

MOTOR DEVELOPMENT HAS A POSITIVE CORRELATION TO ACADEMIC PERFORMANCE IN SCHOOLCHILDREN

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Abstract

Some studies have investigated the association between motor development and cognitive skills. The present study aims to correlate motor development and academic performance in 79 students between 7 to 9 years old from a private school in São Paulo-Brazil. We used the Movement Assessment Battery for Children - Second Edition (MABC-2) to assess the motor development and the results of school report in

Portuguese and Mathematics as a measure of academic performance. Pearson's correlation analysis showed a positive association between motor development and cognitive skills, evidencing that students who had better academic performance, also obtained better scores in motor performance. The association between MABC-2 total score and Portuguese grade, for example, obtained a significant correlation of $p < 0.014$. Further studies should be carried out to understand if motor development improve can modulate cognitive skills.

Keywords: Motor development; Academic performance; cognitive skills

1. Introduction

Motor development occurs progressively during infancy, the environment can promote motor experiences and influences the biological and cognitive improve. There are milestones in the child's motor development that are references for the evolutionary stages, in which each motor improve becomes the child able to exhibit a more elaborate movement (Amorim, 2018). Changes in motor behavior reveals improves in motor development, so that in all age groups, there is a continuous process of learning to move with control and competence (Gallahue & Ozmun, 2005). Thus, the movement can be considered the tool of the motor development process.

Some studies have demonstrated a relationship between motor development and academic performance. Currently, the scientific literature points out that the domains of motor and cognitive development are interrelated (Papalia, 2006). Tavares and Cardoso (2016) carried out a literature review on the interrelationship of learning processes and the development of motor skills. They analyzed 7 articles and 6 of them pointed out evidence of a relationship between learning difficulties and prejudices in motor development. Children with learning difficulties had deficits in motor skills compared to their typically developing peers, which indicates a positive association between these aspects. The authors also present that difficulties in writing and reading are more often associated with problems in motor coordination and balance. Learning disabilities in mathematics are more related to perceptual-motor difficulties (temporal space organization and laterality).

Rosa Neto et al. (2007) studied the motor development of children with learning difficulties at school evaluating the following motor skills: Fine motor skills, global motor skills, balance, body scheme, spatial organization, temporal organization, and laterality. The results showed that 87.1% of the participants had an average of 16 months of motor delay in relation to their chronological age, with the main deficits in the areas of body scheme, spatial and temporal organization. So, the aim of present study is to correlate motor development and academic performance in children between 7 to 9 years old.

2. Methods

The sample consisted of 79 students (41 boys and 38 girls) from 7 to 9 years old from a private school in São Paulo-Brazil, enrolled from the 2nd to the 4th grade of Elementary School. As an exclusion criterion, reports of neurodevelopmental disorders or deficiencies in students' school records were verified. The ethical procedures were approved by the Ethics Committee in research involving human beings from

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Movement Assessment Battery for Children - Second Edition (MABC-2), that is the gold standard for diagnosing Developmental Coordination Disorder (DCD), analyzed the performance of students' motor skills. Developed in England by Henderson and Sugden (1992), its second edition was published in 2007 (Henderson, Sugden and Barnett). MABC-2 is divided into 3 bands by age group: section 1 from 3 to 6 years old, section 2 from 7 to 10 years old, section 3 from 11 to 16 years old. Each of the sections contains 8 tasks divided into manual dexterity, ball skills and static and dynamic balance. Depending on the task, performance is assessed by time and / or number of correct answers and errors and their values are converted into standardized scores. The Brazilian version of MABC-2, band 2, used in this research, was translated, and cross-culturally adapted by Quedas (2019). Only the quantitative assessment of MABC-2 was used in the present study, due to our option of using correlation tests. Results of school report of Portuguese and Mathematics was used as indicator of academic performance. The results of these reports were composed of several assessments, such as tasks, assignments, and tests over 3 months.

Pearson's correlation analysis tested possible correlations of our variables (motor development and academic performance) and verify the possible significance. For this study, a significance level of 0.05 (5%) was defined, therefore, all intervals were constructed with 95% statistical confidence. However, the values $0.05 < p < 0.1$ for being close to the acceptance limit, were considered to tend to be significant (up to 5 percentage points above the value of the adopted alpha), so they were also described in the results as potentially significant effect.

3. Results and discussion

Table 1 describes the correlation analysis between motor development and academic performance in Portuguese. It is possible to observe significant difference in the MABC-2 total score and Portuguese grades ($p < 0.014$). It is also noted that when analyzing separately the motor skills abilities, there is a significant correlation between this discipline grade and fine motor coordination ($p < 0.002$), represented by the tasks of manual dexterity. Table 2 describes the correlation analysis between the motor development and the results of Mathematics. It is possible to observe a tendency to be significant in the MABC-2 total score with the mathematics score ($p < 0.052$).

