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Research Article Open Access

Assessment of the Participation of the Children with a Developmental Coordination Disorder (DCD): A Review of the Questionnaires Addressed to Parents and/or Teachers

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Abstract

Objective: Children with Developmental Coordination Disorder (DCD) struggle with the activities of daily living which require motor coordination. In order to appreciate the impact of the DCD on the participation, several questionnaires for teachers and/or parents have been developed. The questionnaires differ in their structure and contents. This article aims to make a review of the existing DCD questionnaires.

Method: A search of the available articles on the validation of DCD questionnaires was done during September 2014 and June 2015 on the following databases: Medline and Web of Science. The following combined keywords were introduced: developmental coordination disorder, activity and questionnaire. Only questionnaires or checklists for parents/caretakers and/or teachers of children with probable DCD were retained.

Results: Six questionnaires were identified: the Movement Assessment Battery for Children-2 Checklist, the Revised Developmental Disorder Coordination Questionnaire, the DCD Daily Questionnaire, the Motor Observation Questionnaire for Teachers, and the Children Activity Scales for Parents and the Children Activity Scales for Teachers. The sensitivity is high (≥80) in two questionnaires: DCDdaily Q and MOQ-T, it tends to be low in the other questionnaires. The specificity is high (≥90) in three questionnaires: ChAS-T, ChAS-P and DCDdailyQ. The results for the DCDQ'07 in the different studies are divergent and inconclusive.

Conclusion: The questionnaire which had the most reliable sensitivity and specificity is the DCDdailyQ. The DCDailyQ is currently the only questionnaire which has a good balance between the categories of items. It can identify children with and without DCD. In order to confirm this assumption, more cultural and psychometric validation is still needed.

Keywords: Child; Developmental coordination disorder; Attention deficit hyperactivity disorder; Questionnaire; Diagnosis

Introduction

Developmental Coordination Disorder (DCD) is a neurodevelopmental disorder which influences the participation in activities of daily living [1-6]. This disorder is established on the basis of four criterion described in the Diagnostic and statistical manual of mental disorders : (1) the acquisition and execution of coordinated motor skills is substantially below that expected given the individual's chronological age and opportunity for skill learning and use; difficulties are manifested as clumsiness as well as slowness and inaccuracy of performance of motor skills; (2) the motor skills deficit significantly and persistently interferes with activities of daily living appropriate to chronological age and impacts academic/school productivity, prevocational and vocational activities, leisure, and play; (3) onset of symptoms is in the early developmental period; (4) the motor skills deficits are not better explained by intellectual disability or visual impairment and are not attributable to a neurological condition affecting movement.

In order to confirm the second criteria, questionnaires or checklists for parents and/or teachers have been elaborated such as the Developmental Coordination Disorder Questionnaire [2] or the checklist of the Movement Assessment Battery for Children [7]. These questionnaires differ from one another, the items are different and they do not exactly identify the same children [8]. We also supposed that some items of these questionnaires are linked to difficulties of the children with attention deficit hyperactivity disorder (ADHD). Indeed, it has been reported that children with ADHD struggle to realise some activities of daily living [9,10]. When children show clearly more hyperactive symptoms and lack of inhibition [11], they will often act too fast without planning or anticipating the results of their action [12] with the risk of failing activities such as ball skill games. When children rather show a deficit of attention, they may encounter difficulties in activities which require fine motor skills [13]. These children may also have a low score at a motor test because their attention span is low [14].

The goal of this review was to identify and describe the available questionnaires or checklists for parents, caretakers and/or teachers which evaluate the activities in daily living of DCD children aged from 4 to 15 years and to compare their content, sensitivity and specificity.

Method

Procedure

A review of the available articles on DCD questionnaires was done during September 2014 and June 2015 on the following databases searching articles published between the years 2000 and 2015: Medline/Pubmed, Web of Science, Psycinfo/Ovid and CINAHL. The following combined keywords were introduced: Developmental coordination disorder, activity and questionnaire. Only questionnaires or checklists for parents/caretakers and/or teachers were retained.

Analysis

The items of the questionnaires were classified into six categories: (1) ADL includes activities that are related to self-care and self-maintenance; (2) fine motor skills includes activities such as using scissors to cut paper or manipulation of small objects; (3) balls skills; (4) balance that includes static and dynamic balance; (5) control and quality of movements include items such as "losing control over own movement" or "lack of fluency"; (6) others include the items which could not clearly be classified into any of the movement categories. Items were classified in these six categories by the three authors based on their clinical and research experience: 10 years in the clinical and research for the first authors and more than 20 years in the research field for the two other authors.

