

Original Article

Agreement between competing tests for the identification of children with Developmental Coordination Disorder

Concordância entre testes concorrentes para identificação de crianças com Transtorno do Desenvolvimento da Coordenação

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Abstract

Objective: To verify the agreement of the results between different instruments, Movement Assessment Battery for Children – checklist and motor test (MABC-2) and Developmental Coordination Disorder Questionnaire (DCDQ-BR), used to indicate developmental coordination disorder (DCD). **Method:** A cross-sectional study, carried out in 2017, with data from seven to 10-year-old children from municipal schools in São José/SC. They were evaluated for motor performance using the MABC-2 (motor test and checklist) and DCDQ-BR instruments. The statistical analysis included the Kappa coefficient (K) to verify the agreement between the results of the instruments, considering a level of significance of 5%. **Results:** 302 children participated in the study, with a mean age of 8.5 ± 1.09 years old. When comparing the MABC-2 motor test, MABC-2 checklist, and the DCDQ-BR, we observed concordances from regular to weak ($K = 0.303 / 0.116 / 0.039$). **Conclusion:** The present study did not identify consistent agreement between the results of the MABC-2 and DCDQ-BR instruments for an indication of children with DCD, but their combination is a more complete form of evaluation.

Keywords: Child, Evaluation Studies, Motor Skill, Developmental Coordination Disorder.

Resumo

Objetivo: Verificar a concordância dos resultados de diferentes instrumentos, *Movement Assessment Battery for Children – checklist* e teste motor (MABC-2) e *Developmental Coordination Disorder Questionnaire* (DCDQ-BR), utilizados para indicação de transtorno do desenvolvimento da coordenação (TDC). **Método:** Estudo transversal,

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realizado no ano de 2017, com dados de crianças entre sete e 10 anos de idade, provenientes de escolas municipais de São José/SC. Elas foram avaliadas quanto ao desempenho motor por meio dos instrumentos MABC-2 (teste motor e *checklist*) e DCDQ-BR. A análise estatística incluiu o coeficiente *Kappa* (K) para verificar a concordância entre os resultados dos instrumentos, considerando um nível de significância de 5%. **Resultados:** Participaram do estudo 302 crianças, com média de idade de $8,5 \pm 1,09$ anos. Ao comparar o MABC-2 teste motor, MABC-2 *checklist* e o DCDQ-BR, foram observadas concordâncias de regular a fraca ($K = 0,303 / 0,116 / 0,039$). **Conclusão:** O presente estudo não identificou concordância consistente entre os resultados dos instrumentos MABC-2 e DCDQ-BR para indicação de crianças com TDC, mas a combinação deles é a forma mais completa de avaliação.

Palavras-chave: Criança, Estudos de Avaliação, Destreza Motora, Transtorno do Desenvolvimento da Coordenação.

1 Introduction

Developmental Coordination Disorder (DCD) is a condition linked to the impaired ability to perform and learn age-appropriate motor skills in the absence of any known medical condition or neurological dysfunction (American Psychiatric Association, 2014; Yu et al., 2019). Thus, children with DCD have a series of difficulties in several domains (executive function, sensory-perceptual function, fine and gross motor control), which tend to potentiate limitations in their academic, physical and social capacity, generating an impact on their quality of life (Zwicker et al., 2012).

Depending on the analysis criteria and instrument used, the prevalence of DCD can vary from 1.4 to 19% in school-age children (Zwicker et al., 2012). However, the most accepted and used estimative is from the American Psychiatric Association (2014), which indicates that this prevalence affects around 5 to 6% of children. However, the diagnosis of DCD is based on four criteria established by the Manual of Diagnosis and Statistics of Mental Disorders - DSM-V (American Psychiatric Association, 2014), which establishes that: A) the performance in motor coordination tasks is substantially below the expectation, given the person's age and opportunities; B) the motor coordination difficulties significantly interfere with activities of daily living or academic achievement; C) the difficulties started in the initial development period, and D) the difficulties cannot be attributed to an intellectual disability or neurological condition.

