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The efficacy of two task-orientated interventions for children with Developmental Coordination Disorder: Neuromotor Task Training and Nintendo Wii Fit training

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ABSTRACT

Neuromotor Task Training (NTT) and Nintendo Wii Fit Training (Wii training) are both task-based interventions used to improve performance in children with motor coordination problems. The aim of this study was to compare the efficacy of these two interventions on the motor performance, isometric strength and cardiorespiratory fitness (aerobic and anaerobic capacity) of children with Developmental Coordination Disorder (DCD) attending mainstream schools in a low-income setting. A pragmatic, quasi-experimental study design was utilized. Children between the ages of 6–10 years, who scored at or below the 16th percentile on the Movement Assessment Battery for Children-2 (MABC-2) and whose teacher reported a functional motor problem, were allocated to either NTT ($n = 37$) or Wii training ($n = 19$) groups depending on school of attendance. The MABC-2, a hand-held dynamometer, the Functional Strength Measure, the Muscle Power Sprint Test and the 20 m Shuttle Run Test were used to assess performance at baseline and after the intervention. The main findings show that the mean motor performance scores of both groups improved over the study period. However, significant differences in improvement were detected between groups, with the NTT group showing greater improvement in motor performance, functional strength and cardiorespiratory fitness. No improvements in isometric strength were seen in either group. The Wii training group showed significant improvement in anaerobic performance. This study provides evidence to support the use of both the Wii Training and NTT for children with DCD. However, in comparison to Wii training, the NTT approach yields superior results across measures of motor proficiency, cardiorespiratory fitness and functional strength. The decision to use either approach may be influenced by resources and time constraints.

1. Introduction

Developmental Coordination Disorder (DCD) is a motor coordination disorder, which significantly affects the activities of daily living or academic performance of children (American Psychiatric Association, 2000). Prevalence estimates of DCD varies across studies but is generally accepted to range between 5 and 6% among children of school-going age (Kadesjo &

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Gillberg, 1999; Zwicker, Missiuna, Harris, & Boyd, 2012). Although the prevalence of DCD in South Africa is unknown, it is likely that large numbers of children may be affected due to the reported association between poor motor coordination ability and low socioeconomic status (Hardy, Reinten-Reynolds, Espinel, Zask, & Okely, 2012; Lingam, Hunt, Golding, Jongmans, & Emond, 2009).

Children with DCD have been reported to avoid physical activity due to poor self-efficacy (Cairney et al., 2005; Engel-Yeger & Hanna Kasis, 2010). As a result, these children often fail to acquire and develop motor coordination skills, strength and cardiorespiratory fitness compared to typically developing peers (Rivilis et al., 2011; Wu, Lin, Li, Tsai, & Cairney, 2009). These problems are exacerbated when children with DCD attend mainstream schools in low-income areas that do not provide sufficient opportunities and resources to facilitate their development (de Villiers et al., 2012).

Longitudinal studies demonstrate that children with DCD continue to experience difficulties in activities requiring motor proficiency as they get older (Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2010c) and in some cases, also display affective and social problems (Mandich, Polatajko, & Rodger, 2003; Missiuna, Moll, King, Stewart, & Macdonald, 2008; Schoemaker & Kalverboer, 1994). The long-term impact is further highlighted by studies suggesting that children with DCD are at increased risk of becoming obese (Cairney et al., 2010b), and developing cardiorespiratory problems (Faught, Hay, Cairney, & Flouris, 2005) due to their decreased levels of participation in physical activity. Early identification and intervention is therefore important for children with DCD to improve their functional motor ability and to prevent secondary health and social problems (Green, Baird, & Sugden, 2006; Piek, Bradbury, Elsley, & Tate, 2008).

