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Motor performance in children according to the Movement Assessment Battery for Children-2: an integrative review

Desempenho motor em crianças pela Movement Assessment Battery for Children-2: revisão integrativa

Desempeño motor en niños por la Movement Assessment Battery for Children-2: revisión integradora

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This is an integrative review which aims to identify and describe the motor performance of children from seven to ten years old according to the Movement Assessment Battery for Children scale - second edition (MABC-2). The databases we have considered were VHL, Scielo, PubMed, Scopus, Science Direct and Web of Science and the Portuguese and English descriptors applied were MABC-2, motor performance, motor dexterity and balance. As an inclusion criterion, we have considered cross-sectional studies which used MABC-2 being published in a period of seven to ten years from 2007 to 2018. The search resulted in 22 articles from 2010 onwards considering subject children aged five to fourteen years old. To assess the methodological quality of cross-sectional articles, an adapted Loney scale was used and all of them were classified as having good methodological quality. According to the description of motor performance, children with Developmental Coordination Disorder, Autism Spectrum Disorder and Noonan Syndrome were classified as having difficulties of movement, and premature born children and children with delayed neuropsychomotor development were considered to be at risk of having difficulties of movement.
Descriptors: Psychomotor performance; Motor skills; Postural balance.

Esta é uma revisão integrativa que tem como objetivo identificar e descrever o desempenho motor de crianças dos sete aos dez anos de idade, por meio da escala Movement Assessment Battery for Children- segunda edição (MABC-2). Considerou-se as bases de dados: BVS, Scielo, PubMed, Scopus, Science Direct e Web of Science, com descritores português e inglês: MABC-2, desempenho motor, destreza motora e equilíbrio. Como critério de inclusão, considerou-se uso da MABC-2; estudos transversais, sete a dez anos, artigos publicados de 2007 até 2018. A busca resultou em 22 artigos, das quais se apresentaram a partir de 2010 e considerando crianças de cinco a catorze anos. Para avaliar a qualidade metodológica dos artigos transversais utilizou-se a escala Loney adaptada e todos foram classificados com boa qualidade metodológica. Na descrição do desempenho motor as crianças com Transtorno do Desenvolvimento da Coordenação, Transtorno do Espectro Autista e Síndrome de Noonan foram classificadas com dificuldade do movimento, e as crianças prematuras e com atraso no desenvolvimento neuropsicomotor com risco de dificuldade do movimento.
Descritores: Desempenho psicomotor; Destreza motora; Equilíbrio postural.

Esta es una revisión integradora que tiene como objetivo identificar y describir el desempeño motor de niños de siete a diez años de edad, utilizando la escala de Movement Assessment Battery for Children- segunda edición (MABC-2). Se consideraron las bases de datos: BVS, Scielo, PubMed, Scopus, Science Direct y Web of Science, con descriptores en portugués e inglés: MABC-2, desempeño motor, destreza motora y equilibrio. Como criterio de inclusión, se consideró el uso de MABC-2; estudios transversales, de siete a diez años, artículos publicados de 2007 a 2018. La búsqueda dio como resultado 22 artículos cuyos participantes fueron niños de cinco a catorce años. Estos artículos fueron presentados a partir de 2010. Para evaluar la calidad metodológica de los artículos transversales, se utilizó la escala de Loney adaptada y todos se clasificaron con buena calidad metodológica. En la descripción del desempeño motor, los niños con Trastorno del Desarrollo de la Coordinación, Trastorno del Espectro Autista y Síndrome de Noonan fueron clasificadas con dificultades de movimiento, y los niños prematuros y con retraso en el desarrollo neuropsicomotor con riesgo de dificultades de movimiento.
Descriptores: Desempeño psicomotor; Destreza motora; Balance postural.

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INTRODUÇÃO

Motor development in children occurs continuously and progressively, as age advances[1]. Fine, global motor skills and balance help the development of motor control and, subsequently, the improvement of the motor skills related to new experiences with motor skills[2].

During childhood, the child's rapid learning takes place due to neurological development and greater neural plasticity. Both of them can influence motor development[3].

