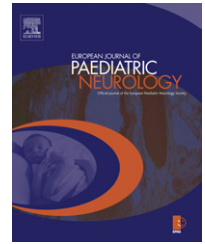




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Review article

Developmental coordination disorder: A review and update

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ABSTRACT

Present in approximately 5–6% of school-aged children, developmental coordination disorder (DCD) is a neuromotor disability in which a child's motor coordination difficulties significantly interfere with activities of daily living or academic achievement. These children typically have difficulty with fine and/or gross motor skills, with motor performance that is usually slower, less accurate, and more variable than that of their peers. In this paper, we review the history of various definitions leading up to the current definition of DCD, prevalence estimates for the disorder, etiology, common co-morbidities, the impact of DCD on the child's life, and prognosis. As well, we briefly describe current interventions for children with the disorder and results of recent neuroimaging studies of the brains of children with DCD, including research by the authors of this paper.

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1. Description, definition and history of DCD

Matthew is a 9-year-old boy who has difficulty tying his shoes, a skill his peers learned to do three years earlier. His mother helps him cut his food and wash his hair, as he struggles to complete these tasks independently. He has not mastered how to ride his bicycle, so he is unable to ride to the park with his friends. Matthew has tried several team sports, but no one passes the ball or puck to him; because he feels excluded and inferior to his teammates, he does not want to participate in sports anymore. Matthew's parents are worried that he is becoming socially isolated and withdrawn. At a recent parent interview, Matthew's teacher commented that, while he is a bright and capable student, his printing is slow and often illegible. Matthew does not complete many of his school assignments and homework activities, and, as a result, his grades are suffering. Matthew's parents are increasingly concerned, but do not know what is wrong with their son.

Matthew is like many children who have a neurodevelopmental disorder known as developmental coordination disorder (DCD). DCD is heterogeneous, with some children having difficulty only with fine motor skills, only gross motor skills, or both.^{1,2} Regardless of which skills are affected, motor performance of children with DCD is usually slower, less accurate, and more variable than in their peers.^{3–10} Motor learning is also impacted, with children with DCD having difficulty acquiring typical childhood skills, such as tying shoes or riding a bicycle.^{3,11} As Polatajko highlighted, DCD is more than just the lower end of normal variance in motor abilities¹²; the motor impairment significantly impacts daily life, and is not due to a neurological disorder or delayed cognitive development.

Using the International Classification of Functioning, Disability and Health (ICF) as a framework,¹³ the Fig. 1 depicts how Matthew's gross motor impairments (body function) limit his ability to ride a bicycle (activity) and consequently restrict his opportunities to ride to the park with his friends (participation). These limitations in his interaction with his peers (environmental factors) further confound his frustration with his motor in coordination and contribute to his low self-esteem (personal factors). The ICF framework will be cited throughout this review, as it relates to DCD.

Per the Diagnostic and Statistical Manual, fourth edition – Text revision (DSM-IV-TR), four diagnostic criteria comprise DCD,^{14 e}:

- 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 (e.g., walking, crawling, sitting),

dropping things, “clumsiness,” poor performance in sports, or 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 (e.g., cerebral palsy, hemiplegia, or muscular dystrophy) and does not meet the criteria for a Pervasive Developmental Disorder.
- D. If mental retardation is present, the motor difficulties are in excess of those usually associated with it.

In 2012, the European Academy of Childhood Disability (EACD) published interdisciplinary clinical practice guidelines for definition, diagnosis, assessment, and intervention for children with DCD.¹⁵ Recommendations within these guidelines resulted from extensive consultation with an international group of researchers and clinicians and were previously approved at two consensus conferences in Germany, with input from German and Swiss medical and therapeutic societies.¹⁵

We will review the history of various definitions leading up to the current definition of DCD, prevalence estimates for the disorder, possible etiology and neurobiology underlying DCD, common co-morbidities, the impact of DCD on the child's daily life, and prognosis for the disorder. As well, we will briefly describe current interventions for children with the disorder, results of recent neuroimaging studies of the brains of children with DCD, and future research aims.

Identified by Orton in 1937, the significance of “clumsiness” was not apparent in the literature until the early 1960s.¹⁶ Since then, many terms have been used to describe children whose motor difficulties interfere with daily living,^{17–19} e.g., clumsy child syndrome,²⁰ sensory integrative dysfunction,²¹ developmental dyspraxia,²² physical awkwardness,²³ and perceptual motor dysfunction.²⁴ In Scandinavian countries, the acronym DAMP has been used to identify children with deficits in attention, motor control, and perception.²⁵

To improve communication and knowledge among clinicians and researchers working with “clumsy” children, an international consensus meeting was held in London, Ontario in 1994 to determine which terminology should be used to describe these children. At this “London Consensus”, the term DCD was accepted.¹⁷ The term “developmental coordination disorder” and the diagnostic criteria for DCD had been added to the third edition of the DSM²⁶ and remain in the most current edition.¹⁴ Ten years after the London Consensus meeting, over 50% of all published articles used the term DCD,²⁷ showing that this term is gaining acceptance as the preferred terminology. The London Consensus was reconfirmed with the 2006 publication of the Leeds Consensus Statement²⁸ highlighting the agreement of international researchers and clinicians to retain the term DCD as a distinct and unique disorder. More recently, the EACD reaffirmed the use of the term DCD in reference to children with

^e With the release of DSM-V in 2013, these criteria may undergo some revision.

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