

Concurrent validation of the MABC-2 and Developmental Coordination Disorder Questionnaire-BR

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DOI: <http://dx.doi.org/10.7322/jhgd.110421>

Abstract

Introduction: The Movement Assessment Battery for Children, Second Edition (MABC-2) has been widely used in national literature for the diagnosis of Developmental Coordination Disorder (DCD). The relationship of MABC-2 with the scientific gold standard instrument for DCD, the Brazilian version of the Developmental Coordination Disorder Questionnaire (DCDQ-BR), is not well established and is rather controversial.

Objective: The aim of this study was to verify the concurrent validity of the MABC-2 motor battery and the DCDQ-BR, controlled for sex and age group.

Methods: The concurrent validation process took place with the participation of 350 schoolchildren aged 7–11 years from the cities of Florianopolis-SC and Manaus-AM and their parents or guardians. The agreement between instruments was assessed with the Spearman correlation test and simple linear regression using SPSS software version 20.0.

Results: Positive correlation between instruments' scales was found.

Conclusion: This study showed evidence of concurrent validity between MABC-2 and DCDQ-BR, suggesting that MABC-2 can be used as an indicator for developmental coordination disorder.

Keywords: validation; MABC-2; DCDQ-BR; motor performance.

INTRODUCTION

The study of motor development is a prerequisite for the full understanding of children's evolution, in which movement is an integral part of life¹. Therefore, motor assessment is important and necessary in preschool individuals² and has been explored in several national³⁻⁷ and international studies⁸⁻¹⁰.

One of the test protocols most widely used in this area to evaluate motor performance is the Movement Assessment Battery for Children - Second Edition (MABC-2), developed in the UK to identify motor difficulties in children aged 3–16 years through the following skills: manual dexterity, ball skills, and static and dynamic balance, organized according to each age group¹¹. MABC-2

is a widely used tool in both national³⁻⁵ and international studies⁸⁻¹⁰.

In Brazil, MABC-2 has been used for the diagnosis of developmental coordination disorder (DCD)³⁻⁵. However, this is not a unique tool for assessment of this disorder, but rather of motor problems as a whole. One of the instruments considered the gold standard for diagnosis of DCD is the Developmental Coordination Disorder Questionnaire (DCDQ), developed in Canada¹² for children aged 5–15 years. It is a questionnaire for parents composed of 15 items related to a child's performance in various everyday activities. Questions are designed to assess three categories: motor control during movement, fine/written motor skills, and general coordination. The instrument has been validated in vari-

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Suggested citation: Montoro APPN, Capistrano R, Ferrari EP, Reis MS, Cardoso FL, Beltrame TS. Concurrent validation of the MABC-2 and Developmental Coordination Disorder Questionnaire-BR. *J Hum Growth Dev.* 26(1): 74-80. Doi: <http://dx.doi.org/10.7322/jhgd.110421>

Manuscript submitted: Dec 09 2015, accepted for publication Feb 03 2016.

ous countries, such as Australia¹³, China¹⁴, Germany¹⁵, Israel¹⁶, Japan¹⁷, and Brazil¹⁸. However, the fact that the instrument uses replies provided by parents or guardians, who may not always have the availability or even knowledge to fill out the questionnaire, compels the researcher to use other tools for diagnosis of DCD that do not require active parental participation. Thus, the increasing use of the MABC-2 motor battery for diagnosis of DCD has been observed.

In light of this information, some studies have verified the concordance between the MABC-2 motor battery and the gold standard, DCDQ¹⁹. In the Netherlands, authors found a high correlation between DCDQ and MABC-2 in children aged 6–11 years²⁰. In China, researchers evaluated 1.823 children and found that the MABC-2 motor battery and DCDQ were correlated, concluding that MABC has good reliability and validity. In Brazil, a pioneer study developed by Capistrano et al.¹⁹ did not reveal significant congruence between the MABC-2 motor battery and DCDQ-BR. Given this lack of consensus, the present study seeks to provide a basis for growth and assessment consolidation in motor performance. Thus, the aim of the present investigation was to analyze the concurrent validity of the MABC-2 motor battery with DCDQ-BR according to sex and age group.

