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Developmental Coordination Disorder: Systematic Review

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Abstract: *Developmental coordination disorder (DCD) is a neuromotor disorder affecting approximately 5-6% of school-aged children.[1]. As described in the American Psychiatric Association's latest edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5),[2] the child with developmental coordination disorder has motor coordination below expectations for his or her chronologic age, may have been described as "clumsy" and may have had delays in early motor milestones, such as walking and crawling. Difficulties with coordination of either gross or fine motor movements, or both, interfere with academic achievement or activities of daily living. A DCD diagnosis is made with the basis on the Diagnostic and Statistical Manual of Mental Disorders – 5th edition (DSM5) [10]. In the manual, DCD is categorized under the umbrella of "neurodevelopmental conditions. In general, interventions for DCD are not supposed to work as "treatment," as the condition has no cure. But interventions can provide skills, strategies, and accommodations to make it easier for children with DCD to execute motor tasks required in daily living activities and school environments.*

Key Words: *Developmental coordination disorder (DCD), motor coordination, Diagnostic and Statistical Manual of Mental Disorders (DSM-5), learning disabilities.*

1. INTRODUCTION:

Developmental coordination disorder (DCD) is a neuromotor disorder affecting approximately 5-6% of school-aged children.[1] In order to be accurately diagnosed with DCD, a child must demonstrate motor coordination difficulties that significantly interfere with activities of daily living or academic achievement[1].

As described in the American Psychiatric Association's latest edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5),[2] the child with developmental coordination disorder has motor coordination below expectations for his or her chronologic age, may have been described as "clumsy" and may have had delays in early motor milestones, such as walking and crawling. Difficulties with coordination of either gross or fine motor movements, or both, interfere with academic achievement or activities of daily living.

Children with DCD have difficulty learning new motor skills. They tend to use their vision more than other types of feedback to guide their movements and, because of this, their motor skills may be more like those of younger children. Children with DCD perform inconsistently from one occasion to the next. Children with DCD often don't recognize the similarities of particular motor tasks, and this leads to difficulties transferring their motor learning from one activity to another (e.g., catching a large ball and then catching a small ball) [3]. The child may be delayed in developing certain motor skills such as riding a tricycle/bicycle, catching a ball, jumping rope, doing up buttons, and tying shoelaces [3].

The child may have difficulty with activities that require the coordinated use of both sides of the body (e.g., cutting with scissors, stride jumps, swinging a bat, or handling a hockey stick.[3]. The child may demonstrate a low frustration tolerance, decreased self-esteem, and a lack of motivation due to difficulties coping with activities that are required in all aspects of his/her life. [3]. The child may avoid socializing with peers, particularly on the playground. Some children will seek out younger children to play with while others will play on their own or follow the educator or playground supervisor.

The child may have difficulty balancing the need for speed with the need for accuracy. For example, handwriting may be very neat but extremely slow. [3] It is not uncommon for parents or educators to be told that a child will "grow out" of their difficulties. However, studies have now shown quite conclusively that most children do not outgrow these

problems. While children do learn to perform certain motor tasks well, they will continue to have difficulty with new, age-appropriate tasks. It is important to recognize these motor difficulties because children with DCD are more likely to develop academic and behavioural problems, demonstrate low self-esteem, depression, and anxiety, and they are at greater risk of becoming overweight [3]

Despite the visible differences in the motor behaviour of children with DCD (when compared to typically developing children), often times their difficulties are dismissed as behavioural problems, especially if they are accompanied by a child's frustration and anger. One of the characteristics of DCD is that the motor impairment exists despite the absence of intellectual deficits. This leads us to the notion that children with DCD are highly aware of their motor difficulties and the fact that they are different from their peers – obviously, they may not understand why they have such difficulties, and why their best attempts to perform a task are often clumsy. Because of that, it is not unreasonable to respond with anger and frustration, which can many times be labelled as behavioral issues.

Many school-related activities require a high level of motor function. For example, 42% of the time during the school day is spent on paper-and-pencil tasks, with the time increasing throughout the grades [4]. Mastering these activities can be frustrating, and can lead to the false notion that children with DCD are not compliant as other children. That is why DCD is still considered a "puzzle" by many – and often times, as previously mentioned, their issues are identified as behavioral problems, rather than a consequence of their motor difficulties.

