

## Management of Developmental Coordination Disorder

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### Introduction

This document contains a brief overview of evidence regarding assessment, diagnosis, intervention, and service delivery for children and youth with developmental coordination disorder (DCD).

### How was the literature review completed?

An electronic search was performed in November 2017 and February 2018 of the following databases: TRIP, Cochrane, OT Seeker, Rehabilitation Reference Centre, UpToDate, CINAHL, and MEDLINE (PubMed). Keywords used in the search included: developmental coordination disorder, DCD, child\*, intervention, systematic review, and therapy. Summaries (e.g., clinical practice guidelines) and evidence syntheses (e.g., systematic reviews) were gathered to summarize research findings. Publications with the highest levels of evidence that were published since the most recent clinical practice guideline, as well as relevant qualitative research, were also included in this summary.

The American Academy for Cerebral Palsy and Developmental Medicine (AACPDM) Levels of Evidence<sup>1</sup> were assigned to relevant studies (see Table 1). The AMSTAR<sup>2</sup> scale was used to rate quality of included systematic reviews. The Appraisal of Guidelines for REsearch & Evaluation II (AGREE II) Instrument<sup>3</sup> was used to assess the quality of any guidelines (see Tables 1 and 2). The International Classification for Functioning, Disability and Health (ICF) was used to describe study outcomes.<sup>4</sup>

### What is Developmental Coordination Disorder (DCD)?

**DCD** is a chronic motor skill disorder seen in children and youth that significantly affects activities of daily living, school performance, and leisure activities.<sup>5,6</sup> The motor deficits must not be attributable to any other known medical or neurological condition (e.g., cerebral palsy or a neurodegenerative disorder).<sup>5</sup>

Although DCD can occur on its own, there is a high co-occurrence with other neurodevelopmental or neurobehavioural disorders, such as attention deficit hyperactivity disorder (ADHD) and/or specific learning and/or language disabilities. DCD also co-occurs with autism spectrum disorder (ASD) and is more prevalent in children born preterm and/or low-birth weight.<sup>5,7</sup>

### What is the incidence of DCD?

DCD is a prevalent disorder, typically affecting 5% to 6% of school-aged children and youth (i.e., one to two children in every Canadian classroom).<sup>8</sup> Males are more often diagnosed with DCD than females, with the male: female ratio varying from 2:1 to 7:1.<sup>5</sup> However, population-based studies have found the ratio to be more similar between the sexes, leading to the possibility that girls may be under-diagnosed, perhaps because parents place less importance on poor motor coordination in girls.<sup>9,10</sup>

### What are the consequences of DCD?

As a long-standing chronic disorder, the consequences of the motor deficits associated with DCD typically affect not only body fitness, activities of daily living, and academic functioning, but also social relationships and participation.<sup>5,6,11-14</sup> Children with DCD also report psychological issues, including

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significantly higher levels of depression and anxiety.<sup>14</sup> Consequently, the quality of life of children and youth with DCD can be considerably compromised compared to typically developing peers.<sup>13,14</sup>

Despite being one of the most common disorders in childhood, DCD is often under-recognized, under-diagnosed, and under-treated by the health care community.<sup>5</sup>

### How is DCD assessed and diagnosed?

DCD is assessed and diagnosed by a health care professional, typically a medical doctor or pediatrician, who is qualified to examine the specific criteria (see below).<sup>5</sup> Ideally, this process involves a multidisciplinary team approach for the most comprehensive assessment.<sup>5,6</sup> Assessment should include a thorough medical and developmental history, as well as the use of questionnaires, clinical examination, and motor test(s), as well as a discussion with the child and key individuals in their lives regarding the impact of the child's motor functioning on daily living skills, school, leisure, and participation.<sup>5,6</sup>

DCD is defined in the DSM-5<sup>15</sup> by the following four criteria:<sup>5</sup>

- A. Acquisition and execution of coordinated motor skills are substantially below what would be expected given the child's age and opportunity for skill learning and use. Difficulties may be seen as clumsiness, inaccuracy, or slowness of performance of motor skills (e.g., catching a ball, using scissors, printing or handwriting, riding a bicycle, or participating in sports).
- B. The motor skills deficit significantly and persistently interferes with activities of daily living and impacts school productivity, vocational skills, leisure activities, and play.
- C. The onset of symptoms is in the early developmental period.
- D. The motor skills deficit is not better explained by intellectual disability, visual impairment, or a neurological or medical condition affecting movement.

To address the above criteria, the assessment should encompass activities of daily living (e.g., self-care, academic abilities, prevocational and vocational activities, leisure participation and play) and the views of the child, parents, teachers, and relevant others.<sup>5</sup> Cultural differences should be considered to ensure that the child has had appropriate opportunities to practice and acquire motor skills.<sup>5</sup>

### Can a dual diagnosis be given?

A dual diagnosis of DCD and other neurodevelopmental disabilities (e.g., ASD, learning disorders, ADHD) should be given if appropriate, and treated according to established clinical guidelines. Treatment of co-occurring conditions can improve outcomes.<sup>5</sup>

### What assessment measures should be used for Criterion A?

Motor abilities should be assessed using objective, reliable, validated, and norm-referenced tests and measures.<sup>5,6</sup> The following motor function assessment tools are recommended as the primary evaluation measures for the assessment of DCD:<sup>5</sup>

#### 1. Movement Assessment Battery for Children, 2<sup>nd</sup> edition (MABC-2)<sup>16</sup>

The MABC-2 is a norm-referenced test for children 3 years 0 months to 16 years 11 months.<sup>16</sup> The measure contains 8 tasks in each of the 3 age ranges (3-6 years, 7-10 years, 11-16 years). Tasks relate to 3 specific areas: manual dexterity, ball skills, and balance (static and dynamic). Total standard scores are calculated and then converted into percentiles to determine how a child's motor coordination compares to typically developing children of the same age. A cut-off score at or below the 16<sup>th</sup> percentile is recommended for children 6 years and older. However, if a child scores below the 5<sup>th</sup> percentile in one domain (e.g., fine motor, balance) but scores above the 16<sup>th</sup> percentile in other domains, a DCD diagnosis could be made if other diagnostic criteria are met.<sup>5</sup> For children under the age of 6 years, a cut-off score at or below the 5<sup>th</sup> percentile on the total motor score is recommended.<sup>5</sup>

