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Evaluating the evidence for motor-based interventions in developmental coordination disorder: A systematic review and meta-analysis



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ABSTRACT

Background: As part of the process of creating an update of the clinical practice guidelines for developmental coordination disorder (DCD) (Blank, Smits-Engelsman, Polatajko, & Wilson, 2012), a systematic review of intervention studies, published since the last guidelines statement was conducted.

Aim: The aim of this study was to 1) systematically review the evidence published from January 2012 to February 2017 regarding the effectiveness of motor based interventions in individuals with DCD, 2) quantify treatment effects using a meta-analysis, 3) examine the available information on different aspects of delivery including use of group intervention, duration and frequency of therapy, and 4) identify gaps in the literature and make recommendations for future intervention research.

Method: An electronic search of 5 databases (PubMed, Embase, Pedro, Scopus and Cochrane) was conducted for studies that evaluated motor-based interventions to improve performance for individuals with DCD.

Results: Thirty studies covering 25 datasets were included, 19 of which provided outcomes on standardized measures of motor performance. The overall effect size (Cohen's *d*) across intervention studies was large (1.06), but the range was wide: for 11 interventions, the observed effect was large (> 0.80), in eight studies moderate (> 0.50), and in five it was small or negligible (< 0.50). Positive benefits were evident for activity-oriented approaches, body function-oriented combined with activities, active video games, and small group programs.

Conclusion: Results showed that activity-oriented and body function oriented interventions can have a positive effect on motor function and skills. However, given the varied methodological quality and the large confidence intervals of some studies, the results should be interpreted with caution.

What this paper adds

This comprehensive systematic review shows that recent data support the immediate benefits on performance of relatively short duration intervention (both activity-oriented and body function-oriented combined with activities), active video games, and small group programs.

Our review also shows the need for more rigorous RCTs with follow-up to demonstrate sustained change rather than just short-term gains in performance.

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Important gaps in the literature have been identified. Controlled studies that compare different intervention approaches, group-based versus one to one intervention, subgroups of DCD on immediate and long term motor outcomes, on participation in physical activity outcomes, and on psychological factors are needed.

1. Introduction

Developmental Coordination Disorder (DCD) is one of the most common movement disorders of childhood and a condition that most children do not out-grow (Cantell, Kooistra, Cermak, & Larkin, 2002; Hill, Brown, & Sorgardt, 2011; Kirby, Williams, Thomas, & Hill, 2013; Losse et al., 1991; Geuze & Borger, 1993; Cantell, Smyth, & Ahonen, 1994). DCD is associated with a range of motor, cognitive, social and psychological issues that negatively affect everyday function (Hay, Hawes, & Faught, 2004; Venetsanou et al., 2011; Wilson, Ruddock, Smits-Engelsman, Polatajko, & Blank, 2013; Wilson et al., 2017). These facts underscore the need for effective intervention to enhance motor skills and the ability to function in everyday life (Au et al., 2014). As part of the process of creating new clinical practice guideline for DCD (Blank, Smits-Engelsman, Polatajko, & Wilson, 2012), a prior systematic review of DCD intervention studies published between 1995 and 2011 was conducted. In that review (Smits-Engelsman et al., 2013), we concluded that task oriented approaches were most beneficial on functional outcomes. We noted, however, that few randomized controlled trials (RCTs) were available. Other issues at that time were a need for stricter application of DSM (Diagnostic and Statistical Manual of Mental Disorders) criteria and consistency in the terms used to describe participants (Geuze, Schoemaker, & Smits-Engelsman, 2015).

Five years later, we present here an update as part of the 5-yearly revision required by Guidelines International Network of the clinical practice guideline for DCD. The main aim of this paper is to present the results of a systematic evaluation of new evidence on the effectiveness of interventions.

1.1. Description of the condition

By definition, children with DCD show characteristic difficulties in performing fine- and/or gross-motor skills to the level of their peers, and exhibit performance difficulties in the tasks of everyday living (American Psychiatric Association, 2013). In the language of the International classification of functioning, disability and health (ICF; WHO, 2001) DCD is manifest in the area of body function and structure (e.g., motor control processes, Blank et al., 2012), activity, and participation (Cairney & Veldhuizen, 2013). A prevalence rate of around 5–6% for DCD is not trivial in school-aged children, with a somewhat higher incidence in boys than girls (Cairney, Hay, Faught, & Hawes, 2005; Lingam et al., 2010; Missiuna, Gaines, Soucie, & McLean, 2006; Venetsanou et al., 2011). Critically, nearly half of those diagnosed in early childhood continue to have difficulties into adolescence and early adulthood (Kirby et al., 2013). In addition, children with DCD frequently experience a range of comorbid problems including attentional issues (viz Attention Deficit Hyperactivity Disorder – ADHD), behavioral issues, language, and psychosocial problems including anxiety, depression and low self-esteem. In general, the higher the severity of DCD and the more comorbid issues, the poorer the outcome (Peters, Barnett, & Henderson, 2001). Poor motor coordination also results in reduced physical activity participation and lower fitness outcomes in populations with DCD (Rivlis et al., 2011; Schott, Aloff, Hultsch, & Meermann, 2007). Consequently, the risk of developing obesity and cardiovascular diseases is increased (Faught, Hay, Cairney, & Flouris, 2005; Cantell & Crawford 2008). This cluster of developmental problems and the persistent nature of DCD show the importance of intervention that enhances activity and supports participation (Smits-Engelsman et al., 2013; Smits-Engelsman, Magalhaes, Oliveira, & Wilson, 2015; Wilson et al., 2013).

1.2. Description of the interventions

There have been numerous activity based approaches to intervention for DCD (Miyahara, Hillier, Pridham, & Nakagawa, 2017; Smits-Engelsman et al., 2013; Wilson et al., 2013), traditionally grouped into two broad areas: those that use activity to target the underlying performance problems, often referred to as process oriented approaches, and, those that use activity to address the performance itself, often referred to as task oriented approaches.

In the review published in 2013, it was observed that task oriented approaches were more efficient than process oriented, yielding better functional performance outcomes in less time for children with DCD (Smits-Engelsman et al., 2013). Task oriented interventions are activity oriented but also clearly facilitate participation. Characteristics of task oriented intervention are:

1. Client centred (meaningful for the client)
2. Goal oriented: Aiming at activities and participation as described in the ICF-Child and Youth (WHO, 2007).
3. Task and context specific
4. Involve active role of the client
5. Aimed at functionality not at normality
6. Aimed at active involvement of parent(s)/caretakers to enable transfer of learning to the every day context.

In the earlier stages of DCD research, intervention approaches were almost exclusively process oriented or in ICF terms, focused on reducing impairment and improving body function and structure (Smits-Engelsman et al., 2013). These approaches were primarily medical or rehabilitative, and attempted either to prevent or ameliorate limitations in body function and structure by correcting or modifying them or by increasing capacity levels. Studies examining these approaches tended to report on changes at the level of body function and structure only. However, more recently, studies of body function oriented interventions have started to report on changes at the level of activity, and occasionally on participation. Similarly task oriented approaches, which tended to report only on

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