

Parental questions about developmental coordination disorder: A synopsis of current evidence

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In recent years, knowledge about developmental coordination disorder (DCD) has accumulated very rapidly. Considerable progress has been made in the understanding of DCD, but recent studies have not been compiled in a way that makes them easily accessible to practicing paediatricians. In the present paper, the literature is reviewed and organized around the questions commonly raised by parents of children with DCD when they meet with their paediatrician. Parents express concern and seek information about their child's movement difficulties. They want to know what causes their child's lack of coordination and whether DCD is the correct diagnosis. Are other developmental disorders involved? What can they do to help their child's daily frustrations? The present review addresses frequently asked questions through a critical appraisal of current research literature. Paediatricians who are familiar with the research evidence will be better able to recognize these children and to share information with parents.

Key Words: *Children; Developmental coordination disorder; Movement skill difficulties; Parents*

Since the early 1900s, the scientific community has acknowledged a large group of children with movement skill difficulties who have not been diagnosed with a general medical condition (1). This difficulty in motor skill competence, observed in children who are developing well intellectually, is termed 'developmental coordination disorder' (DCD). DCD is a recognized syndrome that was described by the World Health Organization in 1992 (2) and has been included in the diagnostic manuals of the American Psychiatric Association since 1989 (3). Historically, children with DCD have been called 'clumsy' or 'physically awkward' or were diagnosed with 'developmental dyspraxia' (4). In 1994, researchers and clinicians from around the world gathered at an international

Les questions des parents sur le trouble de l'acquisition de la coordination : Un synopsis des données probantes courantes

Ces dernières années, les connaissances sur le trouble de l'acquisition de la coordination (TAC) se sont accumulées très rapidement. Des progrès considérables ont été réalisés dans la compréhension du TAC, mais les études récentes n'ont pas été compilées de manière à les rendre facilement accessibles aux pédiatres en exercice. Dans le présent article, on analyse les publications et on les organise selon les questions que posent souvent les parents d'enfants atteints d'un TAC lorsqu'ils rencontrent leur pédiatre. Les parents sont préoccupés et cherchent à obtenir de l'information sur les difficultés de mouvement de leur enfant. Ils désirent connaître la cause du manque de coordination de leur enfant et s'assurer que le TAC constitue bien le bon diagnostic. D'autres troubles du développement sont-ils en cause? Que peuvent-ils faire pour atténuer les frustrations quotidiennes de leur enfant? La présente analyse aborde les questions souvent posées d'après une évaluation critique des publications courantes en recherche. Les pédiatres familiers avec les données probantes de la recherche dépisteront mieux ces enfants et partageront l'information avec les parents.

consensus meeting and agreed to accept the term DCD to classify these children (5).

Parents of young children with DCD search for answers from a multitude of health care professionals (6). They want to know what is 'wrong with their child' (7) and are not sure with whom they should be discussing their child's movement problems. They ask about the causes of these movement difficulties, and because the disorder is not well known or well understood, they ask about possible diagnoses. Do all children with DCD experience similar difficulties? Are there associated developmental disorders involved in their child's movement difficulties? Do children 'grow out' of this problem? What should they, as parents, be doing?

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TABLE 1
Summary of diagnostic criteria for developmental coordination disorder

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- A. Performance in daily activities that require motor coordination is substantially below that expected, given the person's chronological age and measured intelligence. This may be manifested by:
- marked delays in achieving motor milestones (eg, walking, crawling, sitting)
 - dropping things
 - clumsiness
 - poor performance in sports
 - poor handwriting
- B. The disturbance in criterion A significantly interferes with academic achievement or activities of daily living.
- C. The disturbance is not due to a general medical condition (eg, cerebral palsy, hemiplegia or muscular dystrophy) and does not meet criteria for a pervasive developmental disorder.
- D. If mental retardation is present, the motor difficulties are in excess of those usually associated with it.
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Data from reference 3

In the past 10 years, research and knowledge about DCD has progressed and accumulated rapidly (1,8). Key studies published in the past five to 10 years are cited in the present article to offer paediatricians empirical evidence that can be used to answer the questions posed by concerned parents (see Appendix).

What is DCD?