METHODS

Study characterization

This study was conducted as part of a project entitled “Concurrent validation of the MABC-2, according to the Developmental Coordination Disorder Questionnaire Brazil,” which was approved by the protocol number 38772214.3.0000.0118.

Participants

The study included 350 children (175 girls and 176 boys) aged 7–10 years enrolled in public and private elementary schools of Florianópolis - SC and Manaus - AM and their parents or guardians.

Inclusion criteria were age between 7 and 10 years; agreeing to participate in the study; not presenting physical problems that prevented evaluation of the motor performance; returning the free and informed consent form signed by parents or guardians.

Characterization of different environments

Florianópolis/SC and Manaus/AM were chosen because of their contextual differences. These cities differ in their physical structure and therefore in the academic structure among schools. For example, in the schools of Florianópolis/SC, students have courtyards, playgrounds, indoor courts, swimming pools, and physical education classes three times a week taught by teachers. This set of elements could provide new and diversified motor experiences. In the schools of Manaus/AM, students have only courtyards and twice weekly physical education classes taught by teachers.

Tools

To evaluate motor performance, the MABC-2, and the Developmental Coordination Disorder Questionnaire-Brazil (DCDQ-BR) were used and presented as follows:

Movement Assessment Battery for Children, 2nd edition

The MABC-2 is a motor test protocol developed by Henderson²¹ for intervention in children aged 3–16 years with DCD and other motor problems. It consists of a movement battery, a checklist, and a manual. The MABC-2 is organized into three age-specific sections: 3–6 years, 7–10 years, and 11–16 years. The test refers to a series of tasks (manual dexterity, ball skill, and static and dynamic balance), assigned to a value as number of attempts, hits and misses, or time spent to perform the tasks. The test categorizes children according to their level of motor difficulty. The score varies from 1 to 19, and for each value, there is a corresponding percentage that may vary from 0.1% to 99.9%. A score at or below the fifth percentile is the cut-off point for severe motor difficulties, such as DCD; values between the sixth and fifteenth percentile are considered to indicate risk for the development of motor difficulties; performance at or above the sixteenth percentile indicates that there are no motor difficulties²¹. For this study, only the motor battery with tasks specific for the age group 7–10 years was used, and children were categorized into two categories: defined motor problem (risk for the development of difficulties and motor problems) and normal motor performance (no motor difficulties).

Developmental Coordination Disorder Questionnaire

DCDQ is a questionnaire for parents, designed to detect DCD in children aged 5–15 years. Created by Wilson¹², it consists of 15 items divided into 3 categories: motor control, fine/written motor skills, and general coordination. According to the standard protocol for DCDQ administration, parents are instructed to fill out the questionnaire and mark the answers on a Likert scale from 1 to 5 points, which describes the child’s performance on that task. The final score is the sum of the scores of each item, which varies from 15 to 75 points. The total score indicates whether the child is in the group with indicative or suspected DCD or probably no DCD, according to the three cutoffs across age groups. In the group aged 5–7 years and 11 months, a score of 0–46 indicates that the child has DCD or suspected DCD while a score of 47–75 indicates that the child probably does not have DCD. From the age of 8 to 9 years and 11 months, a score 0–55 identifies children who have, or are suspected of having, DCD. In the oldest group, 10–13 years and 11 months, a score of 0–57 indicates that a child has or is suspected of having DCD. In this study, children who have, or are suspected of having DCD, were considered to have a defined motor problem and those who did not were considered to have normal motor performance.

Procedures

Motor assessments were individually performed during physical education classes in the period from Sep-

tember to November 2014 in educational institutions. Students were assessed in a large room with free space, which allowed researchers to conduct the whole test protocol in the same place; this was designed to reduce potential interference. After application of the battery, parents or guardians received a printed copy of the DCDQ-BR questionnaire with a letter explaining how to fill out the instrument and how to contact the researchers in case of further questions.

Statistical analysis

Data were tabulated in the Statistical Package for Social Sciences (SPSS)® software, version 20.0. To characterize data, descriptive statistics were used to compare means of relative and absolute frequencies.

The concurrent validity of MABC-2 and DCDQ-BR by sex and age group was assessed using the Spearman correlation test. The reference values for this analysis were as follows: below 0.40, weak correlation; between 0.40 and 0.59, moderate correlation; between 0.60 and 0.80, good correlation; and above 0.80, very good correlation.