Results

Fourteen articles were retained and 13 articles were accepted and one rejected because no measure of sensibility or specificity was done [15]. Six questionnaires were identified: the Movement Assessment Battery for Children-2 Checklist (MABC2-C; [1], the Revised Developmental Disorder Coordination Questionnaire [2], the DCD Daily Questionnaire [3], the Motor Observation Questionnaire for Teachers [4], and the Children Activity Scales for Parents and the Children Activity Scales for Teachers [5]. Questionnaires that were designated for other developmental disorders were not retained. Only the studies on the revised version of DCDQ were retained and not those on the initial DCDQ. The cultural validation data were not retained but the psychometric values included in the different translations were retained.

Description of the questionnaires

The MABC2-C is the checklist included in the second version of the Movement Assessment for Children (MABC2) [1,7]. The MABC2-C is mainly for teachers of children between 5 and 11 years, but parents can also fill it out. This checklist contains 30 items in two sections. The section A includes 15 activities executed in static and/or predictable environment as the section B includes 15 activities executed in dynamic and/or unpredictable environment. All the items are classified in different categories: self-care skills, classroom skills, and physical education/recreational skills. The rating is a 4-point scale (0=very well; 3=not close), the total test score ranges from 8 to 90. A high score indicates a risk of DCD. On a Dutch sample of 383 children aged 5 to 8 years, [15] reported a high internal consistency (Cronbach's alpha=.94), a low sensitivity (41%) and a fairly good specificity (88%) (Table 1). The correlation between the MABC2-C and the MABC2 was significant but moderate (r=-0.38) (Table 1).

The results of the revised DCD-Q were published in 2009 [2]. The DCDQ'07 is a questionnaire for parents of 5 to 15 year old children and includes 15 questions rated on a 5 point-scale (1=not at all like your child; 5=extremely like your child). The total score ranged from 15 to 75. A lower score indicates suspicion of DCD. Different cutoff scores were established for different categories of ages. Below 8 years, the cutoff is ≤46, for children between 8 and 10 years, the cutoff is ≤55 and for children above 10 years, the cutoff is ≤57. The items are classified in three factors (1) control during movement, (2) fine motor/handwriting, and (3) general coordination. These three factors count for 79% of the total variance. Out of a sample of 232 children aged between 5 and 15 years, Wilson et al. [2] found an high internal consistency (Cronbach's alpha=.89), a good sensitivity (85%) and a lower than acceptable level of specificity (71%). The total score of the DCDQ was correlated with the total impairment scores of the MABC (r=-0.55, p <0.001). The psychometric values of the different translations will be discussed later in the analysis section.

The DCDdailyQ is for parents of 5 to 8 year old children and includes 23 questions with a 3-point scale (1=good, 2=medium, 3=poor). The total score ranged from 23 to 69. A high score indicates a risk of DCD. Van der Linde et al. [3] found a good sensitivity (88%) and specificity (92%), on a sample of 243 five to eight years old Dutch children, comprising 25 DCD children (Table 1). Three factors explained 48% of the total variance: (1) fine motor activities, (2) activities of self-care and self-maintenance, and (3) gross motor playing activities. Significant correlations were found between this questionnaire and the MABC2-Q (r=0.49) and with the DCDQ (r=-0.64) in the TD group, whereas no significant correlation was found in the DCD group.

The MOQ-T is a questionnaire for teachers of 5 to 11 year old children and includes 18 questions evaluated on a 4-point scale (1=never true for the child; 4=always true for the child). The total score ranged from 18 to 72. A high score indicates a risk of DCD. On a Dutch sample of 182 children aged 5–10 years, Schoemaker et al. [4] indicated that this questionnaire had a significant correlation with the MABC (r=0.57) and with the DCDQ (r=-0.63), the sensitivity was good (80.5%) but not the specificity (62%) (Table 1). The factor analysis showed two main components: general motor functioning and handwriting.