A child is considered to have DCD when he or she lacks the motor coordination necessary to perform tasks that are appropriate for his or her intellectual ability, in the absence of other neurological disorders (Table 1) (3). Estimates of the prevalence of DCD range from 5% to 15% in the primary school population (9), and it is agreed that, at a minimum, 5% to 6% of all children are affected (3). DCD coexists with other associated learning (10), language (11), and behavioural and/or social (12) difficulties. Emotional and social problems such as low self-esteem and poor social acceptance are often reported to co-occur (13). Anxiety and depression have also been noted, but it is not yet known whether these conditions are secondary to social isolation and low self-worth (14).

Why is my child clumsy?

Children with DCD demonstrate significant difficulty with self-care tasks (eg, dressing, using utensils), school-related tasks (eg, handwriting, organizing seatwork, physical education class), leisure activities (eg, sports, playground activities, social interaction), or with a combination of the above. Research studies have shown that children with DCD can have deficits in many areas of performance, including postural control (15,16), visual attention and visual-spatial perception (12), proprioceptive or kinesthetic deficits (17), sensory motor deficits (18), motor execution (19) and internal representation of movements (20,21). Each of these has been suggested as a possible reason for the 'clumsiness' seen in children with DCD.

How do I know whether my child has DCD?

If a child has a significant and persistent motor impairment that interferes with academic achievement or activities of daily living (3), and once other medical explanations have been ruled out, then a diagnosis of DCD should be considered. These difficulties can be characterized by clumsiness (or lack of coordination) in a range of manipulative tasks, difficulties with sports or playground activities, difficulties in learning and retaining new motor skills, and frustration or a lack of desire to engage in physical activity (6,22,23). It is actually quite easy to pick out a DCD child in the playground (24,25) when one compares the child with their typically developing peers. Today, the most commonly used tests of motor impairment are the Movement Assessment Battery for Children (26) and the Bruininks-Oseretsky Test of Motor Proficiency (27). These tests have strong psychometric properties and are usually administered by an occupational or physical therapist to provide information about the extent of a child's motor delay relative to their peers.

Parents are a rich source of information about their child's difficulties (7,28). Paediatricians can ask the child's parents a specific series of questions to draw out movement difficulty experiences (29). In addition to integrating the information received from motor assessments and parent interviews, a critical role of the paediatrician is to perform a physical and neurological examination to rule out other possible causes of motor incoordination (see Appendix) (29). Hamilton (30) has outlined an excellent review of this process.

What causes DCD?

Despite numerous theories about the etiology of DCD, it is not yet possible to offer a definitive answer about causality (31). In the past, DCD was described using terms such as 'minor brain damage', implying that minor neurological dysfunction was the cause of the child's movement difficulties (32). Ayres (33) suggested that difficulties arise from a 'sensory integrative dysfunction', whereby the child is unable to integrate sensory or perceptual-motor information in order to produce skilled movements. The term 'developmental dyspraxia' has been also been used (34) to describe a common symptom of DCD, although this does not reflect causality.

Several hypotheses have been proposed and investigated to explain DCD; however, the evidence to date for any particular mechanism is very weak (31). Experimental research has pointed to cerebellar involvement in children with dyslexia (15,35); this same mechanism may be involved in DCD. This is referred to as an automatization hypothesis (35,36), which suggests that children have difficulty making motor behaviours automatic. Lack of automatization becomes particularly challenging when a secondary task is introduced because the child does not have the attentional resources to attend to more than one thing at a time. Given the cerebellum's role in monitoring and automating movement, this hypothesis has some face validity.

Does DCD occur more frequently in boys than girls?

Most studies of children with DCD report a higher prevalence in boys than girls, but the actual sex ratio is extremely variable and depends on the method used to identify children. The American Psychiatric Association (3) reports a male to female prevalence ratio of 2:1. Teacher-identified samples, on the other hand, tend to report much higher numbers of boys, with ratios ranging from 3:1 to 5:1 (37-39). Gillberg and Kadesjo (40) have proposed a sex selection bias in identifying children with motor difficulties, while others have argued that it is the frequent presence of comorbid conditions such as attention deficit hyperactivity disorder (ADHD) that makes teachers more likely to identify boys (41). Researchers have hypothesized that, due to the variation in behavioural presentations in the classroom, girls may be underidentified (40). The actual sex ratio in a population-based sample of children who are identified solely on the basis of motor impairment is not known.

Are there any laboratory tests that could help me better understand my child's condition?

