



Research paper

The efficacy of two activity-based interventions in adolescents with Developmental Coordination Disorder

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ABSTRACT

Background: Adolescents with Developmental Coordination Disorder (DCD) usually experience psychomotor difficulties that affect their participation in everyday tasks and sports. Without effective intervention, adolescents show persistent motor deficits through adulthood. It is therefore critical to develop interventions to address the specific needs of this population. Studies evaluating the impact of motor interventions among adolescents with DCD are limited.

Aim: The study evaluated the efficacy of two activity-based motor interventions in female adolescents with DCD.

Methods and procedures: Forty-three female participants (Mean \pm SD: 14.3 \pm 1.1 years) were identified as having DCD using the DSM-5 criteria. They were randomly assigned to either Task-oriented Functional Training (TFT) or Wii training. Both groups received 45 min training per week for 14 weeks. Outcome measures included isometric muscular strength, motor proficiency, functional performance and participation in activities of daily living (ADL).

Outcomes and results: At the conclusion of the intervention, the two groups had significant improvement in muscular strength, motor proficiency, running and agility, predilection for physical activity and generalized self-efficacy. However, there was no difference in outcomes for the two interventions.

Conclusions and implications: The findings highlight the potential benefits of activity-based motor interventions in reducing impairments, improving functional performance, and enhancing participation. These results support previous findings on the efficacy of task-oriented interventions and demonstrate the value of these approaches at all levels of functioning.

What this paper adds

This study provides evidence of the efficacy of activity-based interventions in female adolescents with DCD.

Female adolescents with DCD respond positively to exercise interventions at the ICF levels of functioning.

Activity-based interventions administered once a week at moderate intensity may not be enough to improve aerobic endurance in this population.

1. Introduction

Research acknowledges the impact of Developmental Coordination Disorder (DCD) on adolescents' daily life (Kirby, Sugden,

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Beveridge, & Edwards, 2008). DCD is characterized by impairment in motor coordination that interferes with academic performance and activities of daily living (Mandich, Polatajko, & Rodger, 2003). Children with DCD have difficulty learning skilled movements (Werner, Cermak, & Aziz-Zadeh, 2012) and participate less in physical activity (Cairney, Hay, Faught, Wade et al., 2005). They struggle with functional tasks such as dressing, riding a bike and engaging in leisure pursuits (Zwicker, Missiuna, & Boyd, 2009). These difficulties are attributable to impairments in posture control, motor learning and sensorimotor coordination (Zwicker et al., 2009), which are part of the key motor characteristics of DCD (Geuze, 2005). The lack of physical activity is the root of many clinical conditions (Falk, 2017). Reduced physical activity in children with DCD leads to increased risk for obesity and coronary heart diseases (Faught, Hay, Cairney, & Flouris, 2005; Tsiotra et al., 2006). Besides the detriments of inactivity such as low cardiorespiratory fitness and strength, individuals with DCD exhibit greater risk for social, emotional and psychiatric difficulties (Mandich et al., 2003; Miller, Polatajko, Missiuna, Mandich, & Macnab, 2001). Their reduced physical activity is linked to reduced self-efficacy towards physical activity (Cairney, Hay, Faught, Wade et al., 2005), lower self-worth (Skinner & Piek, 2001) and poor perceived competence (McIntyre, Chivers, Larkin, Rose, & Hands, 2015). Without effective intervention, these problems may persist into adulthood (Bo & Lee, 2013; Cairney, Hay, Veldhuizen, & Faught, 2011). Clearly the symptoms of DCD track from childhood through adulthood, yet existing intervention studies have focused on primary school children. There are gaps in the current knowledge regarding the efficacy of interventions in adolescents with DCD although this is a critical stage of life where several physiological changes occur and many behavioral habits become established.