In the school phase, performing tasks that require grabbing small objects helps optimizing manual dexterity.[4] Tasks such as writing, painting and cutting may influence fine motor skills maturation when one performs movements that require greater precision[5].

In the context of children's motor performance, knowledge about static and dynamic body balance is essential.[6] In order to have a stable balance, children need to have a functioning triad composed of vision, proprioception and vestibular system, however, any discrepancy in this system may lead to a variation in balance[7],[8] and compromise jumping, walking, running and one-foot stance activities[9].

According to the Movement Assessment Battery for Children- MABC-2, motor performance in school children has pointed out that 39.2% of them showed motor changes when performing manual dexterity activities such as targeting and catching as well as balance tasks[10]. Children with Developmental Coordination Disorder (DCD) may have some motor disabilities related to the execution of daily life and school environment activities which could result in behavioral difficulties[11].

The perceptions of competence and levels of motor development of children in relation to age and sex have helped identifying factors which can contribute not only to motor development but also to create stimulation strategies at the school environment such as pleasant motor experiences, pedagogical tasks based on the assessment of motor skills, positive reinforcement, among others[12].

Thus, the objective of this study was to identify and describe the motor performance of children from seven to ten years of age, using the Movement Assessment Battery for Children scale - second edition (MABC-2), by offering an integrative review of literature on this theme.

METHOD

The present study proposes the use of an integrative review method, which follows six steps[13]: identification of the theme, establishment of inclusion and exclusion criteria for the studies, definition of the information to be extracted from the selected studies, evaluation of the included studies, interpretation of the results and presentation of the review. The guiding question was: What is the motor performance of children aged seven to ten years old according to the MABC-2 scale like?

The keywords involved the combination of Portuguese and English, according to the descriptors (DECS and MESH): MABC-2 (Movement Assessment Battery for Children), desempenho psicomotor (psychomotor performance), destreza motora (motor skills) e equilíbrio (postural balance). It was typed MABC-2 AND motor performance, MABC-2 AND motor skills OR Balance. The selection process of the articles was obtained through the Portuguese and English languages.

The inclusion criteria were: a) articles which have used MABC-2 as an evaluation criterion; b) subject children who were seven to 10 years old; c) articles published from 2007 until September 2018. The following were not included: a) articles for review, intervention, adaptation and validation of scales/instruments; b) studies which used MABC-2 only to select children with coordination developmental disorder.

The articles were collected from the following databases: Virtual Health Library (VHL), SciELO, Medline (PubMed), Scopus, Science Direct and Web of Science. The researchers started

their searches in June 2017 and ended in early September 2018. Based on those steps, information related to the motor performance of children aged seven to 10 years were defined regarding the general classification or percentile obtained by the MABC-2 scale.

The Movement Assessment Battery for Children (MABC-2) scale assesses children's motor performance through eight tasks divided into three domains: Manual Dexterity, Pointing and Receiving, and Balance, separated into three age groups: 3-6, 7-10, 11-16 years. The classification is performed by means of the percentile divided into three topics: difficulty, risk, and absence of difficulty in movement[14].