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The MABC-2 has demonstrated good to excellent inter-rater and test-retest reliability ( $r=0.72-0.95$ ),<sup>17</sup> good specificity, and fair to good construct validity and concurrent validity with the Bruininks-Oseretsky Test of Motor Proficiency (1<sup>st</sup> edition: BOTMP and 2<sup>nd</sup> edition: BOT-2).<sup>5</sup> Sensitivity compared to the BOTMP is fair to good, with higher sensitivity demonstrated when using the 15<sup>th</sup> percentile cut-off.<sup>5</sup> Overall, the level of evidence on the quality and suitability of the MABC-2 for the diagnosis of DCD is moderate to good.<sup>5,17</sup>

### 2. Bruininks-Oseretsky Test of Motor Proficiency, 2<sup>nd</sup> Edition (BOT-2)<sup>18</sup>

The BOT-2 is a norm-referenced motor function test for individuals aged 4 to 21 years, which assesses running ability, agility, balance, bilateral coordination, upper limb speed and dexterity, and visual motor control.<sup>18</sup> The BOT-2 has good to excellent test-retest and inter-rater reliability correlations ( $r=0.80$ ),<sup>17</sup> with good specificity, construct validity, and concurrent validity with the MABC-2. Sensitivity is reported to be lower than that of the MABC-2, although this information is based on weak evidence.<sup>5</sup> In general, the quality and suitability of the BOT-2 is rated moderate for this population.

Clinicians are advised that if any uncertainty exists in interpretation, administration of the alternate standardized motor test may be warranted.

### **What assessment measures should be used for Criteria B, C and D?**

A validated parent or teacher questionnaire should be used to support criterion B.<sup>5</sup> The parent-report Developmental Coordination Disorder Questionnaire (DCDQ)<sup>19</sup> is reported to be the best evaluated and validated questionnaire; use of the MABC-2 checklist<sup>16</sup> is also recommended.<sup>5</sup> Questionnaires and checklists should not, however, be used for population-based screening because of low sensitivity.<sup>5</sup> A history of motor learning challenges should be evident from early in life; parent interview and/or tools such as the Listening for DCD Checklist<sup>20</sup> or clinical interview guidelines<sup>21</sup> may be used to assist in determining Criteria B & C. Standardized testing for criterion D (e.g., IQ testing) is not required if a normal history of school functioning and academic achievements is reported and no uncertainty exists regarding the child's cognitive functioning level.<sup>5</sup>

### **Can DCD be diagnosed before the age of 5?**

Although DCD is usually evident early on in a child's life, the disorder is not typically diagnosed before age five.<sup>5</sup> However, if a preschooler (3 to 5 years of age) shows significant motor impairments (despite having had ample opportunities for learning and with other causes of motor delay have been ruled out), the diagnosis of DCD can be given, based on the findings from at least two longitudinal assessments (such as the repeated administration of the MABC-2) performed at sufficiently long intervals (at least 3 months apart).<sup>5</sup> More specifically, a cut-off of no more than the 5<sup>th</sup> percentile is used for this age group.<sup>5</sup>

### **Which interventions are effective for children with DCD?**

Children with DCD require treatment to remediate their motor challenges; strong (level II) evidence demonstrates physiotherapy and/or occupational therapy intervention are better than no treatment.<sup>5,22-24</sup> Best practice dictates that intervention should begin with collaborative individualized client- and family-led goal setting, focused on functional and meaningful activities and participation outcomes.<sup>5,23</sup> Recommended goal-setting and outcome measurement tools include the Canadian Occupational Performance Measure (COPM),<sup>5,25</sup> the Goal Attainment Scale (GAS),<sup>5,26</sup> the Perceived Efficacy and Goal Setting System (PEGS),<sup>27</sup> and the Pediatric Activity Card Sort (PACS).<sup>28</sup>

Activity- or task-oriented approaches, such as Cognitive Orientation to Occupational Performance (CO-OP) and Neuromotor Task Training (NTT), focus on meaningful activities of daily living to help promote transfer of training, and are supported by strong evidence (level I and II) for improving task performance and satisfaction. This evidence is drawn from clinical practice guidelines<sup>5</sup> and subsequent systematic

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reviews.<sup>23,31</sup> Effectiveness findings for overall motor skill outcomes are inconclusive.<sup>31</sup> Research syntheses report large effect sizes and strong treatment effects for task-oriented approaches.<sup>23,30,31</sup>

To be most effective, the therapy process should be child-centred and include key stakeholders, such as parents and teachers.<sup>5,23,30</sup> Inclusion of parents and teachers is needed to support task-specific practice, and to enable adequate practice time of home exercises/activities outside of professional treatment time.<sup>5</sup> Professional instruction to educate and to coach the parents as a means to support the generalization and application of skills into daily life is recommended.<sup>5,23</sup> Qualitative research suggests that incorporating the priorities of parents and children is crucial for optimising the outcomes of intervention.<sup>32</sup> Parents report valuing the education and support provided by professionals, as it helps to mitigate the apprehension that is often associated with raising a child with DCD.<sup>32</sup>

Compensatory and environmental supports, as well as the use of coping strategies, also need to be considered as part of intervention.<sup>5,13</sup> Occupational therapy should include the modification of tasks and expectations to match abilities, and the adaptation of materials and the environment of the child.<sup>5,6,23.</sup>

