (2.3)	2.8	0.040	0.14	0.6	0.443
GMQ score	99.3 (10.1)	94.6 (12.3)	8.0	<0.001	0.24	0.001	0.971

Note: Data expressed as: mean (Standard deviation); ES= Effect Size - Cohen’s d

Source: Authors

Results reported significant differences in locomotor skills and object control skills according to year of evaluation. Children assessed in 2010 reported greater locomotor skills ($F = 10.2$ $p < 0.001$; $ES = 0.27$), and object control competence ($F = 2.8$ $p < 0.04$; $ES = 0.14$) as compared to children evaluated in 2012. Children assessed in 2010 also reported significantly greater competence in the general motor quotient ($F = 8.0$ $p < 0.001$; $ES = 0.24$) as compared to children assessed in 2012.

Table 2 reports adjusted analyses. Results reported that differences found in the locomotor skills scores were not influenced by school type and family income. However, object control skills score ($F= 7.7$ $p<0.001$ $ES= 0.24$) and general motor quotient ($F= 12.2$ $p<0.001$ $ES= 0.30$) were influenced by school type and family income.

Table 2. Standard motor competence in locomotor skills, object control skills and general motor quotient (GMQ) adjusted by covariates (school type and family income) in the years 2010 and 2012. Recife-PE

	2010 (n = 282)	2012 (n = 270)	Covariates	F	p	ES
Locomotor	10.2 (1.9)	9.1 (2.5)	School type (p=0.511)	15.2	<0.001	0.33
			Income (p=0.086)	16.5	<0.001	0.35
			School type (p= 0.232); Income (0.047)	11.5	<0.001	0.29
Object control	9.6 (2.2)	9.1 (2.3)	School type (p= 0.003)	7.9	<0.001	0.24
			Income (p= 0.096)	4.7	0.009	0.18
			School type (p<0.001); Income (p= 0.008)	7.7	<0.001	0.24
GMQ	99.3 (10.1)	94.6 (12.3)	School type (p= 0.027)	14.2	<0.001	0.32
			Income (p= 0.042)	13.8	<0.001	0.32
			School type (p= 0.004); Income (p= 0.005)	12.2	<0.001	0.30

Note: Data expressed as: mean (Standard deviation); ES= Effect Size – Cohen's d

Source: Authors

Discussion

The purpose of this study was to compare the motor skills of preschoolers in two different years (2010 and 2012) and to verify the effect of contextual aspects (school type and family income) in children's MC. It was expected that MC in children exposed to similar contextual aspects (same school type and family income) would be the same values within the two years of evaluations. Alternatively, differences in contextual aspects (different school types and family income) would negatively influence children's MC.

Results from this study reported that children assessed in 2010 performed better as compared to children from the 2012 evaluation. These findings demonstrated that the MC trend in children declined between the years 2010 and 2012. Scholars of motor behavior are emphatic in claiming that MC does not emerge naturally over the years. Clark²², states that proficiency in motor skills does not come as a "birthday gift" and the idea that maturation exclusively drives changes in the motor behavior is a misconception, and opportunities should be provided for children to practice and enhance their motor skills.

In the preschooler phase, one of the contexts for the development of MC is exposure to physical activity²³. In this critical time frame, engaging in different types of physical activities provide opportunities to enhance individuals' physical-motor elements (physical fitness and motor competence), creating a virtuous cycle of involvement (by engaging in more physical activity and enhancing motor skills elements) that can be taken through the lifespan^{3,5,23,24}. Our results suggest that children with different social economic backgrounds might have different opportunities to engage in physical activity and enhance MC. Literature has indicated that technological and cultural changes have impacted children behaviors and can be considered associated with a lack of physical activity and consequent decrease of MC⁷⁻⁹. Finally, we could suggest that the motor skills of Recife's preschoolers might be compromised, as the physical activity might not be a priority in public school¹⁶.

Our results reported that such variables did not influence differences in locomotor skills. However, for object control skills and the general motor quotient, there were significant

differences between years of evaluation. Our results are consistent with other studies, which highlighted that context in which children live during early childhood can impact the development of motor skills and engagement in physical activity^{17,25-27}. Children spend a considerable part of their time in schools and kindergartens, which, in turn, have an important role in the opportunities for movement²⁸⁻³⁰.