The ChAS-P is a questionnaire for parents of 4 to 8 year old children. The ChAS-P has 27 items: five items on fine motor skills, six items on gross motor skills, six items on organization in space and time, and finally nine items on ADL. The rating scale ranges from 'very well' (5) to 'less adequately' (1). A low score indicates a risk of DCD. The mean score was 4.18 (SD=0.76). A score under 3.43 indicates a probable DCD. The original version is in Hebrew, a translation is English has been done. For the first version, 216 parents have filled the questionnaire. The internal consistency is .94. The sensitivity is of 50% and the specificity is 90%. The relationship between the MABC and the ChAS-P is significant (r=0.51) (Table 1). The CHAS-T is a questionnaire for teachers of 4 to 8 year old children and it contains only 21 items which are similar to the ChAS-P. In fact, six items on ADL were deleted because the teachers encountered difficulties in responding to these questions. The items were classified into three factors: (1) fine motor skills, (2) gross motor skills, and (3)

organisation in space and time. The rating scale is the same as the one of the ChAS-P. This questionnaire has been validated in a sample of 355 teachers of 4 to 8 year old children. The sensitivity is 67% and the specificity 93%. The relationship between the MABC and the ChAS-T is strong (r= 0.75).

Studies	Samples	Age	Responders	Language	Questionnaires	Sensitivity	Specificity
Martini et al. [18]	Community	May-15	Parents	French Canada	DCDQ'07	47	77
Schoemaker et al. [8]	Community	05-Aug	Teachers	Dutch	MABC2-C	41	88
Pannekoek et al. [15]	Community	Dec-15	Parents	English	DCDQ'07	86	25
Palmar et al.	Community	04-Jun	Parents	Dutch	DCDQ'07	21	92
Kennedy-Bher et al. [19]	Community	5-7.11	Parents	German	DCDQ'07	30	87
Caravale et al. [17]	Community	05-Dec	Parents	Italian	DCDQ'07	59	65
Rosenblum [5]	Clinical	5-6.5	Parents	Hebrew	ChAS-P	50	90
Rosenblum [5]	Clinical	5-6.5	Teachers	Hebrew	ChAS-T	67	93
Kennedy-Bher et al. [19]	Clinical	5-6.3	Parents	German	DCDQ'07	73	95
Caravale et al. [17]	Clinical	05-Nov	Parents	Italian	DCDQ'07	88	96
Schoemaker et al. [4]	Mixed group	05-Oct	Teachers	Dutch	MOQ-T	80	62
Wilson et al. [2]	Mixed group	05-Jul	Parents	English	DCDQ'07	85	71
Van der Linde et al. [3]	Mixed group	05-Aug	Parents	Dutch	DCDdailyQ	88	92

Table 1: Types of samples, age of the children, responders, language, sensitivity and specificity of the questionnaires.

Synthesis of the analysis of content

The proportion of questions of one category differs from one questionnaire to another. The proportion of questions related to fine motor skills is around 30% in two questionnaires (DCDdaily-Q and MOQ-T), slightly lower in the revised DCDQ, and clearly lower in the MABC2-C (Table 2). All the questionnaires include items on handwriting whether it is printing shapes or letters (ChAST) or the general quality of the handwriting. The DCDQ'07 makes a difference between the speed and the legibility, the MOQ-T includes the quality of handwriting (irregular production) and the general quality when attention is required. The proportion of items measuring ball skills ranges from 3 to 20%. The two ChAS questionnaires contain one item on ball skills whereas the MABC2-C contains 6 items. The proportion of items measuring balance also varies between questionnaires: 43.3% in the MABC2-C and 5.3% in the MOQ. Thirteen items of the MABC2-C concern balance activities that are realized in stable or moving environment (Table 2). At the opposite, the DCDdaily-Q has only three items on balance. The proportion of items measuring activity of daily living (ADL) is lower in questionnaires for teachers than those for parents. Of the three questionnaires addressed to parents, the DCDdaily-Q and the ChAS-P include a large proportion of ADL items, whereas the DCDQ'07 contains one question on ADL.

The DCDdaily and the DCDQ'07 do not include items on the quality of movements whereas the MOQ-T contains six items. One third of the items of the DCDQ'07 concerns other domains than motor skills, ADL or quality of movements such as: "Your child would never be described as 'a bull in a china shop' (that is, appears so clumsy that she might break fragile things in a small room)", or "Your child does not fatigue easily or slouch and 'fall out' of the chair if required to sit for long periods".

