

Prevalence of motor deficits and developmental coordination disorders in children from South Brazil

Prevalência de déficits motores e desordem coordenativa desenvolvimental em crianças da região Sul do Brasil

Prevalencia de déficits motores y trastorno coordinativo de desarrollo en niños de la región Sur de Brasil

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ABSTRACT

Objective: To investigate the prevalence of probable developmental coordination disorder and its risk, and the typical development in boys and girls aged from four to 12 years-old.

Methods: 1,587 children from South Brazil were evaluated by the Movement Assessment Battery for Children. The participants were divided into four age groups (G1, from four to six years-old; G2, from seven to eight; G3, from nine to ten; and G4, from 11 to 12).

Results: 19.9% of the children were identified as having probable developmental coordination disorder (percentile $\leq 5\%$) and 16.8% were identified at risk of such disorder (percentile $\leq 15\%$), based on the Movement Assessment Battery for Children. Significant interaction was found for the classification of the Movement Assessment Battery for Children between age group and gender ($p < 0.0001$). The gender analysis showed a higher prevalence of Developmental Coordination Disorder in girls at the age groups G3 and G4 ($p < 0.05$). Significant interactions were found for manual dexterity ($p = 0.0001$), ball skills ($p < 0.0001$),

and balance ($p < 0.0001$). Manual dexterity was responsible for the highest variances observed.

Conclusions: The motor difficulties in manual dexterity robustly accounted for the diagnosis of probable and at risk developmental coordination disorder. Boys presented lower level of performance in the manual dexterity and balance tasks, while girls of all age groups had more difficulties related to ball skills. Higher levels of motor impairment were found in older children.

Key-words: motor skill disorders; epidemiology; child development; primary prevention.

RESUMO

Objetivo: Investigar a prevalência de provável desordem coordenativa desenvolvimental e de seu risco e o desenvolvimento típico em meninos e meninas, com quatro a 12 anos de idade.

Métodos: Foram avaliadas 1.587 crianças da região Sul do Brasil com o *Movement Assessment Battery for Children*. Os

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participantes foram divididos em quatro grupos de acordo com a idade (G1, de quatro a seis anos; G2, de sete a oito; G3, de nove a dez; e G4, de 11 a 12).

Resultados: Ao todo, 19,9% das crianças foram identificadas com provável desordem coordenativa desenvolvimental (percentil $\leq 5\%$) e 16,8% com risco de tal desordem (percentil $\leq 15\%$), todas avaliadas pelo *Movement Assessment Battery for Children*. Houve interação significativa entre a classificação no *Movement Assessment Battery for Children*, por grupo de idade e sexo ($p < 0,0001$). A análise por gênero demonstrou maior prevalência de desordem coordenativa desenvolvimental no grupo de meninas nas faixas etárias G3 e G4 ($p < 0,05$). Observaram-se interações significativas para a destreza manual ($p = 0,0001$), habilidades com bola ($p < 0,0001$) e equilíbrio ($p < 0,0001$). Destreza manual foi o item com maior peso nas variações observadas.

Conclusões: As dificuldades nas tarefas de destreza manual repercutiram mais fortemente para o diagnóstico de provável desordem coordenativa desenvolvimental e no risco de tal desordem. Os meninos apresentaram pior desempenho nas tarefas de destreza manual e equilíbrio, enquanto as meninas apresentaram maior deficiência nas habilidades com bola. O desempenho motor deficitário foi mais prevalente no grupo etário de crianças mais velhas.

Palavras-chave: transtornos das habilidades motoras; epidemiologia; desenvolvimento infantil; prevenção primária.

RESUMEN

Objetivo: Investigar la prevalencia de un posible trastorno coordinativo de desarrollo y su riesgo, y el desarrollo típico en niños y niñas, con 4 y 12 años de edad.

Métodos: Se evaluaron a 1.587 niños de la región Sur de Brasil con el *Movement Assessment Battery for Children*. Los participantes fueron divididos en cuatro grupos conforme a la edad (1, de los cuatro a los seis años; 2, de los siete a los ocho; 3, de los nueve a los diez; y 4, de los 11 a los 12).

