

## Children with developmental coordination disorders

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### WHAT IS THE BACKGROUND?

Developmental coordination disorder (DCD) is not a new entity. Over the centuries different terms have been used to describe children with a predominant picture of motor difficulties. It is defined on the basis of a failure of the acquisition of skills in both gross and fine movements, which is not explicable on the basis of impaired general learning and similar exposure to opportunity to gain motor skills as their peers. DCD is often an overlooked developmental problem by clinicians. However, there is extensive evidence that these difficulties can have considerable impact on children's lives as they struggle to plan and organize themselves. They commonly affect the child both in school and at home, and contrast with similar aged children who acquire these skills with little effort.

In 1925, Dupre and others<sup>1</sup> referred to the *debilitate motrice* (motorically deficient). Clumsiness has been seen to be a more pejorative term, and was first used by Orton<sup>2</sup> to describe a group of children with motor difficulties. Pioneering studies started to make their mark in the 1960s.<sup>3-6</sup> In 1962, the first article on clumsy children appeared in the *British Medical Journal* (no author cited) and referred to an earlier paper in the 1940s by Ansell who had described the clumsy child as being:

*'... awkward in movements, poor at games, hopeless in dancing and gymnastics, a bad writer and defective in concentration. He is inattentive, cannot sit still, leaves his shoelaces untied, does buttons wrongly, bumps into furniture, breaks glassware, slips off his chair, kicks his legs against the desk, and perhaps reads badly.'*

Today, dyspraxia is the most commonly used term in the UK with varying definitions; but the most recent, formal and widely internationally used term to describe these children is DCD. It appears in both the *Diagnostic and Statistical Manual for Mental Disorders*<sup>8,9</sup> and the *International Classification of Diseases and Related Health Problems*.<sup>10,11</sup>

Increasing interest in these children, in both academic research and in clinical and educational practice, is starting

to lead to a greater understanding of the identification, management and longer-term impact on the child and the family.

### HOW ARE CHILDREN IDENTIFIED AND CLASSIFIED?

The American Psychiatric Association (APA)<sup>9</sup> and the World Health Organization (WHO)<sup>11,12</sup> both have inclusive and exclusive criteria in the definition. For APA the inclusive criteria include: impairment in the development of motor coordination, which can be manifested in delays in milestones such as standing and walking; poor performance in sports activities; and untidy handwriting. This impairment leads to a disturbance in academic performance and/or activities of daily living. Exclusive criteria include the disturbance not being due to a general medical difficulty such as cerebral palsy or a pervasive developmental disorder. In addition, if mental retardation (learning difficulty) is present the motor difficulties are in excess of those usually associated with it.

The WHO<sup>11</sup> definition overlaps with the APA definition by noting that, on a standardized test of motor impairment, a child would score two standard deviations below the mean accompanied by interference with academic performance and/or activities of daily living. It notes that there should be no diagnosable neurological disorder and excludes those with an IQ below 70.

Despite the guidance provided by the APA and WHO there are still a number of issues surrounding the identification and definitions. The WHO recommendation that individuals with an IQ of 70 and below are excluded from the formal definition is one that would be agreed by most clinicians and researchers.

### CHARACTERISTICS: IS THIS A SINGLE SYNDROME?

The issue of co-occurring conditions is one that provokes much debate.<sup>13</sup> Evidence from a number of researchers<sup>14-16</sup> has shown overlap of DCD with other neurodevelopmental disorders. For example, in the Canadian population study,<sup>17</sup> 23% of children showed signs of DCD, 8% met criteria for attention deficit hyperactivity disorder (ADHD), and 19% were categorized as dyslexic. Nearly 25% of the affected children were found to have all three, while 10% had both ADHD and DCD, and 22% had dyslexia and DCD.

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Gillberg<sup>14</sup> also described the DAMP (deficits in attention, motor and perception) model where a 40% overlap of ADHD and DCD was described.

Further summaries highlighting overlap with other conditions have recently been published,<sup>18,19</sup> including work by Adib *et al.*<sup>20</sup> and Kirby,<sup>21</sup> who have both shown an association between motor difficulties and joint hypermobility syndrome.