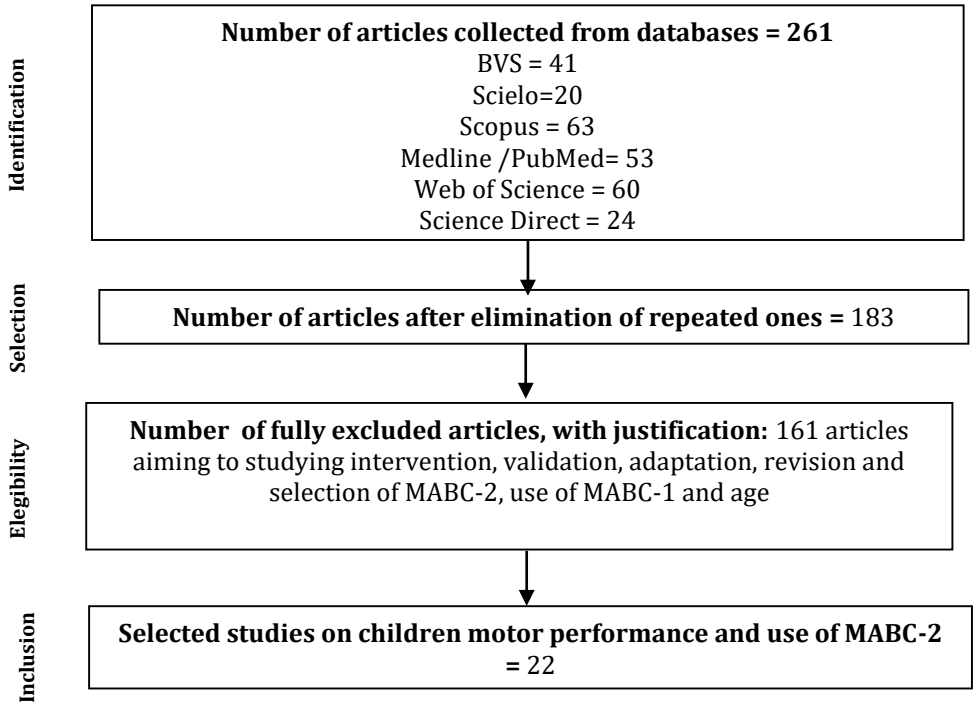
In order to check the methodological quality of the studies, the Loney Scale (1998)[15] including design, sample chart, sample size, result measures, measurement and response rate, interpretation of results and applicability of the findings, was used. This scale is composed of three categories: 1) validity 2) interpretation 3) applicability. With a view to evaluating only cross-sectional studies, we have chosen to target the questions of this scale by taking into account the original score and the objective of the questions. The study is considered to have good methodological quality when it scores seven points or more.

The articles were organized as follows: authors, year of publication, children's age, target population, main results and country.

RESULTS

After applying inclusion, exclusion and justification criteria to the 261 initially considered articles, 22 publications were taken into account, as shown in Figure 1.

Figure 1. Flowchart with number of articles collected from 2007 to 2018. Uberaba, 2019.



The starting point of publications about MABC-2 based on the criteria established in this study was 2010. This information is shown in Figure 2.

In Chart 1, it is possible to see a high prevalence (eleven studies)of subject children diagnosed with Developmental Coordination Disorder (CDC) throughout the 22 selected articles, since the scale has been widely used to identify children with this disorder. In addition, the instrument was considered reliable and valid in different countries.

The subjects' age prevailing in the studies ranged from five to 14 years old. The number of participants ranged from 17 to 380.

Table 2 shows the methodological quality of the articles obtained according to the adapted Loney scale. Among the articles analyzed, all of them had scores above seven points. As a result, they have been classified as good when it comes to methodological quality.

Chart 1. Studies on motor performance with MABC-2 in children aged seven to ten years old (± 2), in the period from 2007 to 2018. Uberaba, 2019.