The International Classification of Functioning (World Health Organization, 2001) proposes a model of rehabilitation that aims to reduce impairments, improve functional activity and reduce participation restrictions. Two broad definitions of therapeutic approaches commonly used by therapists to meet these aims include process-orientated approaches and task orientated approaches (Smits-Engelsman et al., 2012). Process orientated approaches focus on addressing deficits and impairments in body structure and function (Polatajko & Cantin, 2005) whereas task orientated approaches focus on addressing problems in motor learning, motor control and cognitive processes (Wilson, 2005). A recent review of the most effective interventions for treating DCD suggests that task based approaches yielded stronger effects in improving functional outcomes compared to process orientated approaches (Smits-Engelsman et al., 2012). Examples of task-orientated approaches include Neuromotor Task Training (Smits-Engelsman & Tuijl, 1998), Cognitive Orientation to daily Occupational Performance approach (Miller, Polatajko, Missiuna, Mandich, & Macnab, 2001), Motor Imagery Training (Wilson, Patrick, Thomas, & Maruff, 2002) and Virtual Reality or Active Video Gaming (Levac & Galvin, 2012). These interventions have each shown positive effects in improving functional outcomes in children with DCD, adding to the host of effective therapy options available to therapists working with these populations.

Although evidence of improvements in the functional ability of children with DCD has been well documented (Hillier, 2007; Smits-Engelsman et al., 2012), for children attending mainstream schools in low income areas in South Africa, access to these interventions are not readily available (Western Cape Education Department, 2012). Choosing an appropriate therapeutic approach for children with motor coordination problems in this context is largely influenced by concerns related to environmental, resource, and time constraints (Eleweke & Rodda, 2002). Furthermore, in instances where resources are limited, decisions regarding group versus individual treatment may be a factor. Therapists also need to consider factors such as age, severity of problem, verbal and intellectual competence (Blank, Smits-Engelsman, Polatajko, & Wilson, 2012). Moreover, aspects that facilitate active participation, engagement and motivation to adhere to therapy for long enough to bring about changes in motor proficiency are also recognised as important in intervention planning (Jelsma, Pronk, Ferguson, & Jelsma-Smit, 2013).

Neuromotor Task Training and Nintendo Wii Fit Training have been identified as promising strategies to support children with motor coordination problems. NTT is grounded in cognitive neuroscience, motor control and motor learning theories (Smits-Engelsman & Tuijl, 1998) and is recommended for children of all ages, including children with low intellectual competence (Niemeijer, Smits-Engelsman, & Schoemaker, 2007). During NTT, therapists address motor problems using cognitive strategies such as reducing fear, increasing motivation, and improving motor control processes such as parameter setting and motor planning (Schoemaker, Niemeijer, Reynders, & Smits-Engelsman, 2003). The efficacy of NTT has shown positive outcomes in three studies conducted in the Netherlands (Jongmans, Linthorst-Bakker, Westenberg, & Smits-Engelsman, 2003; Niemeijer et al., 2007; Schoemaker et al., 2003). Jongmans, Smits-Engelsman amd Schoemaker (2003) reported improvements in handwriting ability in children and Niemeijer et al. (2007) reported improvement in motor performance among children who received NTT. Although these studies demonstrate the efficacy of NTT, all three studies compared NTT to no intervention and were conducted in well-resourced schools or private practices in Netherlands. Apart from the study by Jongmans, Linthorst-Bakker, et al. (2003) and Jongmans, Smits-Engelsman, et al. (2003) intervention using NTT was generally delivered in a one-on one format and not in groups.

The Nintendo Wii is a gaming system that incorporates aspects of biofeedback and virtual reality. Motion sensor technology in the form of a hand held control and a balance board, is used to engage the player in video game scenarios (http://www.nintendo.co.uk). Studies investigating the use of interactive video games as a form of motor rehabilitation, propose that using this technology, improves motivation to exercise (Sandlund, McDonough, & Häger-Ross, 2009), exercise tolerance (White, Schofield, & Kilding, 2011) and motor performance among children with Down's Syndrome (Berg, Becker, Martian, Primrose, & Wingen, 2012) and cerebral palsy (Jelsma et al., 2013). Hand-eye coordination has also been reported to improve amongst adults following Nintendo Wii training (Giannotti et al., 2013). In a recent study by Hammond, Jones, Hill, Green, and Male (2013), the authors reported gains in motor proficiency and perception of motor ability among children with