Children with DCD are less likely to be physically active and have excess weight gain. DCD has also been associated with mental health issues later in life [14]. In addition, quality of life of these children has been shown to be severely impaired, and even lower than that of children living with chronic health conditions (such as cancer). [15] Coordination difficulties noted in DCD do not relate to any medical condition or disease (e.g., cerebral palsy, muscular dystrophy, visual impairment or intellectual disability). DCD can exist on its own or it may be present in a child who also has learning disabilities, speech/language difficulties, and/or attention deficit disorder [3].

In the previous DSM edition (DSM-IV-TR),[5] developmental coordination disorder was included under the broad category of "learning disorders"; in DSM-5, it is subcategorized as a motor disorder within the broader category of "neurodevelopmental disorders." [2] An additional criterion included in DSM-5 is that the onset of symptoms occurs during the developmental period.

The core deficit of DCD is on the motor system and the difficulties associated with the condition are visible when the individual tries to perform coordinated skills, but there are many deficits that are also associated with the condition. For example, children with DCD have been shown to have difficulties in executive functioning (working memory, inhibition, planning, and fluency) [6], mathematical performance [7], planning for end-state comfort [8], oculomotor processes [9].

2. Diagnosis :

A DCD diagnosis is made with the basis on the Diagnostic and Statistical Manual of Mental Disorders – 5th edition (DSM5) [10]. In the manual, DCD is categorized under the umbrella of "neurodevelopmental conditions." The diagnostic process involves the assessment of four criteria: A) Learning and execution of coordinated motor skills is below expected level for age, given opportunities for skill learning; B) Motor skill difficulties significantly interfere with activities of daily living and impact academic/school productivity, prevocational and vocational activities, leisure and play; C) Onset is in the early developmental period; and D) Motor skill difficulties are not better explained by intellectual delay, visual impairment or other neurological conditions that affect movement.[9]

DCD tends to be a secondary diagnosis, and the recommendation is that a diagnosis is made only around or after age 6 [10]. co-occurrence with Autism Spectrum Disorders (ASD) has been recently explored and reported to be high. In fact, comorbidity in DCD is considered to be the "rule" rather than the "exception".

Technically, only a medical doctor can diagnose DCD (in general, pediatrician, developmental pediatrician, pediatric neurologist, or neurologist) – however; the identification of motor difficulties and the evaluation of each criterion will, most likely, be performed by a team of professionals, which can include (but are not limited to) teachers, psychologists, neuropsychologists, educational diagnosticians, occupational therapists, physical therapists, etc [13]

DCD is generally evaluated with the basis on an individual's performance in the following broad categories: Manual Dexterity, Balance, and Aiming & Catching (ball skills). These are the components of the Movement

Assessment Battery for Children, 2nd edition (MABC-2). Throughout the years, the MABC has become the gold standard assessment for DCD, indicating that children scoring below the 5th (red zone) or even the 16th (amber zone) percentiles have motor difficulties significant enough that they could be considered for a potential diagnosis of DCD[13].

In addition, other assessments may be used to identify motor impairment, and the second most used in the case of DCD (worldwide) is the Bruininks-Oserestsky Test of Motor Proficiency, 2nd edition (BOT-2)[13].

Obviously, the choice of assessment will depend on accessibility, familiarity, and cultural appropriation of the items. However, the recommendation is that at least one standardized assessment of motor development is used during the evaluation process.

3. What are the risk factors?

A 2011 systematic review of 16 studies involving school-aged children showed significantly greater odds of developmental coordination disorder among children who had very low birth weights (< 1500 g) or were very preterm (< 32 wk) than among age-matched controls born at term with normal birth weights [15]. Boys are 1.7 to 2.8 times more likely than girls to have the disorder[16][17].

4. Management & Intervention :

Obviously, DCD is a condition that needs management and intervention. In general, interventions for DCD are not supposed to work as "treatment," as the condition has no cure. But interventions can provide skills, strategies, and accommodations to make it easier for children with DCD to execute motor tasks required in daily living activities and school environments.

From a broad perspective, Missiuna and colleagues [19] suggest that some interventions should target the population level, creating environments that facilitate the learning of motor skills, function and participation for all children. This perspective states that it is important to take the focus out of the child, and instead place the focus on what can be adapted in the surroundings so the child can perform the task(s) successfully.

A new systematic review has extended support for the effectiveness of activity-oriented (task-oriented) intervention approaches, as well as body function-oriented approaches when combined with activity-oriented and active video games interventions [20].

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