Year	Age(in years)	Target population (Children)	Results	Country
2018[10]	6-10	217 classified as possibly having poor motor coordination (DCD)	85 (39.2%) of children obtained a DMov classification, 70 (32.3%) obtained a RDM classification and 62 (28.6%) obtained a ADM classification.	Holland
2018[38]	±9	17 classified as ASD and 20 TD	TSS of AS group resulted in RDM and Dmov classifications.	Italy
2018[19]	10-11	20 with DCD 30 TD	Children of the DCD group (49.8) obtained a DMov classification according to the TSS.	USA
2017[39]	6-11	19 with NS	Children performing the task TT (4.79) obtained a DMov classification, while children performing the BA task (5.95) and the DM task (6.84) obtained a RDM classification. The TSS (4.79) resulted in a DMov classification.	Holland
2017[25]	8-12	181 school children	25 children were classified as possibly having DCD, 35 obtained a RDM classification and 121 were above the 16th percentile.	England
2017[35]	6-12	34 with ASD/ ADHD	Children were classified as RDM according to the task performance TSS	Japan
2017[29]	± 8	284 school children	49 children showed DMov performing the BA task.	Brazil
2016[16]	7-8	45 with NPMDD 45 TD	NPMDD children obtained a RDM classification when performing the BA task (14.0) and a TSS of (53.9), while children performing the MD task (20.1) and TT task (19.8) obtained an ADM classification. Children belonging to the TD group obtained ADM when performing the three tasks.	Brazil
2015[20]	6-11	22 with DCD and 55 TD	Children with DCD performing the MD task (5.0) and the BA task (12.5) obtained a RDM classification, while children performing the TT task (25.3), obtained an ADM classification. Children belonging to the TD group obtained an ADM when performing the three tasks.	Israel
2015[23]	6-10	30 with DCD and 30 TD	Children with DCD showed a TSS of (3.90 ± 1.27) obtaining a DMov classification, while children belonging to the TD group (11.37 ±1.75)obtained a RDM classification.	South Africa
2015[22]	6-11	30 with DCD and 30 TD	Children with DCD showed a TSS of (7.20 ±2.84) and children belonging to the TD showed a TSS of (94.87 ±14.58). Children with DCD obtained a RDM classification.	China
2015[34]	8-13	56 ASD; 63 ADHD; 81 TD	The TSS of the ASD group obtained a DMov classification (4.14 ±2.19), while the ADHD group obtained a RDM (6.38 ±2.67) classification.	USA
2014[24]	5-10	17 with DCD and 17 TD	Children performing the TT task (14.4) obtained a RDM classification, while those performing the MD task (19.1) and the BA task (21.5)obtained a ADM classification.	China
2014[21]	8-14	28 with DCD and 28 TD	Children performing both MD and BA tasks obtained a DMov according to the TSS.	England
2014[40]	8-10	100 prematurely born children	39% of children obtained a RDM and DMov classification. The task result percentiles were 49% for MD; 35% for BA and 26% for PT taks.	Brazil
2013[33]	5- 11	32 ASD	The TSS in most children (78%) indicated DMov. Children performing the MD task and the TT task obtained a DMov classification while children performing BA task obtained a RDM classification.	USA
2013[30]	9-10	57 altered motor coordination capacity	The TSS of children with low motor coordination capacity (64.06) resulted in a RDM classification, while children with medium capacity (79.24) and high capacity (91.13)obtained an ADM classification.	Europe
2012[26]	± 7,7	33 with DCD and 30 TD	The TSS of children with DCD resulted in a RDM (62.36 ±15.50) classification. Children performing BA task and MD task did not obtain DMov (28.21 ±7.07; 21.55 ±8.25), while children performing the PT task obtained a DMov classification (12.61± 4.73).	China
2012[36]	7-14	16 with ADHD and 16 TD	Both groups obtained an ADM classification according to the TSS.	Australia
2012[31]	8	16 with DCD and 16 TD	The TSS of children with DCD resulted in a RDM classification.	Brazil
2011[27]	6-12	81 DCD 67 TD	Children with DC obtained a RDM classification according to the MABC-2 percentile results (11,55 ±14,79).	China
2010[28]	7-10	380 school children	5,5% showed RDM, 6,1% DMov, suggesting possible DCD.	Brazil

Note: Motor performance with MABC-2 in children aged 7-10 years old

Abbreviations: TT, Targeting and Throwing; NPMDD, Neuropsychomotor Development Delay; TD, Typical Development, MD, Manual Dexterity; BA, Balance; MABC, Movement Assessment Battery for Children; SN, Noonan Syndrome; ADHD, Attention Deficit Hyperactivity Disorder; DCD, Developmental Coordination Disorder, ASD: Autism Spectrum Disorder; DMov, Difficulty of Movement, RDM, Risk of Difficulty of Movement; ADM, Absence of difficulty of Movement; TSS, Total Standard Score.

Chart 2. Methodological quality of Observational articles surveyed using the Loney scale from 2007 to 2018. Uberaba, 2019.