In order to check the predictive power of MABC-2 for identifying the DCD in children, a simple linear regression analysis was performed. The independent variable was the total score on the MABC-2 test and the de-

pendent variable was DCDQ-BR scores, the gold standard for identification of DCD. A p value <0.05 was considered statistically significant.

RESULTS

A total of 155 schoolchildren from the city of Manaus, including 81 girls with a mean age of 8.77 (± 1.22) years and 74 boys with a mean age of 8.74 (± 1.12) years, and 195 schoolchildren from the city Florianópolis, including 94 girls with a mean age of 9.09 (± 1.08) years and 101 boys with a mean age of 8.87 (± 1.06) years, were assessed.

Figure 1 shows the motor performance classification assessed using MABC-2 and DCDQ-BR according to sex and age group. In the assessment of the MABC-2 motor battery in the age group of 7–8 years, 26.9% of girls and 34.4% of boys were classified as having a defined motor problem; the DCDQ-BR questionnaire yielded similar findings.

For the age group of 9–10 years, 21.4% of girls and 24.5% of boys were classified as having a defined motor problem according to MABC-2 and 30.2% of girls and 22.3% of boys were classified as such according to DCDQ-BR (Figure 1).

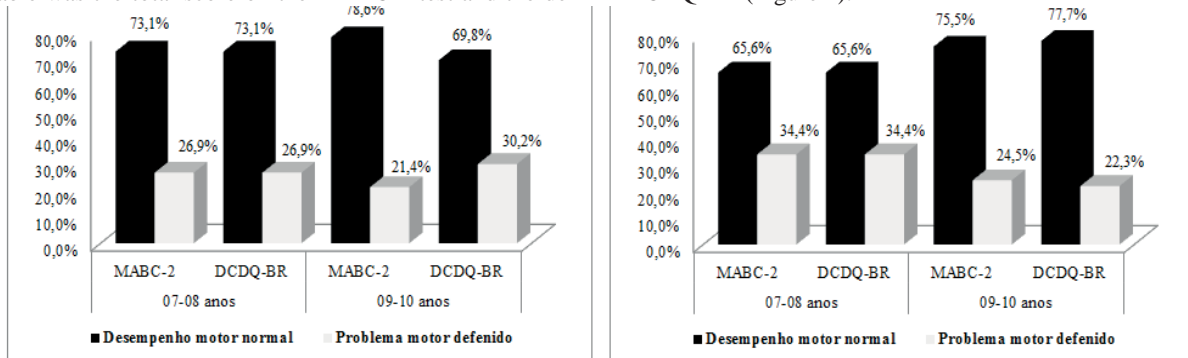


Figure 1: Motor performance classification for girls (left) and boys by MABC-2 motor battery and DCDQ-BR questionnaire according to age group.

When comparing the MABC-2 motor battery and DCDQ-BR for girls in the age groups 7–8 years and 9–10 years, positive correlations between total score and the standard score of MABC-2 according to the

DCDQ-BR for the age group of 7–8 years (total, r = 0.47; p = 0.01; standard, r = 0.45; p = 0.01) and 9–10 years (total, r = 0.32; p = 0.01; standard, r = 0.35; p = 0.01) was observed, respectively (Table 1).

Table 1: Spearman correlation coefficient for female students according to age group

MABC-2	DCDQ-BR	07-08 years	p-value	09-10 years	DCDQ-BR	p-value
MABC-2 Motor Test (total score)	0,47		< 0,01	0,32		< 0,01
MABC-2 Motor Test (Standard score)	0,45		< 0,01	0,35		< 0,01

Table 2 shows the correlations between MABC-2 motor battery (total score and standard score) and DCDQ-BR for men aged 7–8 years and 9–10 years. The results show a significant positive correlation between total score

and the standard score of MABC-2 according to the DCDQ-BR for the age group of 7–8 years (total, r = 0.62; p = 0.01; standard, r = 0.61; p = 0.01) and 9–10 years (total, r = 0.35; p = 0.01; standard, r = 0.37; p = 0.01) (Table 2).