Over the last 15 years an overlap of DCD with other conditions has been demonstrated:

- Reading, attention and motor deficits<sup>22–24</sup>
- Social and emotional and behaviour, anxiety, and depression<sup>25,26</sup>
- Speech and language impairment<sup>27</sup>
- Social and communication impairment.<sup>28</sup>

However, the clinical picture at present is that children with motor difficulties present commonly to occupational therapists, physiotherapists and paediatricians, and psychiatrists are less aware of DCD, even though a large percentage of children presenting to them in ADHD clinics will have motor difficulties that may impact on their everyday lives. Kooistra *et al.*<sup>24</sup> have shown recently that, in children with ADHD, additional motor difficulties were greatest where there were co-occurring disorders. They even suggest that ADHD should be seen not as a discrete disorder but as a continuum, as seen with Asperger's syndrome. Again, this reiterates the need for designing provision that takes into consideration the overlapping picture of developmental disorders rather than the segmentation of services that currently commonly exists. It is of interest to note that, in the *European Clinical Guidelines for ADHD*<sup>29</sup> DCD is highlighted as one of the comorbid disorders, and it states that 'if significant interference with academic achievements or activities of daily living is observed, treatment with stimulants seems to be indicated.'

### IMPACT OF DCD IN THE SHORT AND LONGER-TERM

There was a view until the early 1990s that children with DCD 'grew out' of the condition. Hall<sup>30</sup> discussed in an article the need to look at the cause for clumsiness as related to 'motivation and good teaching' and refers to extrinsic factors affecting the young person. He stated, 'Motor difficulties seem to resolve in the teen years, though they may re-emerge under stress of learning a new motor skill.'

*'... we do our patients no service by treating clumsiness as if it was a disease. With only rare exceptions clumsiness is a talent*

*deficit and like other learning disabilities is primarily an educational problem.'*<sup>30</sup> (pp. 376)

The need to move away from a narrower medical model to a wider bio-social-educational model is essential when considering a longer-term view of the disorder.

Children with DCD are not unaffected by their difficulties and have been reported to have lower self-esteem. Studies in DCD have shown that children perceive themselves as less competent than their peers, not only in the domain of physical play (athletic competence), but also in several other domains including physical appearance and social acceptance.<sup>31</sup> Adolescents with DCD have been shown to have psychiatric symptoms ranging from mood and anxiety disorders to social negativism and withdrawal.<sup>25</sup>

In particular, overlap with ADHD seems to have a worse long-term prognosis. Long-term studies of individuals have shown that those with this mixed picture were more likely to continue to have difficulties into adulthood.<sup>25</sup> A Swedish study<sup>32</sup> showed a higher rate of psychiatric morbidity and personality disorders among the motor-perceptual disorder (MPD)—affective anxiety disorders (ADDs) mixed group, and poor outcomes in 58% of cases. This included ADDs, borderline personality disorders, social negativism and withdrawal, and higher rates of depression and suicidal risk.

Children with DCD have also been shown to be more likely to have a higher rate of health problems than children in the general population.<sup>25</sup> Losse's<sup>33</sup> 10-year follow-up study also highlighted the variable outcome for children with DCD. This study showed that 73% of the original children described as 'clumsy' remained 'poor' or 'very poor' compared to age-matched controls. Cantell's study<sup>34</sup> looked at 15–17 year olds, and showed 65% remained having difficulties with motor coordination.

### UNDERLYING AETIOLOGY

There has been a resurgence of interest in recent years regarding the underlying aetiology. Functional magnetic resonance imaging, genetic studies, and improved kinematic analysis will lead to greater understanding in years to come—similar to work being undertaken in parallel fields of dyslexia and ADHD. Morton's<sup>35</sup> causal modelling approach considering biological, cognitive and behavioural levels may be a conceptual framework to use when undertaking research and to gain a greater understanding in this field. A gene study is currently being conducted to look at genes that may be associated with DCD. However, as in ADHD and other developmental disorders, a single phenotype is highly improbable and any gene identified may vary in effect and strength.