Imaging techniques, such as computed tomography, magnetic resonance imaging and ultrasound, have been used to find minor neurological signs or lesions on the brain that could account for DCD. In a study of premature children (42), minor neonatal lesions were not found to be predictive of neurological dysfunction and perceptual-motor difficulties at school age. This finding was supported by Fallang et al (16), who suggested that other signs, such as unusual postural behaviour at four months, rather than minor abnormalities on ultrasound, were more indicative of later coordination difficulties. Bockowski et al (43) used neuroimaging scans to rule out the presence of any neurological lesions in two boys with DCD and found the scans for both boys to be normal.

A similar nonconclusive scenario is found with regard to genetic studies. Gillberg (44) claimed that familial factors are involved in the development of deficits in attention, motor control and perception. Slaats-Willems et al (45,46) used several different tests of motor control with ADHD children and their nonaffected siblings. They proposed a familial clustering on difficulties such as response inhibition and attentional control, but not on automatic movements (46). In their study, it was not possible to separate the genetics of motor impairment from the attentional problems. Francks et al (47) investigated familial patterns in motor coordination and reading-related disorders. They concluded that genetic effects on motor skill and reading ability appeared to be distinct and suggested that any correlation may have arisen from environmental influences. In summary, medical investigations are currently not very enlightening, and the etiology of DCD remains poorly understood (8).

What difficulties do children with DCD experience?

Children with DCD form a heterogeneous group, but all have generalized motor and perceptual difficulties (8).

Subgroups of children can be seen both in their range of motor difficulties and in the pervasiveness of the problem (41). Handwriting, written expression and organizational issues are the most commonly identified school issues (48). Teachers tend to notice these issues most easily, but they only represent the 'tip of the iceberg' (49).

Children with DCD usually have slower reaction, movement and response times (50); difficulties with timing and force control (51); difficulty responding to unpredictable environments (52); variable motor performance (53); a tendency to over-rely on vision and proximal muscle control to stay balanced (54); poor integration of visual and proprioceptive information (55); a tendency to 'fix' or 'freeze' their joints during task performance (19); and difficulties with imagery (21). Despite these impairments, certain repetitive movements that do not have time constraints (eg, swimming, running, skating, bicycling and canoeing) may be performed equally well by children with and without DCD.

Do some children with DCD have other developmental disorders too?

Recent evidence has shown conclusively that approximately 50% of children who have ADHD (56), learning disabilities (57) and specific language impairment (11) also have DCD. However, we do not know how many children with DCD have other comorbidities because there are no epidemiological studies that begin by first identifying children as having a motor impairment and then examining them for other disorders. While some authors suggest that a child who only has DCD is the exception rather than the rule (8), the research used to justify this has been based on clinical samples, not population-based ones (58). It is equally possible that children with 'pure' DCD (without comorbid difficulties) are simply less recognized. In either case, professionals need to distinguish between DCD and the presence of these other conditions because interventional approaches can be quite different (59) and underlying motor difficulties are often missed. It is also important to note that the frequent occurrence of coordination difficulties among children who present first with psychiatric disorders is rarely recognized (13). The comorbid presence of DCD has been observed, however, to increase the likelihood of negative psychiatric outcomes (60).

Why is it beneficial to identify my child as having DCD?

The idea of labelling a child is controversial. With an under-recognized disorder, however, a diagnosis can be enlightening and reassuring (14). Doors begin to open, and adults and children in the child's environment can be educated and encouraged to understand and provide adaptations to assist the child with DCD. Possibly the most important aspect of receiving the label 'DCD' is that, in understanding the nature of this disorder, the secondary consequences may be prevented (61).

Parents describe their children as having early movement difficulties, but also report a lack of motivation to play with other children (14). Reluctance to participate in

typical childhood physical activities has been attributed to poor self-efficacy (23) and lower perceived competence (62). These consequences of DCD magnify with time, and as teenagers, these children have higher rates of emotional problems (30), are more isolated socially and are at greater risk of victimization (63).

In addition to the mental health consequences of DCD, Cairney et al (64) have shown that children's reduced participation in physical activities is a risk factor for overweight/obesity in childhood and later years. Raynor (19) also demonstrated that the strength and endurance of children with DCD deteriorates significantly between six and nine years of age. These sequelae are precursors for decreased participation in sport or leisure activities, and diminished physical fitness across the lifespan (23,65,66).

Do children with DCD outgrow their motor difficulties?