In this sense, several instruments assess the motor performance of children and identify possible motor difficulties or indicative of DCD. Studies of motor performance assessment (Beltrame et al., 2017; Hsu et al., 2018; Cappelen et al., 2018; Caçola & Killian, 2018; Karras et al., 2019) frequently use the Movement Assessment Battery for Children Second Edition - MABC-2, created by Henderson et al. (2007) and validated for Brazilian children by Valentini et al. (2014).

The MABC-2 consists of a battery of motor tests that verify the children's performance in tasks of manual dexterity, throwing and receiving and balance, proposing to use a checklist filled out by a person who has expressive contact with the

evaluated child, which includes a list of specific motor behaviors observed in the child's daily life (Capistrano et al., 2015a).

A questionnaire for parents with questions related to performance in daily activities, called the Developmental Coordination Disorder Questionnaire (DCDQ) made in Canada (Wilson et al., 1998; Wilson et al., 2009) and validated for Brazil (Prado et al., 2009) is another instrument widely used to identify children with DCD. Usually, the use of DCDQ is to collect data from large samples (Rivard et al., 2014; Zhu et al., 2012) or to assist in the diagnosis of DCD to meet criterion B, established by DSM-V (Bhoyroo et al., 2018; Karras et al., 2019).

Both instruments are valid and reliable tools to characterize children with an indication of DCD. However, they have different measures, raising the need to understand the agreement between the tests to allow accurate and coherent diagnoses. Therefore, considering that DCD as a disorder that directly affects child development, this study aimed to verify the agreement of the results of different types of instruments, MABC-2 motor test, MABC checklist, and DCDQ-BR, for the indication of DCD.

2 Method

This study is part of a macro project entitled “Children's health profile in Greater Florianópolis/SC”, developed by the Learning and Development Disorder Laboratory - LADADE - of the University of the State of Santa Catarina (UDESC) - Brazil, and the Ethics and Research Committee of UDESC approved it under CAAE nº 70599017.6.0000.0118.

The study population consists of elementary school children aged 7 to 10 years old, duly enrolled in municipal schools in São José/SC - Brazil, in 2017. According to data from the Department of Education of the investigated municipality, the population consists of 9,414 children. The sample was selected for convenience in two schools with the largest number of students enrolled in the region. The research was presented to the schools involved and, after its approval, data collection began.

2.1 Assessment instruments

2.1.1 Movement assessment battery for children – second edition

MABC-2 (Henderson et al., 2007) is a motor test created to identify motor difficulties in children aged between three and 16 years old. The battery of motor tests is divided into three sets of tasks (manual dexterity, throwing and receiving and balance), for specific age groups: 1- from 3 to 6 years old; 2- from 7 to 10 years old and 3- from 11 to 16 years old. For each age group, different tasks are established, according to the different levels of complexity. The test categorizes children according to their level of motor difficulty. The score ranges from 1 to 19 points and there is a corresponding percentile that can vary from 0.1% to 99.9% for each value. Children with a total score below the 5th percentile indicate a motor difficulty; between the 5th and 15th percentiles indicate that the child is at risk of motor difficulties, and above the 15th percentile indicates normal motor development. In this study, only age group 2 was used (Henderson & Sugden, 1992; Henderson et al., 2007).

We proposed to apply the motor test along with the checklist that consists of a list of specific motor behaviors that we observe in the daily lives of children, such as skills in personal care, classroom, and recreational activities. It is divided into three sections, with sections A and B seeking to identify the increasingly complex interactions between the child and the physical environment, and section C addressing non-motor factors that can negatively affect the child's movement. In total, this list consists of 43 questions answered by an adult (parent/caregiver). The questions in sections A and B were answered regarding the efficiency of executing the child's movement in a given task, being graded on a Likert scale: 0 – the child performs the task very well; 1 – the child performs it well; 2 - the child is not able to perform the task, but is close to doing it; 3 – the child is not even close to performing the task. According to the child's age, the total score may indicate normal/typical motor development (green zone), the risk for motor difficulty (yellow zone) and motor difficulty (red zone) (Henderson et al., 2007).