Clinical practice guidelines and subsequent systematic reviews and meta-analyses (strong evidence; level II) do not recommend process-oriented approaches (e.g., sensory integrative, perceptual and kinaesthetic training<sup>5,23</sup>), non-task specific interventions (e.g., use of the Wii Fit), and psychological approaches (e.g., self-concept training)<sup>29</sup> because of inconclusive, weak, or negligible effects on motor performance in this population. Some preliminary evidence exists for the effectiveness of motor imagery combined with task practice training<sup>29</sup> and for active video gaming as an adjunct to standard treatment.<sup>31</sup> Despite the overwhelming support for task-specific interventions, a recent narrative meta-review<sup>24</sup> and evidence synthesis<sup>33</sup> convey weak to moderate confidence in previous systematic review findings. Clinicians are therefore encouraged to measure, monitor, and track motor skill outcomes, as well as activity- and participation-level outcomes that reflect families' goals.<sup>5,34</sup>

### Treatment frequency and duration

Optimal treatment frequency and duration have not been determined conclusively because of the non-uniformity of variables across studies.<sup>5,23</sup> However, the majority of effective treatment interventions lasted longer than 10 weeks.<sup>23</sup> Reported treatment frequency ranged from every school day (including home exercises) to weekly, with once per week being most common.<sup>23</sup> Training programs with more frequent practicing schedules (e.g., 3-5 times/week) demonstrated the most significant effects on motor performance.<sup>30,35</sup>

### Group versus individual intervention

Small group intervention settings (4-6 children with one therapist and optional assistant) offer promise,<sup>31</sup> particularly those that involve parents;<sup>23,36</sup> however, this approach needs to be considered carefully for very young children and for those with severe DCD, both of whom may benefit more from individualized therapy.<sup>5</sup> Intervention should be tailored to the individual needs and interests of participants.<sup>29</sup>

Based on outcomes from the highest available level of evidence for each intervention approach for school-age children, grades of recommendation are offered in Table 1. Grades of recommendation are defined in Appendix II.<sup>37</sup> Evidence for early intervention for DCD is limited, but is summarized in the accompanying document, *Early Identification and Early Intervention for DCD* (<http://bit.ly/2D8IDEY>).

### **What is known about intervention for youth and young adults with DCD?**

The persistent nature of DCD needs to be addressed as children transition to adolescence and adulthood. New demands develop during this transition, which lead to subsequent struggles with activities, such as driving and academic tasks.<sup>13</sup> Mental health challenges, such as anxiety and depression, may emerge in early adolescence and continue into adulthood, leading to further reduced








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social participation.<sup>13,14</sup> Little evidence exists for interventions specifically targeted toward social participation for youth and young adults with DCD.<sup>13</sup> Current best practice recommendations include clinicians working with youth and young adults to address compensatory and coping strategies, to consider the impact of co-occurring conditions and secondary sequelae (and refer to other health care professionals, as necessary), to provide education, and to enhance functional abilities.<sup>13</sup> While improving motor skills is critical, the prevention and treatment of mental health difficulties should be a significant component of DCD intervention.<sup>38</sup>

### What is the best service delivery method?











Service delivery recommendations centre around organizing services to meet the comprehensive needs of children with DCD at all stages throughout childhood and adolescence.<sup>39</sup> Key elements of program delivery include: (1) working collaboratively with the child and family; (2) providing best practice treatment that focuses on function, participation, and prevention; (3) advocacy to increase awareness of DCD; (4) coordination among all professionals and community groups; (5) establishing clear care pathways; and (6) using a graduated or staged approach for assessment and intervention.<sup>39</sup> Stakeholders at all levels are encouraged to work together in designing, implementing, and evaluating interventions.<sup>39,40</sup> Two proposed models (Apollo and Partnering for Change) are described in the literature, and may hold promise for the provision of a continuum of services designed to build capacity,<sup>41,42</sup> for decreasing wait times, and for increasing the number of service recipients without sacrificing quality of care.<sup>41</sup>

**Table 1. Grades of Recommendation for Intervention with Children and Youth with DCD**

ICF Dimension	Outcome of interest	Intervention	Recommendation
Body Structure/Function	Gross motor skills	No intervention	 Proven Ineffective <sup>5,23,24,31</sup>
		Activity- or task-oriented approach (e.g., CO-OP, NTT) - individual or group* intervention	 Insufficient Evidence <sup>31</sup>
		Process-oriented approach (e.g., sensory integration, kinesthetic training)	 Conflicting Evidence <sup>5,23</sup>
		Gross motor functions, strength exercises, and weight-bearing	 Insufficient Evidence <sup>5</sup>
		Virtual reality/active video gaming as an adjunct to standard treatment	 Insufficient Evidence <sup>31</sup>
	Fine motor skills	Motor skills intervention	 Insufficient Evidence <sup>30</sup>
	Physical fitness (if targeted) (e.g., physical condition and strength)	Activity- or task-oriented training, (e.g., NTT and sport/play related skill training, and virtual reality)	 Proven Effective <sup>31</sup>



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ICF Dimension	Outcome of interest	Intervention	Recommendation
Activity	Motor task performance	No intervention	 Proven Ineffective <sup>5,23,24,31</sup>
		Activity- or task-oriented Approach (e.g., CO-OP, NTT) - individual or group* intervention	 Proven Effective <sup>5,23,31</sup>
		Process-oriented approach (e.g., sensory integration, kinesthetic training)	 Insufficient Evidence <sup>5,23</sup>
		Non-task-specific interventions (e.g., Wii Fit, Tai Kwon Do)	 Proven Ineffective <sup>29</sup>
		Psychological approaches (e.g., self-concept training)	 Proven Ineffective <sup>29</sup>
		Motor imagery training combined with task practice training	 Conflicting Evidence <sup>5,29</sup>
		Active video gaming as an adjunct to standard treatment	 Insufficient Evidence <sup>31</sup>
Participation	Cognitive, emotional and other psychological factors (e.g., inhibition, self-esteem)	Not specified	 Insufficient Evidence <sup>30</sup>
	Satisfaction with motor task performance	Not specified	 Insufficient Evidence <sup>30</sup>
	Participation in physical activity, sports, or active play.	Activity- or task-oriented approach (e.g., CO-OP, NTT) - individual or group* intervention	 Insufficient Evidence <sup>31</sup>