Table 2: Spearman correlation coefficient for malee students according to age group

MABC-2	07-08 years	09-10 years	DCDQ-BR	p-valor
	DCDQ-BR	p-value		
MABC-2 Motor Test (total score)	0,62	<0,01	0,35	<0,01
MABC-2 Motor Test (Standard score)	0,61	<0,01	0,37	<0,01

From the simple linear regression analysis, it was possible to infer the predictive ability of MABC-2 to identify the presence or risk of the development of DCD in children. The regression model showed statistically sig-

nificant results for boys between the ages of 7 and 8 years and 9 and 10 years ($p < 0.05$) (Table 3), with the largest coefficient of determination observed for the newest ($R^2 = 0.34$) compared to older participants ($R^2 = 0.27$) (Table 3).

Table 3: DCDQ-BR simple linear regression analysis according to the total score of the MABC-2 for males participants.

Parametric	B	β Standard error	β standard	p value	R2	Model p value
Constant	25,61	6,40	7- 8 years -	<0,001		
MABC-2 total score	0,45	0,09	0,52	<0,001	0,34	<0,001
Constant	20,39	6,38	9 -10 years -	0,002		
MABC-2 total score	0,53	0,09	0,58	<0,001	0,27	<0,001

Note: B: better grip line slope; β : for better grip line slope in standard deviation; R2: explained variance / coefficient of determination; p: level of significance.

In females, the regression model yielded statistically significant results for ages 7–8 years and 9–10 years ($p < 0.05$). However, when compared to the coefficient of

determination (R^2) similar values were observed for ages 7–8 years and 9-10 years ($R^2 = 0.10$ and $R^2 = 0.08$, respectively) (Table 4).

Table 4: DCDQ-BR simple linear regression analysis according to the total score of the MABC-2 for females

Parametric	B	β Standard error	β standard	p value	R2	Model p value
Constant	42,77	5,92	7- 8 years -	<0,001		
MABC-2 total score	0,25	0,08	0,28	0,003	0,10	0,003
Constant	44,42	4,97	9 -10 years -	<0,001		
MABC-2 total score	0,24	0,07	0,31	0,001	0,08	0,001

Note: B: better grip line slope; β : for better grip line slope in standard deviation; R2: explained variance / coefficient of determination; p: level of significance.

DISCUSSION

This study contributes to knowledge in this field by demonstrating that there is a positive and significant correlation between MABC-2 and DCDQ-BR total scores, regardless of sex or age group. This suggests that DCDQ-BR provides a useful validity criterion, since motor performance is part of its construct, overall development disorders. This result is consistent with findings of other studies conducted in children aged 5–15 years^{13,22} that generated similar results ($p = 0.01$). Schoemaker et al.²⁰ assessed children aged 5–8 years and found smaller albeit a significant correlation between MABC and DCDQ ($r = 0.36$; $p < 0.001$). A smaller study of Brazilian children conducted by Capistrano et al.¹⁹ found no association between the instruments. These discrepancies may be related to methodological aspects, such as small group sizes. The present research, which includes a much larger sample of children, provides strong evidence for the concurrent validity between MABC-2 and DCDQ-BR in children from two Brazilian states.

The regression between the total punctuation of MABC-2 and DCDQ-BR scores showed evidence that

general coordinative disorders in children can be in part explained by the MABC-2 motor test performance. That is, MABC-2 may explain and also predict which children can have or will have some general developmental coordination disorders, mainly between boys that presented higher determination coefficient with regards to girls. Therefore, this study provides evidence that MABC-2 can be used as an indicator for DCD. Furthermore, owing to its association with the DCDQ-Br, the MABC-2 serves as a good indicator for children with general coordinative disorders, providing a preliminary diagnosis that can be used to identify specific Brazilian children who may need specific clinical or pedagogical approaches. By using MABC-2 to identify the children with the highest risk early on, we can create opportunities for the development of appropriate intervention strategies.

Given that our results confirm findings in national and international literature, we can say with confidence that the compared instruments in this study have a good reliability. Regarding the prevalence of motor disorders according to biological sex, the results indicate agreement with global estimates of higher prevalence of motor disorders among boys²³. These data are consistent with

those from other studies²⁴ showing higher incidence of DCD among boys. Data from the World Health Organization (WHO) indicate that motor difficulty occurs more frequently in boys (four or five boys for every girl). Confirming this predisposition in boys³ an evaluation of 380 scholars in Florianópolis/SC showed that the boys showed lower performance than girls. Green et al.²⁵ assessed 4,331 English children, among whom 173 were considered to have motor difficulty; of these students, 60.6% were boys and 40.4% were girls.