2.1.2 Developmental Coordination Disorder Questionnaire – Brasil

The DCDQ is a questionnaire for parents, specific for detecting DCD in children aged five to 15 years old (Wilson et al., 1998; Prado et al., 2009), consisting of 15 items divided into three groups: control motor, fine/written motor skills and general coordination. Parents should mark the answer that best describes the child's performance in the questioned task, using a Likert scale, which ranges from score 1 - “it is nothing like your child” to 5 - “extremely similar to your child”. The final score is the sum of the scores for each item, which varies from 15 to 75 points, with the total score classifying the child with indicative of DCD according to three cutoff points of the age groups: 05-07 years and 11 months old - score of 15-46; 8 to 9 years and 11 months old - score of 15-55; 10 to 13 years and 11 months old - score of 15-57. Scores above these cutoff points indicate that the child probably does not have DCD.

2.2 Collection procedures

Data collections were carried out in two schools in the municipality of São José/SC, with the institutions with the largest number of students in the municipal education network. The MABC-checklist and the DCDQ-BR were answered by parents/caregivers at home, together with the signing of the Free and Informed Consent Form. After returning the terms and instruments, 302 children participated in the study and underwent the MABC-2 motor test. All activities were performed by two evaluators previously trained. One of them carried out the guidelines and control of the test and the other observed and helped in the adjustment of the materials. The children performed the test individually in a reserved and exclusive space for the activity.

For statistical purposes, the children were divided into two categories in all instruments: without an indication of DCD (normal motor performance or risk for the development of motor difficulty) and with an indication of DCD (defined motor problem).

2.3 Statistical procedures

All data collected were recorded in a Microsoft Excel spreadsheet, accessed only by researchers, in which each child used an identification number to preserve the participants' identity, keeping the information confidential.

Statistical analyzes were performed using SPSS software, version 20.0. The data were presented in the form of descriptive statistics (mean, standard deviation and relative and absolute frequency). The frequency data for indicative of DCD were presented for each instrument and subsequently by combining them. For that, those with a diagnosis of both instruments combined in the analysis were considered as indicative of DCD. Kappa coefficient investigated the agreement analysis between the results of the instruments used for evaluation (MABC motor test, MABC checklist, and DCDQ-BR). Reference values were considered: greater than 0.80 - almost perfect agreement; between 0.61 and 0.80 - substantial agreement; between 0.41 and 0.60 - moderate agreement; between 0.21 and 0.40 - regular agreement; below 0.21 - weak agreement (Landis & Koch, 1977). The level of statistical significance adopted was $\alpha=0,05$.

3 Results

The study included 302 children, 54% were female, with a mean age of 8.5 (\pm 1.09) years old. The classifications using the MABC motor test, checklist, and DCDQ-BR, for indicative of DCD are described in Table 1, and the frequency of indicative of DCD varies by 2.3% (referring to the combination of the three instruments or combination between DCDQ and MABC-2 motor test) at 39.7% (using only the MABC-2 checklist).

Table 1. Classification of motor performance by the different instruments evaluated.

Test		N	%
MABC-2 – motor test	Without IDCD	277	91.7
	With ITDC	25	8.3
MABC-2 – checklist	Without IDCD	182	60.3
	With ITDC	120	39.7
MABC-2 –motor test + checklist	Without IDCD	289	95.7
	With ITDC	13	4.3
DCDQ-BR	Without IDCD	252	83.4
	With ITDC	50	16.6
MABC-2 – motor test + DCDQ	Without IDCD	295	97.7
	With ITDC	7	2.3
MABC-2 – checklist + DCDQ	Without IDCD	266	88.1
	With ITDC	36	11.9
MABC-2 (motor test and checklist) + DCDQ-BR	Without IDCD	295	97.7
	With ITDC	7	2.3

Legend: DCDQ-BR: *Developmental Coordination Disorder Questionnaire – Brazil*; IDCD: indicative of Developmental Coordination Disorder; MABC-2: *Movement Assessment Battery for Children – Second Edition*; N: number of children.