CO-OP, Cognitive Orientation to Daily Occupational Performance; NTT, Neuromotor Task Training

\*Small group intervention recommended *with* parent involvement, for older children with milder DCD<sup>5</sup>

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**Table 2: AMSTAR Conduct Rating<sup>2</sup>**

Conduct Rating Questions	Articles								
	Zwicker <sup>14</sup>	Slater <sup>17</sup>	Pless <sup>35</sup>	Hillier <sup>22</sup>	Smits-Engelsman <sup>23</sup>	Miyahara <sup>24</sup>	Preston <sup>29</sup>	Yu <sup>30</sup>	Smits-Engelsman <sup>31</sup>
1. Was an a priori design provided?	Yes	No	No	No	No	No	Yes	Yes	Yes
2. Was there duplicate study selection and data extraction?	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes
3. Was a comprehensive literature search performed?	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
4. Was the status of publication (i.e., grey literature) used as an inclusion criterion?	Yes	Yes	Yes	No	No	No	No	Yes	No
5. Was a list of studies (included and excluded) provided?	No	No	No	No	No	No	Yes	No	No
6. Were the characteristics of the included studies provided?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Was the scientific quality of the included studies assessed and documented?	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
8. Was the scientific quality of the included studies used appropriate in formulating conclusions?	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
9. Were the methods used to combine the findings of studies appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10. Was the likelihood of publication bias assessed?	No	No	No	No	No	No	No	Yes	No
11. Was the conflict of interest included?	No	No	No	No	No	No	Yes	Yes	Yes
<b>Total Rating</b>	<b>8/11</b>	<b>7/11</b>	<b>3/11</b>	<b>5/11</b>	<b>6/11</b>	<b>6/11</b>	<b>8/11</b>	<b>10/11</b>	<b>8/11</b>
<b>AACPDM Level of Evidence (see Appendix 2)</b>	<b>II</b>	<b>II</b>	<b>II</b>	<b>II</b>	<b>II</b>	<b>II</b>	<b>I</b>	<b>I</b>	<b>I</b>

Note: AACPD=American Academy for Cerebral Palsy and Developmental Medicine

### Quality Rating for AACPD levels of evidence I through III<sup>1</sup>

High Quality      8 to 11  
 Moderate Quality      4 to 7  
 Low Quality      0 to 3

## Management of Developmental Coordination Disorder

**Table 3: AGREE II Appraisal Instrument<sup>3</sup> for Blank<sup>5</sup> article**

Rating Questions	Reviewer 1	Reviewer 2	Domain Score
1. The overall objective(s) of the guideline is (are) specifically described.	7	7	14
2. The health question(s) covered by the guideline is(are) specifically described.	6	6	12
3. The population (patients, public, etc.) to whom the guideline is meant to apply are specifically described.	5	7	12
<b>Scope and Purpose Domain Total Score</b>	<b>18</b>	<b>20</b>	<b>38 (89%)</b>
4. The guideline development group includes individuals from all the relevant professional groups.	5	4	9
5. The views and preferences of the target population (patients, public, etc.) have been sought.	4	6	10
6. The target users of the guideline are clearly defined.	6	5	11
<b>Stakeholder Involvement Domain Total Score</b>	<b>15</b>	<b>15</b>	<b>30 (67%)</b>
7. Systematic methods were used to search for evidence.	7	7	14
8. The criteria for selecting the evidence are clearly described.	6	6	12
9. The strengths and limitations of the body of evidence are clearly described.	7	7	14
10. The methods for formulating the recommendations are clearly described.	4	5	9
11. The health benefits, side effects and risks have been considered in formulating the recommendations.	3	4	7
12. There is an explicit link between the recommendations and the supporting evidence.	6	6	12
13. The guideline has been externally reviewed by experts prior to its publication.	4	3	7
14. A procedure for updating the guideline is provided.	1	1	2
<b>Rigour of Development Domain Total Score</b>	<b>38</b>	<b>39</b>	<b>77 (64%)</b>
15. The recommendations are specific and unambiguous.	6	6	12
16. The different options for management of the condition or health issue are clearly presented.	6	6	12
17. Key recommendations are easily identifiable.	7	7	14
<b>Clarity and Presentation Domain Total Score</b>	<b>19</b>	<b>19</b>	<b>38 (89%)</b>
18. The guideline describes facilitators and barriers to its application.	2	2	4
19. The guideline provides advice and/or tools on how the recommendations can be put into practice.	4	2	6
20. The potential resource implications of applying the recommendations have been considered.	3	3	6
21. The guideline presents monitoring and/or auditing criteria.	5	5	10
<b>Applicability Domain Total Score</b>	<b>14</b>	<b>12</b>	<b>26 (38%)</b>
22. The views of the funding body have not influenced the content of the guideline.	4	3	7
23. Competing interests of guideline development group members have been recorded and addressed.	1	1	2
<b>Editorial Independence Total Score<sup>a</sup></b>	<b>5</b>	<b>4</b>	<b>9 (21%)</b>
<b>Overall Guideline Assessment Quality<sup>b</sup></b>	<b>5</b>	<b>5</b>	
<b>Overall Guideline Assessment Recommendation for Use<sup>c</sup></b>	<b>Yes</b>	<b>Yes</b>	

**Domain scaled score (in brackets)=(Domain score – minimum possible score)/(maximum possible score – minimum possible score) x 100**

<sup>a</sup>AGREE Score: 1 to 7 (1=strongly disagree, 7=strongly agree)

<sup>b</sup>Overall guideline assessment: 1 to 7 (1=lowest possible quality, 7=highest possible quality)