Since the late 1980s, it has been recognized from longitudinal studies that DCD does not simply disappear as children grow older (60,61,63). Only recently has evidence surfaced that the motor difficulties of childhood are retained into adult life and can keep adults from performing important activities of daily life (61), such as driving a car (67). Numerous studies (6,61,66) have concluded that early identification, effective intervention and vocational counselling are important for children diagnosed with DCD to avoid the negative experiences that can affect their academic and social life. If children with DCD are neither identified nor offered any sort of intervention or management for their difficulties, there is an increased likelihood of secondary consequences that include behavioural problems (40), emotional distress (7), low self-worth (68), poor perceived competence (69), anxiety (62), depression (70), bullying (69) and obesity (64).

What should I do to help my child?

Parents of children with DCD experience a number of problems on the road to understanding their child's movement difficulties, including uncertainty in the ways they parent their child, recognize his or her difficulties, and support him or her in daily life (6). Because the movement difficulties experienced by a child with DCD encompass all daily activities, health professionals and people close to the child need to become involved. Studies have reported positive outcomes when involving parents in the understanding (6), identification (71), management and treatment (69,72,73) of their child's difficulties. Free educational materials providing evidence-based tips and strategies are available on the CanChild Web site (<www.canchild.ca>). Many parents become empowered when they are able to access and distribute these materials to significant others (eg, extended family members, teachers, coaches, sports instructors) in their child's life.

Who should see my child?

A medical diagnosis of DCD is of great importance to affected children and those around them (6). The recognition

and diagnosis of this condition by the paediatrician facilitates access to services and support for the child (6). A primary role of the paediatrician is to recognize parents' early descriptions of motor difficulties, conduct developmental and neurological examinations, and order any additional medical tests necessary to include or exclude any suspected disorder in a differential diagnosis of motor coordination difficulties (see Appendix). Once other causes for motor coordination difficulties are ruled out, a diagnosis of DCD should be considered. Parents and paediatricians may also work in collaboration with other health and educational professionals, including:

- Occupational therapists for self-care difficulties (eg, dressing, toileting, grooming), organizational problems, handwriting and written productivity, and difficulty participating in leisure and play activities.
- Physical therapists for more severe motor impairments, including problems with balance, strength or endurance; delays in the development of gross motor skills; and safety issues.
- Speech/language pathologists for receptive and/or expressive language delays, and articulation problems.
- Psychologists for comorbid conditions such as attentional or learning problems, hyperactivity, and learning disabilities.
- Educators for functional difficulties in the classroom setting, as well as for making adjustments to the child's environment to promote learning and social integration.

How can children with DCD be helped?

Parents and teachers who work with professionals can positively influence children's motor skills (72). They are in a position to alter and adapt a child's everyday environment, changing difficult activities into easier, more manageable tasks (22). Sugden and Chambers (72) stress that some children, possibly those most severely affected, may require the intervention of specialized therapists, such as those described earlier. Cognitive or 'top-down' approaches to intervention for DCD have shown the most promise (74).

In Canada, DCD is not a diagnosis that is recognized by boards of education for the purpose of formal identification. Having a medical diagnosis, however, opens educational doors for the child to receive an individualized education plan that adapts their learning environment to facilitate their special needs. Paediatricians can facilitate this process by writing a letter that states that the child has DCD – a disorder that can impact significantly on the child's performance on written evaluations. If the child appears to be inattentive due to postural instability or avoidance of motor-based tasks but does not have ADHD, it is particularly helpful to identify this. When a child's balance and coordination are more impaired, safety issues should be highlighted to prevent injuries. Parents report that teachers

respond well to articles such as "They're bright but can't write: Developmental coordination disorder in school aged children", which outline accommodations for children with DCD (22).

CONCLUSION

Having a child with DCD can negatively influence the quality of family life (7). Health professionals need to be aware of the stress experienced by families as they try to solve the mystery of DCD and wade through a maze of health professionals when trying to deal with their child's limitations (6). Having DCD recognized and diagnosed by a paediatrician will help the child and family begin on a pathway toward understanding and appropriate management. Future research is required to better understand the needs of

children with DCD and their families and to determine the efficacy of early identification and education of those around the child in preventing the long-term physical and mental health challenges faced by these children.

APPENDIX: Detailed information on the diagnostic criteria for DCD, how to conduct a differential diagnosis, the screening activities that can be administered in the office, and interview questions for parents can be obtained at <www.dcdpack.ca> (username: dcdpack / password: dcdchild) (Web site current at October 5, 2006).

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