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Does relative body fat influence the Movement ABC-2 assessment in children with and without developmental coordination disorder?

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ABSTRACT

Developmental coordination disorder (DCD) is a condition that results in an impairment of gross and/or fine motor coordination. Compromised motor coordination contributes to lower levels of physical activity, which is associated with elevated body fat. The impact of elevated body fat on motor coordination diagnostic assessments in children with DCD has not been established. The purpose of this study was to determine if relative body fat influences performance on the Movement Assessment Battery for Children, 2nd Edition (MABC-2) test items in children with and without DCD. A nested case–control, design was conducted within the Physical Health Activity Study Team longitudinal cohort study. The MABC-2 was used to assess motor coordination to categorize cases and matched controls. Relative body fat was assessed using whole body air displacement plethysmography. Relative body fat was negatively associated with the MABC-2 "balance" subcategory after adjusting for physical activity and DCD status. Relative body fat did not influence the subcategories of "manual dexterity" or "aiming and catching". Item analysis of the three balance tasks indicated that relative body fat significantly influences both "2-board balance" and "zig-zag hopping", but not "walking heel-toe backwards". Children with higher levels of relative body fat do not perform as well on the MABC-2, regardless of whether the have DCD or not. Dynamic balance test items are most negatively influenced by body fat. Health practitioners and researchers should be aware that body fat can influence results when interpreting MABC-2 test scores.

1. Introduction

Developmental coordination disorder (DCD) is characterized by problems with gross and fine motor ability, resulting in a significant impairment in physical, social and academic functioning, but is not the result of another psychiatric, neurological, or other medical condition (American Psychiatric Association, 2000). Developmental coordination disorder results in impairment in gross and/or fine motor skills (Cermak & Larkin, 2002). Prevalence of DCD in school-aged children is approximately 5–6% (American Psychiatric Association, 2000; Kadesjo & Gillberg, 1998). However, motor coordination deficiencies in children are generally underestimated and can significantly influence the quality of life and development of

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the child. Reasons for underreporting include a lack of awareness of DCD as well as the need for early screening tools (Faught et al., 2008; Hay, Hawes, & Faught, 2004). Nevertheless, if identified early, the physical, academic, and emotional challenges of affected children can be addressed (Polatajko, Fox, & Missiuna, 1995; Schoemaker et al., 2006). The potential for improved quality of life warrants efforts to screen for and identify children with DCD (Barnhart, Davenport, Epps, & Nordquist, 2003).

Developmental coordination disorder covers a heterogeneous group of children and not all will demonstrate the same clinical picture (Hoare, 1994; Sugden & Keogh, 1990). Children's coordination challenges can result from an arrangement of one or multiple impairments related to proprioception, motor programming, as well as timing, or sequencing of muscle activity (Barnhart et al., 2003). Developmental coordination disorder is not usually diagnosed until a child reaches school age when their lack of coordination becomes a problem resulting in failure to satisfy particular environmental demands (Cermak, Gubbay, & Larkin, 2002). Multiple criteria are required in identifying children who are suspected of DCD. Typically, initial screening for indicators of motor challenges is followed by a confirmatory assessment using standardized tools to substantiate both fine and gross movement in coordination (American Psychiatric Association, 2000). Two of the most recognized standardized tools include the Movement Assessment Battery for Children 2nd Edition (MABC-2) (Henderson, Sugden, & Barnett, 2007) or the Bruininks-Oseretsky test of Motor Proficiency (BOTMP) (Crawford, Wilson, & Dewey, 2001). Both MABC-2 and BOTMP integrate gross motor skill tasks, which are important to assess the impact of DCD on daily activities in children such as running, jumping and ball skills. Beyond the physical challenges of daily living, children with DCD regularly report lower levels of perceived self-competence, self-esteem and peer acceptance (Cairney, Hay, Faught, & Hawes, 2005; Cairney, Hay, Faught, Wade, et al., 2005; Losse et al., 1991). This sense of compromised motor competence and perceived self-adequacy contribute to children with DCD engaging in lower levels of participation in physical activity compared to their peers (Cairney, Hay, Faught, Flouris, & Klentrou, 2007; Faught, Hay, Cairney, & Flouris, 2005). Subsequently, reduced levels of physical activity can significantly increase the risk of factors contributing to coronary vascular disease, including elevated body fat, cardiac output, stroke volume, and left ventricular mass (Cairney, Hay, Veldhuizen, & Faught, 2011; Chirico et al., 2012; Faught et al., 2005; Tsiotra, Nevill, Lane, & Koutedakis, 2009). Further, the persistence or elevated body composition measures of BMI and waist circumference have been reported in longitudinal surveillance studies of children with DCD compared to their healthy peers (Cairney, Hay, Veldhuizen, & Faught, 2010).

While DCD has repeated demonstrated to influence negative body composition, there is a suggestion that increased body composition could negatively influence DCD, particularly in the assessment of motor proficiency. Brady, Knight, and Berghage (1977) reported a negative influence of increased body fat on gross body coordination tests of pull-ups, cable jump and 1.5 mile run. Similarly, Goulding, Jones, Taylor, Piggot, and Taylor (2003) found BOTMP balance scores were negatively correlated with body weight, body mass index, relative body fat and total fat mass in boys suggesting that overweight adolescents possess poorer balance compared to their healthy weight peers. Finally, D'Hondt, Deforche, De Bourdeaudhuij, and Lenoir (2008) reported fine motor control deficit in overweight and obese boys and girls in the standing position compared to healthy weight peers. Furthermore, detrimental fine motor control continued to exist with obese boys and girls in a sitting position, but not in overweight and healthy weight children. While these studies suggest a negative relationship between adiposity and fine and gross motor coordination, none have specifically examined this relationship with respect to children with DCD. The purpose of this study was to determine if relative body fat influences MABC-2 scores in children with developmental coordination disorder.

2. Methods

2.1. Study sample

Complete procedures regarding initial motor coordination using the short form of the Bruininks-Oseretsky test of motor proficiency and invitation to participate in this study have been previously reported (Cairney, Hay, Veldhuizen, & Faught, 2010; Cairney, Hay, Veldhuizen, Missiuna, et al., 2010). The Physical Health Activity Study Team (PHAST) incorporated a nested case–control design ancillary to the PHAST longitudinal cohort study. The study population consisted of 63 controls and 63 DCD cases matched based on gender, school location and age within 3 months. This study was approved by both research ethics boards for Brock University and the District School Board of Niagara. Each subject and a parent provided written consent to participate in this study upon arriving to the laboratory.

2.2. Measures

2.2.1. Motor coordination

The PHAST prospective cohort design implemented the Bruininks-Oseretsky test of Motor Proficiency (BOTMP-SF) for baseline assessment of motor coordination of the main study cohort. This motor proficiency test measures reaction time, balance and coordination and was administered to every consenting child. A score below 38 was an indication of being at risk of DCD. A full explanation of the main PHAST study can be found in previous publications (Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2009; Faught et al., 2008). From the main study group a selection of 126 participants were selected for further evaluation and testing. Sixty-three children who tested as DCD using the BOTMP-SF were selected and 63 matched controls were recruited. The Movement Assessment Battery for Children 2nd Edition (MABC-2) was administered, to assess motor coordination of both fine and gross motor skills (Henderson et al., 2007). MABC-2 examines children for manual