<sup>c</sup>I would recommend use of this guideline: Yes, Yes with modifications, No; Strongly recommend' or 'recommend' or 'would not recommend' or 'unsure'







## Management of Developmental Coordination Disorder

### Appendix I: AACPDM - Levels of Evidence for Group Intervention Studies (December 2008)<sup>1</sup>

Level of Evidence	Group Intervention Study Designs
I	Systematic review of randomized controlled trials (RCTs) Large RCTs (with narrow confidence intervals) (n>100)
II	Smaller RCTs (with wider confidence intervals) (n<100) Systematic reviews of cohort studies "Outcomes research" (very large ecologic studies)
III	Cohort studies (must have concurrent control group) Systematic reviews of case-control studies
IV	Case series Cohort study without concurrent control group (e.g., with historical control group) Case-control study
V	Expert opinion Case study or report Bench research Expert opinion based on theory or physiologic research Common sense/anecdotes

AACPDM, American Academy for Cerebral Palsy and Developmental Medicine; RCT, randomized controlled trial

### Appendix II: Traffic Lighting Classification Scale<sup>34</sup>

Colour Code	Criteria	State of the Evidence
 MEASURE 	Group design Level I or II evidence of good* quality demonstrating negative outcomes (e.g., absence of change compared to no treatment)	<b>Proven Ineffective</b>
 MEASURE 	Group design Level I or II evidence of poor <sup>∞</sup> quality regardless of outcome Group design Level III-V evidence of any quality regardless of outcome Single study research design Level I-V of any quality regardless of outcome Inconclusive results	<b>Insufficient Evidence</b>
	No evidence about the intervention's effectiveness	<b>No Evidence</b>
	Group design of either Level I or II evidence, where both studies of the same level of evidence show conflicting results	<b>Conflicting Evidence</b>
 MEASURE 	Group design Level I or II evidence of good* quality, demonstrating statistically significant positive outcomes	<b>Proven Effective</b>

\*=Moderate or Strong quality (Group Design AACPDM Conduct Rating Scale<sup>1</sup> score 4-7 or AMSTAR<sup>2</sup> score 4-11)

<sup>∞</sup>=Weak quality (Group Design AACPDM Conduct Rating Scale<sup>1</sup> or AMSTAR<sup>2</sup> score of 1-3)

# DCD Assessment Information Sheet



## What is Developmental Coordination Disorder (DCD)?

DCD is a chronic motor skill disorder seen in children and youth, which significantly affects activities of daily living, school performance, and leisure activities.<sup>1,2</sup>

### The disorder is diagnosed using DSM-5 criteria:<sup>3</sup>

- A.** Acquisition and execution of coordinated motor skills are substantially below what would be expected given the child's age and opportunity for skill learning and use. Difficulties may be seen as clumsiness, inaccuracy, or slowness of performance of motor skills (e.g., catching a ball, using scissors, printing or handwriting, riding a bicycle, or participating in sports).
- B.** The motor skills deficit significantly and persistently interferes with activities of daily living and impacts school productivity, vocational skills, leisure activities, and play.
- C.** The onset of symptoms is in the early developmental period.
- D.** The motor skills deficit is not better explained by intellectual disability, visual impairment, or a neurological or medical condition affecting movement.

## Why is assessment important?

DCD is a chronic disorder that affects fitness, activities of daily living, academic functioning, social relationships, and participation in meaningful life activities.<sup>1,2,4-6</sup> Children with DCD also report psychological issues, including significantly higher levels of depression and anxiety, and decreased quality of life than their typically developing peers.<sup>6,7,8</sup> Assessment facilitates the implementation of individualized, evidence-informed treatment that can improve physical, social, and psychological outcomes for these children.

## Who can do the assessment?

DCD is typically diagnosed by a medical doctor or pediatrician (and in some jurisdictions, a psychologist) who is qualified to examine the specific DSM-5 criteria.<sup>1</sup> Comprehensive assessment leading to diagnosis ideally involves a multidisciplinary health professional team.<sup>1,2</sup> Occupational therapists have a key role in assessing Criteria A and B.

## At what age is a DCD diagnosis appropriate?

DCD is usually evident early on in a child's life but not typically diagnosed before age 5.<sup>1</sup> Preschoolers (aged 3 to 5 years) who show significant motor impairments (despite having had ample opportunities for learning and

with other causes of motor delay ruled out) can receive a DCD diagnosis based on the findings from at least two longitudinal assessments (e.g., repeated administration of the MABC-2 at least 3 months apart).<sup>1</sup> Please also refer to the accompanying information sheet, *Early Identification and Early Intervention for DCD* (<http://bit.ly/2D8IDEY>).

## How do I assess for DCD?

Assessment should include:<sup>1,2</sup>

- A thorough medical and developmental history
- Clinical examination
- Motor testing
- Questionnaires
- Discussion with the child and key individuals regarding the impact of the child's motor skills on daily living skills, school, leisure and participation.

The following tools are recommended as primary assessment measures for school-age children for suspected DCD:<sup>1</sup>

Diagnostic Criteria	Assessment Domain	Recommended Measures	Key Information
A	Motor functioning	Movement Assessment Battery for Children, 2 <sup>nd</sup> ed. (MABC-2) <sup>9</sup>	<b>Age range:</b> 3 years to 16 years 11 months <b>Subsections:</b> Manual dexterity, ball skills, and balance (static & dynamic)
		Bruininks-Oseretsky Test of Motor Proficiency, 2 <sup>nd</sup> ed. (BOT-2) <sup>10</sup>	<b>Age range:</b> 4 to 21 years <b>Subsections:</b> Running ability, agility, balance, bilateral co-ordination, upper limb speed, and dexterity, and visual motor control
B	Activities of daily living	Developmental Coordination Disorder Questionnaire (DCDQ'07) <sup>11</sup>	<b>Age range:</b> 5 to 15 years Subsections: Control during movement, fine motor skills & handwriting, general coordination Free download available at <a href="http://www.dcdq.ca">www.dcdq.ca</a>
		Movement Assessment Battery for Children Checklist, 2 <sup>nd</sup> ed. (MABC-2 Checklist) <sup>10</sup>	<b>Age range:</b> 5 to 12 years <b>Subsections:</b> Movement in a static environment, movement in a dynamic environment, non-motor factors
C	Early onset	Parent interview and/or tools such as the Listening for DCD Checklist <sup>12</sup> or clinical interview guidelines <sup>13</sup> may be used	Developmental history as part of OT and/or physician assessment; a history of motor learning challenges should be evident from early in life
D	Medical examination	Neurological exam and other tests, as required	Refer to physician to rule out other possible medical or neurological explanations for motor difficulties <sup>14</sup>
	Cognitive functioning	IQ testing	Not required if no history of challenges with school functioning/academic achievement <sup>1</sup>