Resultados: En total, 19,9% de los niños fueron identificados con probable trastorno coordinativo de desarrollo (percentil $\leq 5\%$) y 16,8% con riesgo de tal trastorno (percentil $\leq 15\%$), todos evaluados por el *Movement Assessment Battery for Children*. Hubo interacción significativa entre la clasificación en el *Movement Assessment Battery for Children* por grupo de edad y sexo ($p < 0,0001$). El análisis por género demostró mayor prevalencia de trastorno coordinativo de desarrollo en el grupo de niñas en las franjas de edad

3 y 4 ($p < 0,05$). Se observaron interacciones significativas para la destreza manual ($p = 0,0001$), habilidades con balón ($p < 0,0001$) y equilibrio ($p < 0,0001$). Destreza manual fue el ítem con mayor peso en las variaciones observadas.

Conclusiones: Las dificultades en las tareas de destreza manual repercutieron más fuertemente para el diagnóstico de probable trastorno coordinativo de desarrollo y en riesgo de tal trastorno. Los niños presentaron peor desempeño en las tareas de destreza manual y equilibrio, mientras que las niñas presentaron mayor deficiencia en las habilidades con balón. El desempeño motor deficitario fue más prevalente en el grupo etario de niños mayores.

Palabras clave: trastornos de las habilidades motoras; epidemiología; desarrollo infantil; prevención primaria.

Introduction

Children with developmental coordination disorder (DCD) present motor deficits⁽¹⁻³⁾ and low levels of daily practice of physical activity⁽⁴⁾. The disorder can be observed in the delay of motor milestones and the clumsy way in which the child performs basic movements, such as catching objects, crawling and sitting. After some time, the uncoordinated behavior becomes evident in the performance of more complex activities that involve oculo-manual coordination between segments and/or all the body. Motor difficulties drive this children to avoid the practice of sports^(5,6), what leads to the increased risk of diseases associated with physical inactivity⁽⁵⁾. Social risks are associated to DCD. Because of their clumsy behavior, these children are often ridiculed by their peers, criticized by their teachers, and even by family members, which, in general, are not aware of the difficulties of the child. As a consequence, children with DCD demonstrate an inability to properly process social information⁽⁷⁾, often suffer depression and social isolation⁽⁸⁾, low self-esteem^(7,8) and low level of academic ambition^(6,9).

Repercussions in the short and long term impact on the quality of life of children with DCD, so the early diagnosis and the referral to compensatory programs that minimize the problems arising from the disorder are essential^(6,9). It is estimated that 6% of the world population is affected by DCD⁽¹⁰⁾, suggesting that this disorder is becoming extremely common and that, there is, probably, one case of DCD in each classroom⁽⁹⁾.

Higher rates of incidence of DCD have been reported in the few countries that conducted studies on a large scale. These new estimates range from 2 to 19%, causing a

worldwide concern about the quality of services offered to these children. For example, a study in the Netherlands and Germany showed a 7.7% incidence of DCD in children from 4 to 13 years⁽¹¹⁾, similar to results reported in Switzerland (7.3%)⁽¹²⁾. In England, a recent investigation with 6,990 children aged 7 years reported a rate of 1.7% children with probable DCD and 4.9% in situation of risk⁽¹³⁾. Expanding the diversity regarding the incidence of DCD, a cross-cultural study, involving children from Canada and Greece, found extremely different values – 8 and 19%, respectively⁽¹⁴⁾.

Based on facts such as the inconsistent estimates of DCD, the current results on the prevalence of this disorder in researches conducted in different countries, and the shortage of estimates for Brazil, this study's main aim was to investigate the prevalence of probable DCD and its risk in boys and girls in southern Brazil, from 4 to 12 years. Furthermore, given the disturbing recognition that DCD does not seem to be overcome by most children^(15,16) and the fact that compensatory intervention is essential to minimize the disorder's negative impact on daily life, the second aim of this study was to investigate in which motor tasks boys and girls from southern Brazil, with probable diagnosis of DCD, at risk of having the disorder, and with typical development, present major difficulties.