Studies in young children reported improvements in motor skills, emotional well-being and aspects of physical fitness after functional training or playing active computer games (Farhat et al., 2015; Ferguson, Jelsma, Jelsma, & Smits-Engelsman, 2013; Hammond, Jones, Hill, Green, & Male, 2014; Piek et al., 2013). In a study conducted among Australian children, it was revealed that a task-oriented motor programme (the Animal Fun) improved motor ability. Compared to girls, the boys showed superior improvements over time (Piek et al., 2013). Likewise, when two different group-based task-oriented programmes were compared in children with DCD, both approaches were found to improve motor skills (Caçola, Romero, Ibana, & Chuang, 2016). Similarly, it has been shown that 8 weeks of functional skill training elicited improvements in aerobic endurance, anaerobic performance and exercise tolerance in children with DCD (Farhat et al., 2015). Collectively, these results confirm the efficacy of task-oriented interventions in the DCD population (Preston et al., 2016; Smits-Engelsman et al., 2013). Much of the current research on active video games (AVG) has focused on outcomes such as motor function (Ashkenazi, Weiss, Orian, & Laufer, 2013), balance (Bonney, Jelsma, Ferguson, & Smits-Engelsman, 2017b; Jelsma, Geuze, Mombarg, & Smits-Engelsman, 2014; Smits-Engelsman, Jelsma, & Ferguson, 2016; Smits-Engelsman, Jelsma, Ferguson, & Geuze, 2015) and motor proficiency (Ferguson et al., 2013; Hammond et al., 2014). Notably, these works have shown that AVG leads to moderate-to-large improvements in motor proficiency. To date, only one study has compared functional training (Neuromotor Task Training) and AVG (Wii training). In children with DCD, the authors demonstrated that functional training yielded greater improvements in motor performance, cardiorespiratory fitness and functional strength compared to AVG. However, the children who played self-selected Wii games performed better on an anaerobic test (Ferguson et al., 2013) although that training was not designed to elicit specific adaptations in fitness. This finding underscores the potential benefits of the Wii in improving physical fitness if training principles can be integrated into the protocol. To the best of our knowledge, research involving direct comparison of different motor interventions in adolescents with DCD is lacking. Also, no AVG studies in children with DCD have explored how different parameters of gameplay can be manipulated to improve physical fitness. Given the complexity of the symptoms of DCD and their impact on daily life, it is necessary to describe the effects of motor-based interventions at the three levels of functioning as stipulated in the International Classification of Functioning, Disability and Health framework (also known as ICF) (World Health Organization, 2001).

Typically, the ICF framework categorizes health at three levels; body function and structure (impairment), activity (activity limitations), and participation (participation restrictions) (Mandich et al., 2003; World Health Organization, 2001). The ICF framework provides a broader view of health and functioning, and defines the interrelationship between health conditions and contextual factors (environmental and personal factors) (Ferguson, Jelsma, Versfeld, & Smits-Engelsman, 2014; Mandich et al., 2003). According to the ICF, function emerges from the interactions between body function and structure, activity and participation, and is influenced by health conditions and/or contextual factors (Ferguson, Jelsma et al., 2014). It is therefore not surprising that motor impairments (e.g. motor coordination deficits, muscle weakness), experienced by children with DCD often lead to activity limitations (reduced ability to run, jump or dance) (Cairney, Hay, Veldhuizen, & Faught, 2010; Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2010; Cairney & Veldhuizen, 2013) and participation restrictions (reduced ability to engage in household chores and sports) (Jarus, Lourie-Gelberg, Engel-Yeger, & Bart, 2011). It has been suggested that personal and environmental factors constrain physical activity participation in adolescents with DCD (Barnett, Dawes, & Wilmut, 2013). In this paper, the ICF was adopted to enable the description of outcomes in a more functional manner. This would stimulate researchers and clinicians to identify participation as an important outcome in the management of persons with DCD. Participation is integral to children's health and is also recognized as an important intervention goal (Imms et al., 2017). However, it has received little attention in DCD research (Ferguson, Jelsma et al., 2014; Jarus et al., 2011; Magalhães, Cardoso, & Missiuna, 2011). This might be due to lack of validated tools to assess changes in participation in both research and clinical populations with DCD.

To examine how female adolescents respond to exercise, a virtual reality gaming technology (Wii training) was compared to Task-oriented Functional Training (TFT). The TFT involves the execution of everyday activities and games whereas the Wii training consists of a variety of computer games administered in an organized format to increase functional performance. In this paper, changes occurring at the level of body function, activity and participation are reported. As task-oriented training closely relates to everyday tasks, it was hypothesized that participants who received the TFT would have greater improvements in outcomes than the Wii group. The use of the Wii games in this population was motivated by findings of earlier studies (Ashkenazi et al., 2013; Ferguson

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