The psychometric properties of these measures are described in the Management of DCD Evidence for Practice (E4P) Synthesis.

## What motor performance scores indicate a possible DCD diagnosis?

Cut-off scores <sup>1</sup>	Children 3-5 years	Children 6 years and older
MABC-2	≤ 5th percentile	≤ 16th percentile; however, if a child scores below the 5th percentile in one domain (e.g., fine motor, balance) but scores above the 16th percentile in other domains, a DCD diagnosis could be made if other diagnostic criteria are met
BOT-2	2 SD below the mean	1 SD below the mean; as above

## Where can I learn more?

- Evidence on DCD assessment/diagnosis and management [Evidence for Practice (E4P) Synthesis]: <http://www.childdevelopment.ca/DCDAdvocacyToolkit/DCDAdvocacyToolkitEvidenceforPracticeSummary.aspx>
- Advocating for a DCD diagnosis (information sheet): <http://www.childdevelopment.ca/DCDAdvocacyToolkit/DCDAdvocacyToolkitResources.aspx>
- Best practices in DCD treatment (information sheet): <http://www.childdevelopment.ca/DCDAdvocacyToolkit/DCDAdvocacyToolkitResources.aspx>
- Early Identification and Early Intervention for DCD (information sheet): <http://www.childdevelopment.ca/DCDAdvocacyToolkit/DCDAdvocacyToolkitResources.aspx>
- Review of standardized motor assessments: <http://www.therapybc.ca/eLibrary/resources.php>
- Listening for DCD Interview Guide (CanChild): <http://bit.ly/2Ca1qDw>
- DCDQ : <http://www.dcdq.ca>

*This document was prepared in March 2018 and will be updated as new evidence emerges.*

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# DCD Diagnosis Advocacy Information Sheet



## What is Developmental Coordination Disorder (DCD)?

DCD is a chronic motor skill disorder seen in children and youth, which significantly affects activities of daily living, school performance, and leisure activities.<sup>1,2</sup> In order to meet DCD diagnostic criteria, the motor deficits must not be the result of any other known medical or neurological condition (such as cerebral palsy or a neurodegenerative disorder).<sup>1</sup>

## What is the occupational therapist's role in advocating for a DCD diagnosis?

One of the key roles and competencies of occupational therapists is advocating for the occupational potential, occupational performance, and occupational engagement of clients.<sup>3</sup> Establishing a DCD diagnosis is an important first step to help a child and family receive appropriate treatment and care. If you suspect a child/client has motor coordination difficulties, having them seen by a family doctor or pediatrician is critical to ensure that the movement problems are not due to any other physical, neurological, or behavioural disorders, and to determine whether more than one disorder may be present.<sup>4</sup> Although only a doctor or pediatrician (and psychologists in some jurisdictions) can make a DCD diagnosis, the occupational therapist can play a pivotal role in advocating for a diagnosis of DCD in a client.

## What can the occupational therapist do to advocate for a DCD diagnosis?

The following framework (adapted from<sup>5,6,7</sup>) can guide your actions:



## 1. Identify the issue

- ✓ Child/client with motor coordination difficulties
- ✓ Speak with parents
- ✓ Speak with daycare/preschool or classroom teacher

## 2. Gather the facts

### OT assessment

- ✓ Complete assessment to confirm presence of motor coordination difficulties
- ✓ Determine severity of the difficulties and the impact of the motor coordination difficulties on the child's daily functioning

## 3. What's the message?

- ✓ Document key findings of occupational therapy assessment and observations, including how assessment findings support diagnostic criteria A and B
- ✓ Include key information from parents and teachers
- ✓ Be clear and concise

## 4. Build support

- ✓ Engage family to speak to family doctor or pediatrician
- ✓ Engage teacher to write letter(s) to family and doctor

## 5. Communicate the message

- ✓ Engage the family to speak to family doctor or pediatrician
- ✓ Ensure occupational therapy assessment results get into the hands of the doctor or pediatrician (e.g., send report with a cover letter [see template here: <http://bit.ly/2D8IDEY>] about the importance of diagnosis and/or meet in person to discuss)

## 6. Monitor, assess and adjust

- ✓ Follow-up with the doctor to ensure occupational therapy information was received
- ✓ Offer opportunity for discussion
- ✓ Address any requests from the physician or pediatrician

*This document was prepared in March 2018 and will be updated as new evidence emerges.*

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# DCD Early Identification and Intervention Sheet



## Advocacy Toolkit

### What is Developmental Coordination Disorder (DCD)?

Developmental Coordination Disorder (DCD) is a chronic motor skill disorder seen in children and youth, which significantly affects activities of daily living, school performance, and leisure activities.<sup>1,2</sup> In order to meet DCD diagnostic criteria, the motor deficits must not be the result of any other known neurological or medical condition (such as cerebral palsy or a neurodegenerative disorder).<sup>1</sup>

#### The disorder is diagnosed using DSM-5 criteria:<sup>3</sup>

- A.** Acquisition and execution of coordinated motor skills are substantially below what would be expected given the child's age and opportunity for skill learning and use. Difficulties may be seen as clumsiness, inaccuracy, or slowness of performance of motor skills (e.g., catching a ball, using scissors, printing or handwriting, riding a bicycle, or participating in sports).
- B.** The motor skills deficit significantly and persistently interferes with activities of daily living and impacts school productivity, vocational skills, leisure activities, and play.
- C.** The onset of symptoms is in the early developmental period.
- D.** The motor skills deficit is not better explained by intellectual disability, visual impairment, or a neurological or medical condition affecting movement.