A study developed by Huotari et al.³¹ evaluated the secular trend of motor competence in adolescents. This study carried out the evaluation of locomotor skills, object control and motor coordination in two different years and in two distinct samples that represented this population (in 2003 and 2010). The results show that there was a decrease in motor coordination and object control skills (boys only) and that there were no significant differences in locomotor skills. After seven years, adolescents showed less motor competence in fundamental motor skills. Barbosa et al.²⁹ analyzed the physical activity and the sedentary behavior of preschoolers through accelerometry during their time in school. In this study, children spent approximately 90% of this time on sedentary behavior; on the other hand, the level of physical activity from moderate to vigorous intensity of children was associated with the infrastructure and routines of activities present in the school context. For example, the existence of internal recreation rooms and external park appeared to be a protective factor in 4-year-old children, not allowing them to have a longer period of sedentary behavior; this study also pointed out that when the school environment has a recreation room, park and playground, it increases the chances of 6-year-olds being physically active. In fact, some studies have pointed out that schools with different characteristics can provide different experiences for children. In the study by Queiroz et al.¹⁶, infants enrolled in private schools in the city of Recife presented better performance in object control skills and in the motor quotient as compared to public school children. In another study, True et al.³⁰ identified that children attending schools with larger classrooms and a greater size of the external environment for the practice of motor skills obtained greater performance. The study by Mélo et al.³² analyzed the association between the number of students enrolled in school and the level of physical activity. The results showed that physical activity was not associated with contextual variables while, in the larger schools (> 100 students), the conditions allowed for a greater chance of achieving higher levels of physical activity according to the contextual variables analyzed (offering physical education classes; at least one recreation per day; presence of recreational-oriented physical activity; permission for children to bring toys to school; provision of structured physical activities). These results highlight the importance of both school structure and multiple motor experiences within a child's daily context.

Another relevant issue for the development of motor skills is the availability to use toys, equipment, and to practice sports^{27,28}. This context seems to be closely related to the socioeconomic level of the child, which, in turn, is a factor that contributes to the development of motor skills^{17,33,34}. In this scenario, children with low socioeconomic status may have the disadvantage of not being exposed to environments with toys and equipment, as well as the lack of social support from parents to practice physical activities and sports³⁵. However, children from high socioeconomic strata can access organized and systematized sports practices through other initiatives such as clubs and sports organizations²⁶. Compared to this, children with low socioeconomic status can access projects from governmental organizations, or be even more involved in non-systematized physical activities such as "street games"¹⁸. This seems to reduce possible differences when compared to children from higher socioeconomic strata.

Another result to be highlighted in the present study is that the skills that involve locomotion did not suffer the same influence of the context as the object control skills. In this respect, Henrique et al.³⁶, when investigating longitudinally the competence of preschoolers, had already suggested that there may be a hierarchy in the development of fundamental motor

skills, as well as a certain dependence on the context for motor competence in object control. Thus, the locomotor skills appear earlier in the motor repertoire, and do not require materials or specific instruction. On the other hand, the object control skills arise later and need materials and conditions (equipment, instruction) that allow their practice.

On secular trends, Malina³⁷ reports that factors such as changes in body size and/or acceleration of maturation are individual biological factors that may contribute to changes in performance over time and, in turn, require follow-up for longer identification. However, other possible modifiable factors, such as lifestyle, eating habits and/or involvement in the practice of physical activity and sports, can be modified more dynamically over time and in turn generate changes in individual variables. In addition, different contextual factors have a greater stabilization tendency, but they are also subject to occasional changes. In this way, the evaluation at shorter time intervals is necessary to identify latent changes over time.

Some limitations should be considered in this study. The design adopted does not allow for the interpretation of causality of the results. However, its use is important for the verification of changes in the variables investigated with the change of the moment of observation. In addition, the absence of evaluation of the sports practice and the physical education classes may limit the generalization of our results. However, we can suggest strengths of the study, such as the assessment of the motor competence of children in early childhood, since this is the most sensitive developmental cycle period for changes in behavior. Thus, we can suggest that future studies follow the temporal motor skills in early childhood, and transition phases in the developmental cycle (from childhood to adolescence). The results found in this study make clear the need for public policies (education and health) and the awareness of professionals and family members about the need to consider the context in which the development of preschoolers is being promoted.

Conclusion

In the interval of two years, there was a decline in the motor competence of Recife preschoolers. The contextual school type and family income contributed to the differences found for object control skills and the general motor quotient, but did not affect competence in locomotor skills.

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