Methods

This cross-sectional study investigated 1,587 children aged from 4 to 12 years, attending public schools in southern Brazil (states of Rio Grande do Sul, Paraná, and Santa Catarina). Children from the institutions that agreed to participate in this study were sampled randomly, and the number of children in each institution was proportional to the size of the cluster. The sample size calculation was performed in Programs for Epidemiologists, version 4.0. For a confidence level of 99% and a proportion of answers of 50%, we found the total number of 1,500 children. The sample consisted of 48.1% girls whose mean age was 8.3 ± 1.7 years and 51.9% boys with 8.4 ± 1.7 years. Information about neurodevelopmental status of participants was reported by parents and/or legal guardians and by the principals of schools. Children with motor difficulties and previous diagnosis of neuropathologies such as cerebral palsy, hemiplegia, muscular dystrophy, etc., were excluded from the study⁽¹⁰⁾. Departments of Health and Education from 14 municipalities approved the study in schools that agreed to participate ($n=36$). Parents and/or legal guardians signed an informed consent and the study was approved by the Research Ethics Committee of Universidade Federal do Rio Grande do Sul (UFRGS).

The instrument used was the Movement Assessment Battery for Children (MABC)⁽¹⁷⁾, which is a battery of tests widely recognized as important in the identification of DCD in children. The test has specific and differentiated characteristics for each age group: G1, 4 to 6; G2, 7 and 8; G3, 9 and 10; and G4, 11 and 12 years. MABC is composed of subtests of manual dexterity, ability in handling the ball, and balance, each with eight motor tasks. The gross values obtained in each of the motor tasks are added and converted to scores from zero to five for the whole subtest (higher scores represent higher motor difficulties). The sum of the scores of each domain provides the value of total motor impairment, which is converted to a percentile. We adopted cutoff points recognized in the literature⁽¹⁸⁾: $\leq 5\%$ scores represent atypical motor development, indicative of DCD; percentile 6 - 15% is considered suspect (risk of DCD); and percentile $> 16\%$ is considered as typical motor performance.

The evaluation was conducted in schools by trained professionals and with at least 3 years experience in perceptual-motor evaluation and diagnosis. The assessment of each child took, in average, 25 minutes. Children first received verbal instructions and then demonstration of the motor tasks. When children did not understand one of the tasks, a new explanation was offered. Inter-observer reliability was high (0.98).

Chi-square test was used to analyze the prevalence rates of probable DCD, risk of DCD and typical development (TD) in age groups (AGs) and in sex. Partial η^2 was used to estimate effect sizes, considering as small, $\eta^2=0.01$; moderate, $\eta^2=0.06$; and large, $\eta^2=0.14$. Multivariate analysis was used to investigate motor difficulties of participants according to AGs and sex, adopting the Wilks' lambda (λ) criterion. When significant interactions were observed, continuity tests were conducted using analysis of variance (ANOVA). The confidence interval adopted was 95%.

Results

In the total sample, 19.9% children had probable DCD and 16.8%, were at risk. Thus, 63.3% of children presented TD. The chi-square test showed that the prevalence of likely DCD was significantly higher in girls and the prevalence of TD was higher in boys ($p=0.006$). In comparisons between AGs, the prevalence was not evenly distributed ($p=0.0001$). The continuity test showed that the higher prevalence of TD was observed in AG 2, while higher prevalences of probable DCD and risk of DCD were observed in AG 4. Table 1

presents information on the prevalence rates (number and percentage) of probable DCD, risk of DCD, and TD, according to AGs and sex, as well as statistical results for the comparisons between AGs and between sexes.

When comparisons between sexes were conducted, considering the AGs, results showed a higher prevalence of probable DCD for girls in AG 3 ($p=0.01$), while, for boys, there was significantly higher prevalence of TD in the age group from 9 to 10 years ($p=0.04$). In other AGs, significant differences were not observed between boys and girls. Table 2 presents information on the prevalence rates (number and percentage) of boys and girls from southern Brazil with probable DCD, risk of DCD and TD in each AG, as well as statistical results for sex comparisons.

The results of multivariate analysis indicated significant interactions between the classification in the MABC versus AG versus sex ($p<0.0001$, $\eta^2=0.26$). With moderate η^2 , it was observed that 26% of variability could be attributed to

differential performance of boys and girls at different ages. Significant interactions were observed for manual dexterity ($p=0.0001$, $\eta^2=0.38$), ball skills ($p<0.0001$, $\eta^2=0.17$) and balance ($p<0.0001$, $\eta^2=0.29$). The results showed that manual dexterity showed the highest level of responsibility for the variation observed (38%); balance was the second most responsible for variations (29%) and ball skills, the third (17%). Continuity tests using univariate analysis were conducted to investigate the significant interaction between classification versus AG versus sex. Tables 3 (manual dexterity), 4 (ball skills) and 5 (balance) presented means and standard deviations for each AG in the scores obtained by girls and boys, as well as statistical differences in each classification by AG and sex.