### Can DCD be identified before the age of 5 years?

DCD is usually evident early on in a child's life but is not typically diagnosed before age 5.<sup>1</sup> However, preschoolers (aged 3 to 5 years) who show significant motor impairments (despite having had ample opportunities for learning and with other causes of motor delay ruled out) can receive a DCD diagnosis based on the findings from at least two longitudinal assessments (e.g., repeated administration of the MABC-2 at least 3 months apart).<sup>1</sup>

### Why should we focus on early identification of DCD?

Parents who seek help for young children often experience greater delays and difficulties getting a DCD diagnosis, as compared to older children, which may contribute to higher stress levels.<sup>3</sup> Earlier diagnoses and interventions for children at risk of DCD may change the developmental trajectory for these children and positively contribute to family functioning and overall well-being.



## What are the risk factors for and early signs of DCD?

While the diagnosis of DCD may not be appropriate in the early years, occupational therapists have an important role in identifying children who may be at risk of DCD. Key risk factors for DCD include prematurity,<sup>4</sup> low birth weight,<sup>4</sup> male sex,<sup>4</sup> autism,<sup>5</sup> and significant speech and/or language difficulties that persist at 4-5 years of age.<sup>6</sup>

Several early signs for possible DCD have been proposed, largely based on clinical impressions, history taking, and parent report.<sup>3,6-9</sup> Commonly identified signs include poor performance in activities of daily living (ADLs) that require motor coordination (e.g., dressing, utensil use), poor balance, clumsiness, poor motor sequencing, spatial awareness problems (e.g., poor figure ground skills and falling/bumping into others), poor visual tracking, immature grasp, poorly established hand dominance, and slower, less accurate movements. Motor milestones may or may not be delayed, but there is a history of difficulty learning age-appropriate motor skills.

## Who can help to identify children with/at risk of DCD before the age of 5 years?

**Parents** play a critical role in the initial identification of motor difficulties for their children. Half of parents surveyed identified concerns prior to their child's 3<sup>rd</sup> birthday and sought help approximately 1.5 years after they first started to have concerns.<sup>3</sup> A smaller study found that nearly all the parents in an interview sample had identified concerns by age 4.<sup>10</sup> Early parent anxieties regarding poor motor development and behaviour are often confirmed by **early educators** in daycare or preschool settings.<sup>11,12</sup> These early educators are well poised for naturalistic observations of children in play and can be guided in identifying those most at risk of motor coordination difficulties;<sup>7</sup> most notably by **occupational therapists**<sup>13</sup> and **physical therapists**.<sup>14</sup> More attention has also been given to the potential role of **speech language pathologists** as early identifiers of children at risk for DCD given the high co-occurrence of speech and language impairments and motor impairments.<sup>6</sup> **Physicians**<sup>15</sup> are positioned to potentially identify children through well-baby and annual check-ups, but they will likely need a formal assessment of motor skills (Criterion A) and documentation of the impact on the motor skills deficit on daily life (Criterion B) (See Letter to the Doctor template [<http://bit.ly/2D8IDEY>]).

## What assessment tools can be used for early identification of children with/at risk of DCD?

**Criterion A:** The most commonly used measure is the **Movement Assessment Battery for Children-2** (MABC-2).<sup>16</sup> The MABC-2 has been shown to have excellent sensitivity (identifying children at risk of DCD) but also many false positives at age 3 years.<sup>17</sup> A cut-off score of  $\leq$  5th percentile is used for children  $\leq$  5 years of age, usually over 2 assessments at least 3 months apart.<sup>1</sup> Children at risk of DCD may be identified in infancy. For example, a retrospective study of preterm children diagnosed with DCD at 4.5 years found that these children scored more poorly on ALL early motor assessments, from as young as 4 months of age, compared to children who did not have motor problems.<sup>18</sup> These assessments include the **Movement Assessment of Infants**,<sup>19</sup> the **Bayley Test of Infant and Toddler Development – 3<sup>rd</sup> ed**<sup>3,20</sup> and the **Peabody Developmental Motor Scale – 2<sup>nd</sup> ed**.<sup>21</sup> The **Alberta Infant Motor Scale**<sup>22</sup> has also been used to identify preterm infants at risk of later motor impairments.<sup>23,24</sup>

**Criterion B:** The most studied and the only questionnaire validated in Canada is the **Little Developmental Coordination Disorder Questionnaire (Little DCDQ)** (available for \$50 CAD at <http://www.dcdq.ca/little-dcdq-ca.html>).<sup>25</sup> The Little DCDQ is a parent-report questionnaire designed specifically to identify children (3 years to 4 years 11 months) at risk of DCD. Other questionnaires include the DCDQ<sup>26</sup>

(<http://www.dcdq.ca>, for children aged 5 years+), and the **Early Years Movement Skills Checklist** (a parent- and teacher-report measure)<sup>27</sup> developed in the United Kingdom.