Studies	Valid methods of study						Results Interpretation	Results Applicability	
	1	2	3	4	5	6	7	8	*POINTS*
Aertssen et al (2018)	*	*	*	*	*	*	*	*	**8**
Ansuini et al (2018)	*	*	*	*	*	*	*	*	**8**
Tseng et al (2018)	*	*	*	*	*	*	*	*	**8**
Croonen et al (2017)	*	*	*	*	*		*	*	**7**
Blanchard et al (2017)	*	*	*	*	*	*	*	*	**8**
Higashionna et al (2017)	*	*	*	*	*	*	*	*	**8**
Da Silva Reis et al (2017)	*	*	*	*	*	*	*	*	**8**
Dornelas e Magalhães (2016)	*	*	*	*		*	*	*	**7**
Raz-Silbiger et al (2015)	*	*	*	*	*	*	*	*	**8**
Ament et al (2015)	*	*	*	*		*	*	*	***7***
Ferguson; Wilson; Smits- Engelsman (2015)	*	*		*	*	*	*	*	***7***
Li et al (2015)	*	*	*	*	*	*	*	*	***8***
Cheng et al (2014)	*	*	*	*	*		*	*	***7***
Moreira et al (2014)	*	*	*	*		*	*	*	***7***
Prunty et al (2014)	*	*	*	*		*	*	*	***7***
Liu T (2013)	*	*	*	*	*		*	*	***7***
Wilson, et al (2013)	*	*	*	*		*	*	*	***7***
Tsang et al (2012)	*	*	*	*	*		*	*	***7***
Papadoupolos et al (2012)	*	*	*	*		*	*	*	***7***
Santos et al (2012)	*	*	*	*		*	*	*	***7***
Fong et al (2011)	*	*	*	*	*	*	*	*	***8***
Miranda et al (2011)	*	*	*	*		*	*	*	***7***

Note: 1- Are the study designs and sampling methods appropriate to answer the research question? 2-Is the sample base adequate? 3-Is the sample size adequate? 4- Was it adopted adequate and standardized objectives to measure the study? 5- Is measurement impartial? 6- Is the response rate adequate? 7- Were the results presented in a detailed way? 8- Are the participants and the context described in detail and can they be generalized to other similar situations?

DISCUSSION

Empirically, several studies corroborate the results of low general motor performance of the children while performing the MABC-2 scale tasks. The first step of the integrative review was to analyze the general motor performance through the total standard score and then relate them to the activities such as manual dexterity, aiming and catching and balancing of the MABC-2 scale.

One of the studies showed that there are correlations between proprioceptive impairment of the wrist (wrist position) with fine motor function and balance. Children with Developmental Coordination Disorder (DCD) were classified as having difficulty of movement. Besides, it mentioned an association between the position of the wrist to problems of fine motor skills[19].

Another work related motor performance, participation in leisure activities and quality of life of children with DCD between school holidays and school period. The MABC-2 balance task scores were correlated with the participation in sedentary activities in both groups. Children with DCD obtained a movement difficulty classification for the total standard score. As to manual dexterity and risk balance tasks, they also obtained a movement difficulty classification.[20] Regarding the manual dexterity task, one study examined DCD children handwriting and pointed out to correlations between visual perception measures and visual motor integration. It has also found that these children presented motor performance with movement difficulties while performing a manual dexterity task. [21].

Another study used the synesthetic movement test to detect passive arm movement to compare the synesthetic sensitivity and motor performance in children with DCD. Children with DCD showed a more sensitive result to movement detection, while in relation to motor performance, they were classified as being at risk of difficulty of movement[22].

In another study, children with DCDD participated in a virtual task in which they moved a digitized image according to a sequence of objectives by using a digital pen. In order to correlate this task to MABC-2, the children presented a difficulty of movement rating[23]. Therefore, when examining the motor deficits of children with DCD, researchers' choice for the MABC-2 scale could link motor deficit and perceptual visual skills. More specifically, the test consisted of computerized tasks for sequential eye-hand coupling in order to examine visual skills performance. Thus, the correlation between motor performance and the Aiming and Catching task classified the children as being at risk of difficulty in movement[24]. Among school children who were assessed through the MABC-2 scale, eleven of them had specific diagnoses for DCD[25].

In turn, when evaluating children with DCD, another study has identified skeletal maturity through the Sunlight Bonage system which assesses skeletal age in both children and adolescents by analyzing growth. The motor performance of these children presented a classification of risk of difficulty of movement in the task of aiming and catching[26].