Table 1 – Correlation analysis between the MABC-2 (total and score) Portuguese grades

MABC-2	<i>Pearson's r</i>	<i>p</i>	<i>n</i>
MANUAL DEXTERITY	0,343	0,002	79
AIMING AND CATCHING	0,158	0,164	79
BALANCE	0,026	0,820	79
TOTAL	0,275	0,014	79

Table 2 – Correlation analysis between the MABC-2 (total and score) Mathematical grades.

MABC-2	<i>Pearson's r</i>	<i>p</i>	<i>n</i>
MANUAL DEXTERITY	0,163	0,150	79
AIMING AND CATCHING	0,184	0,105	79
BALANCE	0,072	0,529	79
TOTAL	0,219	0,052	79

These results corroborate the findings of a recent study by Costa et al. (2020), whose objective was to analyze the associations between gross motor skills and academic performance of schoolchildren in a city of São Paulo-Brazil. They assess 929 children of both sexes (5 to 11 years old) in the study. Anthropometric measurements (weight, height, waist circumference) were evaluated and motor skills were measured using the Körperkoordinationstest für Kinder - KTK test. The usual level of physical activity was assessed by means of a questionnaire and the academic performance by school reports. The results showed that students with good or very good motor coordination are 7.9 times more likely to obtain a good or excellent academic grade in Portuguese and mathematics when compared to students with motor impairment. The authors evidenced a positive relationship between gross motor skills and academic performance of schoolchildren, that is, the higher the values achieved in motor skills, the higher the values of academic grades for both Portuguese and mathematics.

Maurer and Roebbers (2014) correlated motor and cognitive performance of children of 5 and 6 years. In their research, they assessed the fine motor coordination skills, using the manual dexterity scale of MABC-2, band 1. For cognitive performance, they used reading, writing and mathematics tests. Like our study, the results showed a significant correlation between motor development and academic tests. Rodrigues (2011) also found a significant and positive correlation between motor and school performance in Brazilian children of 6 to 10 years. They used the School Performance Test – TDE (Stein, 1994) to assess academic performance, which includes tasks for reading, writing and arithmetic skills. They conclude emphasizing the importance of qualified and integrated motor programs to school age children to their integral development.

Therefore, the results of this article corroborate some findings in the literature and reinforce the hypothesis that the better the student's motor development, the better his academic performance, represented here by the Portuguese and Mathematics grades. An Australian study Macdonald et al. (2020), evaluated the association between motor proficiency and academic performance in mathematics and reading, in 55 children of both sexes, from Year 1 (referring to the 1st year of Education). They observed that only fine motor coordination scores were significantly associated with both disciplines, unlike the present study, which found a correlation only with the Portuguese discipline. It also points out that the general motor proficiency obtained a significant relationship only with the discipline of mathematics, differently from the finding in this research in which there was a correlation with both disciplines.

Moreover, even the data from this research have been collected before the beginning of the covid-

19 pandemic, our results lead us to reflect about importance of motor performance and cognitive development. Many current studies have shown that, due to restrictions on circulation and social distance in function of covid-19 pandemic, there has been a significant reduction in physical activities and an increase in sedentary behavior, including school and work activities carried out by Internet. Using multinational survey performed in 14 countries, Wilke et al. (2021) examined the effect of pandemic confinements on physical activity levels. They observed that physical activity levels have substantially decreased globally during the COVID-19 pandemic. Mitra et al. (2020) analyzed a survey data collected one month in the beginning of Covid-19 pandemic, in order to explore changes in healthy movement behaviors among Canadian children and youth. They verified a decrease in physical activity-related movements during the pandemic, including walking/biking, outdoor or indoor physical exercise and outdoor play. Similar results were observed by Schmidt et al. (2020) for German children and adolescents aged 4 to 17 years. Further results should also analyze the impact of this reduction on academic performance.

4. Conclusion

For the specific group evaluated, there was a significant correlation between motor development and academic performance, that is, students who had better grades, also obtained better scores in the motor skills of MABC-2. It is also considered that, when analyzing specific motor skills separately, manual dexterity, that is associated with fine motor coordination, was possibly responsible for the correlation with the Portuguese score. New studies should be carried out to better understand the association between motor development, and its specific skills, and academic performance in its different segments of learning. Further studies should also be carried out to understand if motor development improve can modulate cognitive skills.

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