Responders	Questionnaires	Activity of daily living		Fine motor skills		Ball skills		Balance		Control/Quality Movement		Others		Total
		N	%	N	%	N	%	N	%	N	%	N	%	
Teachers	MABC2-Q	5	17	4	13	6	20	13	43	2	7	0	0	30
	MOQ-T	1	6	5	29	2	12	1	56	6	35	1	6	17
	ChAS-T	3	11	7	26	1	4	3	11	1	4	6	22	27

Parents	DCDQ'07	1	7	4	27	3	20	4	27	0	0	5	34	15
	DCDdailyQ	10	44	7	30	3	13	3	13	0	0	0	0	23
	ChAS-P	9	33	7	26	1	4	3	11	1	4	6	22	27

Table 2: Number of items in each category and percentage (%).

Three types of statements are used in the questionnaire items. Firstly, positive statements include items such as, "playing ball" in the ChAS T/P, "catching a small ball thrown from a distance of 1.8 to 2.4 meters" in the DCDQ'07, "catching a ball with two hands" in the DCDDdailyQ. Secondly, negative statements include items such as, "the child is unable to timely react to an approaching ball" in the MABC2-C. Thirdly, statements based on the child's difficulties include items such as in the MOQ-T: "The child has difficulty performing activities involving whole-body movements (e.g. …catching a ball)". Some statements are equivocal because many activities are included in one item, for example in the DCDQ'07: "Your child's printing or writing letters, numbers and words is legible, precise and accurate, or if your child is not yet printing, he or she colors and draws in a coordinated way and makes pictures that you can recognize".

The types of answering options are also different. Two questionnaires require a comparison of child's performance with other children with an explicit requirement in the DCDQ'07 and an implicit one in the MOQ-T. The rating scale is on three positions for the DCDdailyQ most of the time), four positions in the MABC2-C and in the MOQ-T, five in the ChASP/T and in the DCDQ'07.

Synthesis of psychometric value

The sensitivity of the DCDQ'07 in a community sample ranges from 21% among children 4 to 6 years of age [16] to 86% in Australia but with a large confidence interval [15]. In a clinical sample, the sensitivity of the questionnaires ranges from 50 of the ChASP to 88 with the Italian version of the DCDQ [17]. In a mixed group composed with clinical and control participants, the sensitivity of the questionnaires ranges from 80 of the MOQ-T to 88 of the DCD dailyQ. The specificity of the questionnaires is quite low, for example in the DCDQ'07 addressed to parents of DCD adolescents in Australia (Table 1). The French Canadian version the DCDQ'07 [18] has a great difference between sensitivity (21) and specificity (92) (Table 1). The same conclusion is done for the German version [19]. The correlation with the MABC or the MABC2 ranges from 0.34 with the DCDQ'07 and .75 with the ChAS-T.

In conclusion, the questionnaires with an acceptable sensitivity ≥ 80; [4] are the MOQ-T, the DCDQ'07 and the DCDdailyQ. The questionnaires with a good specificity ≥ 90; [4] are the CHAS-T, the CHAS-P and the DCDdailyQ. The DCDQ has contradictory results among the different versions and studies, no clear conclusion can be drawn (Table 1).

Discussion

In order to respond to the second criterion of the DSM–5 which concerns the influence of motor deficits on activities of daily living, it is necessary to investigate the different domains of ADL such as school, leisure and self-care/self-maintenance [20]. The proportion of items on self-care and self-maintenance is low among the questionnaires for teachers, probably because items on self-care and self-maintenance are perceived more reliably by parents than by teachers. Of the three questionnaires for parents, two questionnaires (DCDdailyQ and ChAS-P) contains more than one third of items on ADL as the DCDQ'07 has 7% of items on ADL despite it is known that most of the children with DCD are struggling with activities such as cutting food or opening and closing the zipper [21].

More specifically for leisure, the types of activity can vary from one country to another, from one family to another, it is important to conceive the questionnaires in reference to the local habits. For example ball skills are not considered as important in all countries and are often gender-related. If we think about soccer, girls are less involved than boys in almost all the countries. At the opposite, boys can be less involved in fine motor activities such as folding a Jacobs ladder. In their meta-analysis on age and gender difference in motor performance, Thomas and French [22] described that boys showed better ball skills performance than girls whereas girls showed better performance in eye-hand coordination than boys. Rivard, Missiuna, McCauley, and Cairney [23] confirmed these gender differences in their study on factor analysis of the DCDQ'07.