Regarding the motor performance of children with DCD and weight status (BMI) using the MABC-2 scale, a study found that the DCD group was classified as at risk of difficulty in movement which was correlated with a large number of overweight children[27]. In this contexto, some studies[28,29] have observed that 6.1% of the children had DCD, and among them, 8.7% were also overweight. Children with DCD were at risk of difficulty in movement in the task of aiming and catching[28]. When identified by BMI, gender and type of foot, boys are more likely to have difficulty in balance according to the MABC-2 task[29].

Regarding motor performance with the possibility of low to high motor coordination, referring to DCD and associating the MABC-2 scale score, one study[30] showed a percentage of 62% for the average coordination ability and 35% for low coordination ability, so that the fourth task of the MABC-2 scale (targeting and catching a ball) was used. However, the use of glasses was added which has made it possible to capture the images seen by the child. Four of those children were diagnosed with a possible DCD, and four were at risk of developing a DCD. It is important to note that all of the tasks on the MABC-2 scale were performed, but the authors were interested in the task of targeting and catching a ball, as they believe it is relevant for the child's insertion in the sport and in integrative activities such as games[30].

When investigating the motor performance of children with motor difficulties and the relation with low levels of physical fitness, which is indicative of DCD, a study classified them as at risk of difficulty in movement according to the MABC-2 scale[31].

Children with DCD in this integrative review, therefore, had a higher incidence of risk classification of movement difficulty in the total standard score, for general motor performance and risk in the pointing and receiving task proposed by the MABC-2 scale. The task of aiming and catching a ball can help to identify deficit degrees of motor performance in children[32]. In this case, the children had a classification for movement coordination disorder.

Regarding the motor performance of children with Autism Spectrum Disorder (ASD), studies have found a classification of risk of difficulty in movement[33] while children witn Attention deficit hyperactivity disorder (ADHD) were found as at risk of movement difficulty. Children with ASD showed motor impairment in greater motor performance tasks compared to children with ADHD[34]. In another study, children with ASD and ADHD had worse motor performance in relation to their ability to coordinate their motor skills[35]. In contrast, a study investigated children with ADHD, without autism, and classified them as having no difficulty in movement. Therefore, those children did not show impaired motor performance.[36].

Therefore, because TEA classification encompasses autistic children with Asperger's Syndrome and children with Global Developmental Disorder, such children may present impairments whose intensity varies from mild to severe in the domain of motor behavior, especially when they perform repetitive actions[37]. On the other hand, an investigation on the performance of children with ASD in relation to the tasks of manipulating objects, with a single hand or both, found that these children performed similarly to the group of children with typical development, but the total standard score of 65% of these children were classified either at risk or with movement difficulties.[38].

When investigating motor performance in children with Noonan Syndrome (NS), a study used the MABC-2 scale in its Dutch version and found a low motor performance in children in relation to pointing and receiving tasks, according to the MABC-2 score, generating a movement difficulty rating. Regarding the task of manual dexterity and balance, children were at risk of difficulty in movement. Motor performance is said to be influenced by the clinical picture of this syndrome, since in general the child has heart problems with a direct influence on decreased muscle strength and greater fatigue[39].

In another study, in relation to developmental delay, children were classified as at risk of difficulty in movement in the total standard score and in the balance task[16]. However, in another study with children with a possible poor motor coordination in their school phase, 39.2% of them were classified as having movement difficulties, suggesting a possible Developmental Coordination Disorder (DCD), which in addition to the use of the MABC-2 scale, aerobic and anaerobic fitness, isometric muscle strength, functional strength for upper and lower limbs were considered[10].

CONCLUSION

This review of the investigations carried out with the MABC-2 in different populations of children have identified that the motor performance of children diagnosed as having Developmental Coordination Disorder, Attention Deficit and Hyperactivity Disorder, Autism Spectrum Disorder and Noonan Syndrome showed difficulties in performing movement and prematurely born children presented neuropsychomotor development delay as well as risk of developing difficulty in movement.

This study was limited to the use of research works which prioritized cross-sectional methodological designs. Thus, for future studies on this theme, one could focus on studies on MABC-2 scale validation, adaptation and MABC-2 based intervention assessment.

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Maria Fernanda Sabongi Izeppi e **Caroline de Oliveira** have collaborated with the conception of the study, data collection and analysis, writing and editing. **Karina Pereira** has contributed to the conception of the study, writing and editing.

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