## HOW ARE CHILDREN ASSESSED?

Children with DCD are assessed in a variety of ways, but currently there is no appropriate gold standard assessment instrument and no instrument that goes from child to adulthood. In many countries, a notable exception being the USA, the Movement ABC Battery<sup>36</sup> is the most widely used instrument, and contains a standardized normative referenced test, plus a criterion referenced checklist. However, other instruments such as Bruininks–Oseretsky test of motor proficiency<sup>37</sup> are used with various forms of evaluations being made based on a variety of criteria. When research studies are being quoted, it is often difficult to compare findings as the population groups are chosen in different ways, leading to a lack of stability in the conclusions that can be made from, for example, intervention studies.<sup>38</sup>

## WHAT IS THE PREVALENCE OF DCD?

Wright and Sugden<sup>39</sup> advocated a two-step approach to assessment using the Movement ABC Battery<sup>36</sup> as the standardized measure for motor impairment and the Movement ABC checklist as a guide to examining the effects on daily living. Using this methodology, they found that the prevalence figure was 4–5% in mainstream primary schools. Clearly, prevalence is directly related to the manner in which assessment is employed and the establishment of cut-off points, and APA suggests a figure of around 6% for the age range 5–11 years. Gender differences have been examined on numerous occasions and the consensus is that the condition is more prevalent in boys than girls, with estimates ranging from a small difference to three or four to one.

## WHAT DO WE KNOW ABOUT INTERVENTION?

In general, the research on progression in children with DCD concludes that, without intervention, the majority of children do not outgrow the condition.<sup>25,33,34,40</sup> However, the research base on intervention in DCD is not nearly as comprehensive as in other developmental disorders such as dyslexia, ADHD and autistic spectrum disorder, highlighting the need for longitudinal studies in this field of work. There is a body of literature that can point to success in intervention.<sup>41–43</sup> So far, there have been two major approaches to intervention, under different labels, but often referred to as either process-oriented or task-oriented approaches.

Process-oriented are broad-based, usually administered by health professionals (e.g. occupational therapists or physiotherapists), and include such methods as sensory integration therapy. They aim at pinpointing the underlying process or processes in which the child has not developed appropriately and which are thought necessary for successful

performance and acquisition of motor skills. Thus, the intervention, for example, would aim to improve the child's kinaesthetic functioning with the aim of this transferring to the functioning of several motor skills.<sup>43</sup>

Task-oriented approaches use a range of methods but all concentrate on the tasks themselves. A significant set of these involve what have come to be called cognitive methodologies, and success using this approach has been achieved with a range of children. The basis of these approaches is the interaction between the child's resources, the task to be learned and the context in which it is set. The task, often determined through consultation with parents and the child, is taught directly, sometimes broken down into component parts.<sup>44</sup> In a meta-analysis of the different approaches, the task-oriented ones have emerged at this time as more successful<sup>45</sup> and should be implemented by paediatricians running children's services.

Like autistic spectrum disorders, DCD is regarded as a dimensional and not a categorical disorder. For this reason alone, clinicians from a number of fields who work with children who have a range of developmental disorders need to enquire routinely about motor difficulties along with social and communication, attention and language disorders. This needs to be done prior to entry into the services to ensure that the child has all their needs met and not, as happens commonly with children presenting with attention and concentration difficulties, just one aspect. If this is not undertaken, time and money may be wasted in children being passed from service to service.

Further research is required in order to gain a greater understanding of the different subtypes or individuals, and how to further specify treatment approaches for these groups as compared to the whole, as has been done for ADHD.<sup>46</sup>

## FUTURE DIRECTION AND CHALLENGES

In the UK, as in many other countries in the past few years, there has been increased awareness of DCD by parents. This has also resulted in increased demand on the available services.<sup>47</sup> One of the challenges for supporting children and their families with DCD will be providing effective and consistent management models based on a good evidence base. A recent consensus statement has been produced by professionals from a wide range of disciplines including health, education and psychology in the UK and has been launched following a series of meetings funded by the ESRC. This is available from <http://www.dcd-uk.org><sup>48</sup>

A need for randomized, controlled trials comparing intervention models is the obvious next stage. However, a starting point would be for clinicians to make sure the initial enquiry not only looks across at the developmental spectrum but also provides a method of triaging patients,

so that those with the most complex difficulties do not sit waiting for support or therapy for several years. Working jointly with paediatricians, child and adolescent psychiatrists, and allied health professionals is essential to the improvement of both efficacy and efficiency.

It is important to use different methodologies, e.g. parent training which has been shown to be successful in the care of children with Asperger's.<sup>49</sup> This approach is starting to be used. The advent of the common assessment framework may see a move towards the start of common terminology, and this may be a potential way forward.

*Competing interests* Dr Amanda Kirby has a son who has been diagnosed as having DCD.

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