Kappa test identifies that there was no agreement between the MABC-2 motor test with the DCDQ-BR ($p = 0.067$), as well as between the MABC-2 motor test with the MABC-2 checklist ($p = 0.138$). However, in the analysis between the MABC-2 checklist with DCDQ-BR and the MABC-2 motor test + checklist with DCDQ-BR, there was statistical significance for the test ($p < 0.05$), however, the values of the coefficient are considered weak (Table 2).

Table 2. Analysis of agreement between instruments for the assessment of Indicative of DCD.

Instruments	Kappa Coefficient	p-value
MABC-2 motor test x MABC-2 checklist	0.045	0.138
MABC-2 motor test x DCDQ-BR	0.080	0.067
MABC-2 checklist x DCDQ-BR	0.056	0.028
MABC-2 (motor test + checklist) x DCDQ-BR	-0.019	<0.001

Legend: DCDQ-BR: *Developmental Coordination Disorder Questionnaire – Brazil*; MABC-2: *Movement Assessment Battery for Children – Second Edition*; p: significance probability.

4 Discussion

Several instruments can be used as a tool to identify children with DCD and MABC and DCDQ are the most used, both in clinical practice and in research (Beltrame et al., 2017; Hsu et al., 2018; Cappelen et al., 2018; Caçola & Killian, 2018; Bhoyroo et al., 2018; Karras et al., 2019). However, the agreement of the results of these instruments is not yet clear (Schoemaker et al., 2006; Capistrano et al., 2015b; Montoro et al., 2016). Thus, this study allowed for greater knowledge and discussions on the topic, highlighting that, despite being used to point out the indicate of DCD, they did not show a high level of agreement, bringing reflections on the assessment methods for such diagnosis.

Among the four criteria established by the DSM-V (American Psychiatric Association, 2014), the first item proposes that the acquisition and execution of coordinated motor skills are substantially below expectations, with such difficulty linked to the clumsiness and imprecision in the performance of motor skills. According to Kirby & Sugden (2013), there is no test for the gold standard to establish this criterion, but a review carried out by Gueze et al. (2001) established that the MABC motor test is the most used by clinicians and researchers for motor assessment with identification of DCD, which can be seen in current studies (Beltrame et al., 2017; Hsu et al., 2018; Cappelen et al., 2018; Caçola & Killian, 2018; Karras et al., 2019).

In this sense, using only the evaluation using the MABC-2 motor test, 8.3% of the evaluated children had significant movement difficulties. Even though the American Psychiatric Association (2014) points out that DCD affects 5 to 6% of school-age children, studies that used the MABC-2 motor test showed varied results regarding the frequency of indicative of DCD, as in the study by Amador-Ruiz et al. (2018), which indicated that 9.9% of the children investigated had possible DCD. Studies with the Brazilian population showed frequencies of indicative of DCD even higher, with the proximity of 11% of students (Silva et al., 2006; Santos & Vieira, 2013).

In the second criterion established by the American Psychiatric Association (2014), the deficit in motor skills of criterion “A” significantly and persistently implies in the daily activities appropriate to the chronological age (self-care and self-maintenance), causing an impact on academic/school productivity, in professional activities, leisure and playing. For this, MABC-2 proposes the use of the checklist, which contemplates the criterion “B”. Thus, when considering the results of the checklist alone, there was a frequency of 39.7% of the sample with indicative of DVD. In the study by Capistrano et al. (2015b), who used the MABC-2 Checklist to assess motor performance in daily activities, with the participation of parents or caregivers of the children, 42.5% of the children were classified as having “significant movement difficulties”, values above than in this study. The study also pointed out the importance of evaluation by education professionals in collaboration with parents, since the level of understanding and perception of human movement by these professionals may be more judicious than the parents.

However, when considering the combination of results between the motor test and the checklist, the frequency of indicative of DCD is now 4.3%, as well as in the combination of the MABC-2 motor test with the DCDQ-BR, which becomes 2.3%. In this sense, when analyzing the agreement between the instruments, no statistically significant values were obtained between the DCDQ-BR and the MABC-2 motor test, and there was statistical significance in the analysis of agreement between DCDQ-BR with MABC-2 checklist; however, with very low coefficient value. Despite the results, most studies found in the literature used only the motor test to classify children with and without DCD (Golenia et al., 2013; Batey et al., 2014; Valentini et al., 2014; Raz-Silbiger et al., 2015; Beltrame et al., 2017).