## What treatment approaches can be used for children with/at risk of DCD?

Individual intervention is generally recommended for younger children,<sup>1</sup> but evidence is emerging for group-level interventions.<sup>28-31</sup> The following treatment approaches show promise (mostly based on Level V best evidence, e.g., case reports, single subject research designs, pre/post designs with no control group) for younger children with/at risk of DCD:

- Modified Cognitive Orientation to Occupational Performance (CO-OP)<sup>32-34</sup>
- Task-specific intervention and parent education<sup>31</sup>
- Occupational Performance Coaching (teacher) and play-based intervention (child)<sup>35</sup>
- Motor Magic (occupational therapy embedded in the curriculum)<sup>29,30</sup>
- Fundamental Movement Skills<sup>28</sup>
- Animal Fun<sup>36</sup> (specific results for children with DCD have not yet been published)
- Strength training<sup>37</sup>

## Where can I learn more?

- Results of scoping review of early identification and early intervention of children with/at risk of DCD will soon be submitted for publication (Lee & Zwicker, in preparation)
- Evidence on DCD assessment/diagnosis and management [Evidence for Practice (E4P) Synthesis]: <http://www.childdevelopment.ca/DCDAdvocacyToolkit/DCDAdvocacyToolkitEvidenceforPracticeSummary.aspx>
- Advocating for a DCD diagnosis (information sheet): <http://www.childdevelopment.ca/DCDAdvocacyToolkit/DCDAdvocacyToolkitResources.aspx>
- Review of standardized motor assessments: <http://www.therapybc.ca/eLibrary/resources.php>

*This document was prepared in March 2018 and will be updated as new evidence emerges.*

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# DCD Treatment Information Sheet



## Advocacy Toolkit

### What is Developmental Coordination Disorder (DCD)?

Developmental Coordination Disorder (DCD) is a chronic motor skill disorder seen in children and youth, which significantly affects activities of daily living, school performance, and leisure activities.<sup>1,2</sup> In order to meet DCD diagnostic criteria, the motor deficits must not be the result of any other known neurological or medical condition (such as cerebral palsy or a neurodegenerative disorder).<sup>1</sup>

### Who should receive treatment?

Treatment should be provided for all children with DCD.<sup>1-6</sup> Current recommendations indicate a comprehensive treatment approach across the lifespan, from early intervention (<5 years) through school-age, and during transitions to adolescence and adulthood.<sup>1,2,7,8</sup> Please see related information sheet: *Early Identification and Early Intervention for DCD* (<http://bit.ly/2D8lDEY>).

### What approach is most effective?

Best evidence indicates physiotherapy and/or occupational therapy are both better than no treatment.<sup>1,3-6</sup> Task-oriented approaches [e.g., Cognitive Orientation to Occupational Performance (CO-OP), Neuromotor Task Training (NTT)], have demonstrated the best effectiveness,<sup>5,9</sup> while process-oriented approaches (e.g., sensory integration, kinaesthetic training<sup>1,5</sup>), non-task-specific interventions (e.g., use of the Wii Fit), and psychological approaches (e.g., self-concept training)<sup>8</sup> produce variable or minimal effects. Small group intervention offers promise but may not be optimal for very young children and children with severe DCD.<sup>1,5,10,11</sup> Occupational therapy should include compensatory supports (e.g., modifying tasks and expectations to match abilities), and adapting materials and the environment.<sup>1,2,5,7</sup>

### Key principles of effective intervention include:

- Task-oriented approach focused on meaningful activities of daily living<sup>5,9</sup>
- Child-centred therapy process<sup>1,5</sup>
- Involvement of key stakeholders (e.g., parents, teachers)<sup>1,5</sup>
- Task practice outside of therapy session,<sup>1</sup> ideally 3-5 times per week<sup>3,12</sup>
- Education and coaching parents to support skill generalization and application to daily life.<sup>1,5,13</sup>

### How much treatment is required?

Optimal treatment frequency and duration have not been established, but current best evidence suggests treatment programs lasting longer than 10 weeks are generally more effective.<sup>5</sup>

### How do I measure outcomes?

Measuring and monitoring outcomes over time is necessary. Treatment should start with collaborative, individualized goal setting led by the child and family. Goals should focus on meaningful functional activity and participation-level outcomes.<sup>1,14</sup> Tools that can assist with goal setting include the Perceived Efficacy and

Goal Setting (PEGS)<sup>15</sup> and Pediatric Activity Card Sort (PACS).<sup>16</sup> Recommended outcome measures include the Canadian Occupational Performance Measure (COPM)<sup>1,17</sup> and Goal Attainment Scaling (GAS)<sup>1,18</sup>. More information on how to facilitate collaborative goal setting using these tools can be found here: <http://www.childdevelopment.ca/CollaborativeGoalSettingCollaborativeGoalSettingEvidenceforPracticeSummary.aspx>

## Where can I learn more?

- Evidence supporting DCD treatment and management [Evidence for Practice (E4P) Synthesis]: <http://www.childdevelopment.ca/DCDAdvocacyToolkit/DCDAdvocacyToolkitEvidenceforPracticeSummary.aspx>
- Collaborative Goal Setting with Children and Families in Rehabilitation (tools and resources): <http://www.childdevelopment.ca/CollaborativeGoalSetting>
- Best practices in DCD assessment (information sheet): <http://www.childdevelopment.ca/DCDAdvocacyToolkit/DCDAdvocacyToolkitResources.aspx>

*This document was prepared in March 2018 and will be updated as new evidence emerges.*

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# Participate in Research

## Creating profile of children with Developmental Coordination Disorder (DCD) in British Columbia

### Principal Investigator:

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### RESEARCH AREA:

**Developmental Coordination Disorder (DCD)**

### QUESTIONS?

### PLEASE CONTACT

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**Are you a child/youth with DCD or do you have a child with DCD?**

**Consider participating in the DCD Clinic Research Database**

### What is this study about?

The purpose of the database is to create a profile of children with DCD in BC and to invite families in the database to participate in other studies.

### Who can participate?

Participants in the research:

- have a diagnosis of DCD
- are between 4 and 18 years old
- speak English

### What's involved?

By providing us access to medical and rehabilitation information related to children's developmental history and DCD diagnosis.

By completing questionnaires (parents).

### What are the benefits of participating?

Participation in the database will help us to learn more about children with DCD. Families may be invited to participate in other research and intervention studies.