In Table 3 we can observe that the statistical differences in sex regarding the subtest of manual dexterity occur in AGs 2 (children with TD), 3 and 4 (children with likely DCD), all favoring the better development of girls.

Table 1 - Prevalence of probable developmental coordinative disorder, risk of developmental coordinative disorder and typical development according to age groups and sex

Age group and sex	n	Probable DCD	Risk of DCD	TD
		n (%)	n (%)	n (%)
AG 1	151	24 (15.9)	30 (19.9)	97 (64.2)
AG 2	703	84 (11.9)	94 (13.4)	525 (74.7)*
AG 3	592	147 (24.8)	111 (18.8)	334 (56.4)
AG 4	141	61 (43.3)*	31 (22)*	49 (34.8)
Girls	763	177 (23.2)*	126 (16.5)	460 (60.3)
Boys	824	139 (16.9)	140 (17)	545 (66.1)*
Total	1,587	316 (19.9)	266 (16.8)	1005 (63.3)

DCD: developmental coordinative disorder; TD: typical development; AG: age group; *Significant differences in continuity tests ($p<0.05$)

Table 2 - Prevalence of probable developmental coordinative disorder, risk of developmental coordinative disorder and typical development in each age group by sex

Age groups	n	Probable DCD	Risk of DCD	TD	p-value
		n (%)	n (%)	n (%)	
AG 1					0.990
Girls	75	12 (16)	15 (20)	48 (64)	
Boys	76	12 (15.8)	15 (19.7)	49 (64.5)	
AG 2					0.140
Girls	346	49 (14.2)	49 (14.2)	248 (71.7)	
Boys	357	35 (9.8)	45 (12.6)	277 (77.6)	
AG 3					0.010
Girls	276	84 (30.4)	47 (17)	145 (52.5)	
Boys	316	63 (19.9)	64 (20.3)	189 (59.8)	
AG 4					0.350
Girls	75	32 (48.5)	15 (22.7)	19 (28.8)	
Boys	66	29 (38.7)	16 (21.3)	30 (40)	

DCD: developmental coordinative disorder; TD: typical development; AG: age group.

In ball skills subtest (Table 4), for all classifications (probable DCD, risk of DCD and TD) in AGs 2, 3 and 4, boys presented significant higher scores than girls.

In balance subtest (Table 5), girls showed higher performance levels than boys in all classifications in AGs 2 and 3; in AG 4, significant differences favoring girls were found only in children with TD. In AG 1 there were no significant differences in any subtest.

Discussion

The study aimed to investigate the prevalence and the motor difficulties of boys and girls with probable DCD and risk of DCD. We evaluated 1,587 children in four AGs. In the total sample, we found that 19.9% of children presented probable DCD and 16.8% were at risk of DCD – results which are comparable to those observed in Greece (19%)⁽¹⁴⁾

Table 3 - Mean and standard deviation of manual dexterity according to diagnostic classification, age group, and sex

	Probable DCD Mean (SD)	Risk of DCD Mean (SD)	TD Mean (SD)
AG 1 (n=151)			
Girls	7.0 (3.5)	4.7 (2.8)	1.8 (2.0)
Boys	7.6 (3.7)	5.3 (2.5)	2.3 (2.0)
Sex (<i>p</i> -value)	0.690	0.520	0.250
AG 2 (n=703)			
Girls	7.4 (3.2)	5.0 (2.5)	1.9 (1.9)
Boys	7.6 (3.6)	5.6 (2.4)	2.4 (2.2)
Sex (<i>p</i> -value)	0.810	0.270	0.005
AG 3 (n=592)			
Girls	8.3 (3.3)	6.5 (2.8)	3.0 (2.6)
Boys	9.7 (3.0)	6.4 (2.3)	3.0 (2.2)
Sex (<i>p</i> -value)	0.010	0.850	0.940
AG 4 (n=141)			
Girls	8.3 (3.8)	4.5 (2.8)	2.3 (1.9)
Boys	10.2 (3.2)	6.2 (3.8)	3.1 (2.5)
Sex (<i>p</i> -value)	0.040	0.160	0.230

SD: standard deviation; DCD: developmental coordinative disorder; TD: typical development; AG: age group.