However, when considering both forms of assessments, this reduction in the frequency of DCD shows the importance of using more than one means of assessment, not least because, as previously described, the diagnosis of DCD is based on four criteria established by the American Psychiatric Association (2014) and each instrument proposes to meet a different diagnostic criterion, which justifies the absence of statistical agreement found in the analyzes between the MABC-2 motor test and the DCDQ-BR and between the MABC-2 motor test and the MABC-2 checklists. This combination of instruments in the evaluation is very relevant so that the identification of indicative of the disorder is more accurate since the perception of the children's ability in activities of daily living is essential for professionals who work with this type of condition, not only to diagnose DCD but also to provide ideal treatment, to mitigate the daily consequences for these children (van der Linde et al., 2015). However, the frequency values resulting from questionnaire-shaped instruments ended up being overestimated (DCDQ-BR: 16.6%; MABC-2 checklist: 39.7%), showing that there is still agreement considered to be regular among the instruments that involve questionnaires.

Therefore, some differences between the instruments must be scored. The MABC-2 motor test involves the child directly when performing a set of tasks, whose movements are analyzed by a qualified professional, gathering quantitative and qualitative data (Henderson & Sugden, 1992; Toniolo & Capellini, 2010). However, it does not assess more directly the way the child performs daily tasks. The MABC-2 checklist and the DCDQ are questions for parents or teachers, who live more with the child, about specific motor behaviors observed in everyday life. Thus, when answered by parents, it favors, mainly, the analysis of

tasks performed at home than those performed at school, which often the parents do not have much contact, and when answered by the teacher, the opposite was also evident. The instruments do not discriminate questions for different evaluators. Also, the literature points out that the level of understanding of different evaluators could also interfere with the results (Pasquali, 2009; Capistrano et al., 2015b).

When analyzing the questionnaire answered by parents/teachers, another fact that may also be related to a greater number of children with an indication of DCD may be that when experiencing some motor difficulties of children, adults begin to overprotect them and, when answering questions of the questionnaires, they end up underestimating their motor skills (Galvão et al., 2014). Unlike a specific professional for the evaluation of the motor battery, who often may not have daily contact with the child and only needs to observe the activity at the time of its execution during the application of the motor test. However, this relationship still needs to be further investigated.

Thus, the need to use more than one instrument in the process of identifying indicative of DCD is emphasized since uncertain or unreliable diagnoses can generate anxiety and harm to family members and the child. The association of motor assessment instruments and interviews or questionnaires with parents and teachers allowed a more comprehensive assessment of the children's motor performance to obtain a better definition of the diagnosis of DCD (Green et al., 2005; Junaid et al., 2000; Toniolo & Capellini, 2010).

The main limitation of this study was the sample not being representative, which compromises the extrapolation of data to the population of Brazilian children. However, the data presented expands the knowledge of professionals involved in the diagnosis of children with DCD, and assisting them more critically, regarding the choice of instruments for this purpose. Also, as the results in the literature are still controversial, new studies comparing results between different evaluators and instruments must be performed, as well as the combination between them.

5 Conclusion

O presente estudo não identificou boa concordância entre os resultados dos instrumentos MABC-2 teste motor, *checklist* e DCDQ-BR para indicação de crianças com TDC. No entanto, evidenciou que, por responderem a dois critérios diagnósticos diferentes estabelecidos pela APA, a melhor forma para avaliar possíveis diagnósticos de crianças com TDC é por meio da combinação dos instrumentos, uma vez que eles se complementam.

This study did not identify a good agreement between the results of the MABC-2 motor test, checklist and DCDQ-BR instruments for the indication of children with DCD. However, because they answered to two different diagnostic criteria established by the APA, the combination of the instruments is the best way to assess possible diagnoses of children with DCD since they complement each other.

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Author's Contributions

Authors were responsible for the design of the text and approved the final version of the manuscript.

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