Age has also an influence on the relevance and importance of specific motor skills. For example, cutting or gluing, are important activities when the child is young but are less important activities when getting older. Handwriting becomes less important as a function of age because the child can use a keyboard to write. Therefore, the DCD questionnaires should differentiate between ages, e.g., suitable age periods could be 3 to 5 years, then 5 to 7 years, 8 years to 10 years, and above 10 years. Actually, the little DCDQ [24] is addressed for children from 3 to 5 years and then the DCDQ'07 for children from 5 to 15 years of age. Age periods are however partly related to cultural contexts. School age entrance might also play a role in expectations of motor skills, more specifically fine motor skills.

The differences found among the six questionnaires are quite substantial and might mean that they do not screen the same children. In fact, a child who shows only fine motor skill deficits will be most likely identified with the DCDdailyQ than with the MABC2-C. At the opposite, a child with balance deficits will most likely be identified with the MABC2-Q rather than with the MOQ-T. This review raises several questions and concerns. In fact, according to the chosen questionnaire and to the profile of the child, the second DSM criteria will not be assessed at the same level of carefulness. Moreover, the child may have a low score at a motor test but a fairly good score in one of the questionnaires. In fact, Kennedy-Behr et al. [19] have shown that 10% of a clinic sample and 17% of a community sample had a score below the 15th percentile at the MABC2 and a score that indicates no motor impairment at the German version of the DCDQ.

The DCDQ'07 and the ChASP-T contain respectively five and six items that are not directly related to motor skills such as planning of activities. They may pick up children with other diagnosis. For

example, children with ADHD may also have difficulties in planning [25]. Moreover, the item of the DCDQ'07:

"Your child does not fatigue easily or slouch and "fall out" of the chair if required to sit for long periods" can also be applied to ADHD children. In fact, these children may have difficulties to stay on a chair for a long time. This item however did not load the factor of general coordination in the study of Rivard et al. [23].

The value of the sensitivity and the specificity should reach respectively above 80 and 90 to be a valid measure. Results of research suggest that among a clinical sample or a mixed group, the DCDQ'07 has a good sensitivity. Nevertheless, based on community samples, the sensitivity of the DCDQ'07 is most of the time very low [16-19]. The DCDQ'07 does not identify sufficiently the difficulties in daily activities of children with a probable DCD. It has thus limited use as a screening questionnaire in community samples when used as the only screening instrument [16]. The MABC2-C also has a low sensitivity among a community sample whereas the ChAS-P has a low sensitivity but in a clinical sample. It is difficult to give a single explanation for these results. While the MABC2-C includes only one item on ADL, the ChAS-P includes a larger proportion of items on ADL. Other motor tests than the MABC should also be used as a criterion when the psychometric properties of questionnaires are investigated [26].

The specificity is over 90 in three questionnaires (ChAS-T, DCDdailyQ, ChAS-P). These questionnaires are able to discriminate between children with DCD and children without DCD. The MOQ-T [4] has specificity under 80 and could identify children with DCD as they might not have DCD. They are thus likely to over identify children with DCD. The values of specificity of the different adaptations of the DCDQ are divergent and no clear conclusion can be established.

Limitations

This review only integrated six questionnaires which have been analyzed and published in English. It was thus not a systematic review and some other questionnaires that have been missed. The evaluation of the items in regard of the requirement of attention and motor skills has been made on the basis of the existing literature and the clinical research experience of the three authors with an agreement on each of the items. Sometimes, the fact that the comprehension of the items can differ between the raters may have influenced the results presented in Table 2. It should be noted that the lack of inhibition can also be one of the causes of the difficulties that children with DCD often encounter in daily activities such as walking while holding something. This aspect was not considered in this article. More research is needed in this field [27].

Conclusion

We suggest that a screening procedure which consists of two questionnaires, should be used in order to properly assess the second criteria of the diagnosis of DCD; the first one is addressed to the parents/caretakers, whereas the second to the teachers. Different questionnaires should be employed to cover the different motor functions of children capable at different ages. Motor items that require less of the child's attention should also be assessed in the early stages. Furthermore, as mentioned by van der Linde et al. [28-31], questionnaires and an objective measure of the activities should be administered.

The DCDailyQ is currently the only questionnaire which has a good balance between items to identify the difficulties of the child. It contains no equivocal items; all the items fall inside one category. The predictive values are excellent. The DCDailyQ can identify children with and without DCD. More cultural and psychometric validation is still needed in order to use it more widely.

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