Table 4 - Mean and standard deviation of ball skills according to diagnostic classification, age group, and sex

	Probable DCD Mean (SD)	Risk of DCD Mean (SD)	TD Mean (SD)
AG 1 (n=151)			
Girls	5.9 (3.0)	3.0 (2.3)	2.0 (1.9)
Boys	6.2 (1.9)	3.4 (2.3)	1.7 (1.9)
<i>p</i> -value	0.750	0.640	0.370
AG 2 (n=703)			
Girls	6.0 (2.2)	4.7 (2.4)	2.3 (2.0)
Boys	4.5 (2.8)	3.2 (2.2)	1.3 (1.7)
<i>p</i> -value	0.008	0.002	0.001
AG 3 (n=592)			
Girls	4.9 (2.8)	2.7 (2.4)	1.6 (2.0)
Boys	3.3 (3.0)	1.6 (1.8)	0.6 (1.0)
<i>p</i> -value	0.001	0.006	0.001
AG 4 (n=141)			
Girls	4.1 (2.4)	1.8 (1.5)	2.0 (1.6)
Boys	1.8 (1.8)	0.9 (1.3)	0.4 (0.9)
<i>p</i> -value	0.001	0.050	0.001

SD: standard deviation; DCD: developmental coordinative disorder; TD: typical development; AG: age group.

Table 5 - Mean and standard deviation of balance according to diagnostic classification, age group and sex

	Probable DCD Mean (SD)	Risk of DCD Mean (SD)	TD Mean (SD)
AG 1 (n=151)			
Girls	6.2 (3.8)	4.6 (2.4)	1.7 (1.9)
Boys	7.2 (5.0)	3.9 (2.2)	1.5 (1.9)
Sex (<i>p</i> -value)	0.620	0.410	0.630
AG 2 (n=703)			
Girls	2.8 (2.0)	1.7 (1.7)	0.4 (0.8)
Boys	4.8 (2.7)	2.2 (1.7)	0.7 (1.1)
(<i>p</i> -value)	0.001	0.140	0.001
AG 3 (n=592)			
Girls	4.4 (2.7)	2.1 (1.7)	1.4 (1.5)
Boys	5.8 (3.0)	3.2 (1.8)	1.7 (1.6)
(<i>p</i> -value)	0.004	0.001	0.070
AG 4 (n=141)			
Girls	7.1 (3.0)	4.5 (2.3)	2.0 (1.8)
Boys	5.7 (3.0)	4.4 (3.0)	3.3 (2.4)
(<i>p</i> -value)	0.090	0.980	0.060

SD: standard deviation; DCD: developmental coordinative disorder; TD: typical development; AG: age group.

and Japan (16.6%)⁽¹⁹⁾. However, the prevalence of cases in this study was higher to the rates obtained in Canada^(5,14), England⁽¹³⁾, Switzerland⁽¹²⁾, the Netherlands and Germany⁽¹¹⁾. In Brazil no studies were found which included all age groups and a high number of participants, but some Brazilian studies, with specific age groups, reported lower levels than those found in the present study. For instance, in a study conducted in the state of São Paulo, in the countryside, 10.5% cases of DCD and 14.6% risk of DCD were found in children from 9 to 10 years⁽²⁰⁾. Souza *et al*⁽²¹⁾ reported approximately 11% of DCD and risk of DCD in Manaus.

There was higher prevalence of DCD (23.2%) among girls, which is inconsistent with the world estimates of higher prevalence of the disorder in boys⁽¹⁰⁾. Other Brazilian studies indicate higher prevalence of DCD among girls⁽²⁰⁾. Both in international studies and in those developed in Brazil, the prevalence by age group has been little investigated, reducing the possibility of comparisons with previous researches. In the present study, the higher rates are observed in older children (AGs 3 and 4). Two possible explanations can be raised regarding this finding. First, it should be highlighted that the manual dexterity subtest contains the tasks in which the children demonstrated greater difficulties in the present study. Consequently, the results in these tasks contributed for the high prevalence of DCD in AG 4. This subtest has been criticized and it is often not considered as gold standard⁽²²⁾ for the assessment and diagnosis of coordinative difficulties

in children from the age group between 12 and 14 years. Nevertheless, it was observed that the AG 3 also presented high levels of prevalence of DCD, and gradual increases were observed in the various age groups studied. It is inferred that the shortage of diagnosis of DCD in the first school years and the lack of compensatory programs, that may offset the restrictions on movement, end up by worsening the motor limitations of children who are in the area between risk of DCD and normality in the developmental course. Over the years, such children avoid motor tasks that cause embarrassment, are reluctant in participating in sports activities^(5,6) and, also, because they perceive themselves as little competent in these tasks⁽²³⁾, they worsen their motor limitations and differentiate even more from peers who present a history of TD.