There is no clear explanation for this higher prevalence of motor difficulty among boys in the current literature. However, Zwicker et al.²³ found some evidence that low motor performance may be more common in children born with low birth weight or premature children. In addition, this study showed an increased risk of neurological damage among boys born with these conditions. As such, a higher prevalence of motor difficulty in boys may be attributable to effects in early life and infancy.

We observed that children's maturation process decreased the association between MABC-2 and DCDQ-BR. That is, the MABC-2 had better predictive power in younger children than in older children who participated in this study. With regard to motor performance classification by applying the MABC-2 motor battery and DCDQ-BR questionnaire, the prevalence found was the same for the age group of 7–8 years in both sexes, suggesting that, despite the methodological differences between instruments, MABC-2 is a good indicator for the diagnosis of DCD in children aged 7–8 years. These results are surprising, given that DCDQ is considered the gold standard for evaluation of DCD in this population. In males aged 9–10 years, MABC-2 classified more children with motor problem than DCDQ-BR; however, the difference was small: < 10 percentage points.

Cardoso, Magalhães, and Rezende²⁶ assessed 793 Brazilian children aged 7–8 years and found no differences in the DCD classification between DCDQ and MABC-

2; 34 children were considered to have DCD by both instruments. However, other studies have shown larger differences regarding the prevalence of motor problems among children between the two instruments. Pannekoek et al.²² and Capistrano et al.¹⁹ suggested that this discrepancy can be explained due to methodological aspects used in the construction of the research tools²⁷ as well as varying cutoff points used to identify problems in different motor tests.

With regard to the fact that differences between instruments were only observed in the 9–10-year-old group, we suggest two possible explanations. The natural course of child development may decrease the strength of the associations between motor performance and general motor disorder. Alternatively, increased independence in older children may decrease the amount of time that parents and guardians spend surveilling their behavior. The DCDQ is filled out by parents or guardians, who may not play an active role in the children's daily life by the age of 7–8 years.

The lack of sample representativeness is the main limitation of this study, which prevents extrapolation of data conclusions. Additional studies of a representative sample are required in order to confirm data obtained in the current research. Another limitation is the lack of longitudinal follow-up data to confirm the capability of MABC in predicting general developmental coordination disorders. This criterion validation can be conducted in two possible ways, either by accompanying children through their life until adolescence, or by transversely applying the same tests in children with a definitive clinical diagnosis of a developmental disorder.

■ ACKNOWLEDGEMENTS

Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina – FAPESC 2015 TR 390.

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Resumo

Introdução: o Movement Assessment Battery for Children, Segunda Edição (MABC-2) vem sendo amplamente utilizado na literatura nacional para diagnóstico do transtorno do desenvolvimento da coordenação (TDC). Problema: A relação do MABC-2 com o instrumento padrão ouro para o TDC, a versão brasileira do Developmental Coordination Disorder Questionnaire (DCDQ-BR) não está bem consolidada, apresentando controvérsias.

Objetivo: o objetivo do presente estudo foi testar o nível de congruência entre o teste motor do MABC-2 com o DCDQ-BR.

Método: o processo de validação concorrente ocorreu com a participação de 350 escolares, na faixa etária de 7 a 11 anos de idade, dos municípios da grande Florianópolis-SC e Manaus-AM e seus respectivos pais ou responsáveis. A concordância entre os instrumentos foi verificada por meio do teste de correlação de Spearman e regressão linear simples no programa estatístico SPSS versão 20.0, considerando um nível de significância de 5%.

Resultados: Foi verificada uma associação entre as escalas dos dois instrumentos de medida.

Conclusão: O estudo mostrou evidências de validação concorrente entre o MABC-2 e o DCDQ-BR sugerindo que o MABC-2 pode ser usado como um indicativo do transtorno do desenvolvimento da coordenação.

Palavras-chave: validação, MABC-2, DCDQ-BR, desempenho motor.