The high prevalence of DCD and the higher prevalence among older children and girls become extremely worrying, as this disorder tends to exceed the limit of a problem that is only motor and coordinative, interfering with the overall development⁽²⁴⁾. In Brazil there is a high prevalence of motor delay in childhood^(25,26), with limited opportunities for low-income children to go through diverse and appropriate experiences for the development in compensatory programs. Compensatory programs are, in general, offered by private clinics, in which the access is economically limited. Another worrying factor is the high prevalence among girls, which may be reflecting the cultural context. Traditionally, girls are encouraged to engage in quieter games, such as drawing

and playing with dolls, and boys engage in more vigorous games, such as contact sports⁽²⁷⁾; this pattern may limit, for girls, the access to a series of experiences that favor the development of basic motor skills.

The major difficulties observed in children were tasks involving manual dexterity tests. The results show that, regardless of gender, age, and classification, about 40% of the variability in results can be explained by scores obtained by children in these tasks. Difficulties in manual dexterity of children with DCD and at risk of DCD become gradually higher with increasing age. Moreover, boys with probable DCD from AGs 3 and 4 tend to present an even more unsatisfactory development than girls. The delay in the development of fine motor skills of children with DCD is reported in the literature⁽²⁸⁾. The accomplishment of such tasks involves perceptual skills, in which children with DCD have deficits⁽²⁸⁾. This result worsens as children with impaired manual dexterity tend to present, as a consequence, greater difficulties in the education process^(17,28). When they become older, these children have even greater difficulties, so continuing assessments and interventions conducted by the school and the relatives are imperative.

Balance tasks have also imposed challenges to the children with DCD and risk of DCD, since they were responsible for 29% of the variability in the performance of boys and girls of different ages. Children with DCD often have difficulties in maintaining postural control and balance⁽²⁹⁾. In the present study, the youngest children (AG 1) and the oldest (AG 4) are those who presented the poorer results on balance tasks. There was again a trend towards boys with DCD and at risk of DCD showing worse results than girls, restricted to AGs 2 and 3.

Tasks involving ball skills were those in which, in the present study, children with DCD and at risk of DCD presented the best results; however, these are the tasks in which the differences between boys and girls emerge more strongly, not only for children with DCD and risk of DCD, but also for those with TD. This leads to the inference that these are the

tasks that determine, for the most part, the higher prevalence of DCD among girls in the present sample. Traditionally, literature reports better results in ball activities for boys^(26,30), a fact that is due to the higher encouragement and greater opportunities offered to boys to develop skills that involve mastery and control of objects⁽²⁶⁾.

The high prevalence of cases of DCD proved to be worrying, especially considering the limited resources available in Brazil for compensatory and preventive care for these children. The results regarding difficulties in manual dexterity emphasize the need to identify this disorder before children enter school, so that they are provided with specific treatment. In short, the present results suggest the following interventional goals: improving fine motor skills in children with DCD and at risk of DCD before entering school, and keeping interventional continuity throughout the school years, so that these difficulties will not worsen, as observed in the present study; providing opportunities, particularly in schools, for girls to develop ball skills. It should also be emphasized, the clear need for future investments in different scientific areas, for the better understanding of the heterogeneous nature of DCD and its underlying mechanisms.

Although the present study has advanced in relation to previous ones, as it reported the prevalence of DCD in a more representative sample of the population, it has the limitation of being an investigation conducted only in southern Brazil. The lack of financial and human resources for the routine monitoring of children with DCD and the combination of other evaluation procedures for a more conclusive diagnosis (e.g., involving parents, educators, therapists and pediatricians) are other limitations of the study and of the current research on the theme. However, despite limitations, it is believed that the efforts employed to conduct studies in large scale may contribute to raising awareness about this disorder and to changing public policies regarding the care of children with DCD.

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