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# Reprint of “Relationship between BMI, waist circumference, physical activity and probable developmental coordination disorder over time” ☆



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### ABSTRACT

**Background:** Cross-sectional studies have shown that children with developmental coordination disorder (DCD) are less likely to be physically active and have excess weight gain. However, longitudinal studies examining the relationship between DCD and measures of body composition (BMI and waist circumference) over time are lacking. It is not known if sex and physical activity affect the relationship between DCD and measures of body composition over time.

**Objective:** (1) To examine if BMI and waist circumference in children with and without probable DCD (pDCD) remain constant over time or change as children age, and whether this relationship varies by sex. (2) To examine if differences in physical activity between children with and without pDCD account for differences in BMI and waist circumference over time.

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*Methods:* Physical Health Activity Study Team (PHAST) data were used for this longitudinal analysis. At baseline, a total of 2,278 (pDCD = 103) children aged 9–10 years were included in the analysis. The total follow-up period was five years. Mixed-effects modeling was used to estimate change in body composition measures in children over time.

*Results:* Children with pDCD have higher BMI and waist circumference compared to typically developing children, and this difference increased over the study period. The relationship between pDCD and BMI over time also varied by sex. A similar trend was observed for waist circumference. Boys with pDCD were found to have a more rapid increase in BMI and waist circumference compared to girls with pDCD. Physical activity had neither a mediating nor a moderating effect on the relationship between pDCD and measures of body composition. However, physical activity was independently and negatively associated with measures of body composition.

*Conclusions:* pDCD is associated with higher body mass and waist circumference, both important risk factors for cardiovascular disease, type 2 diabetes, and psychological problems and other health conditions.

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## 1. Introduction

Developmental coordination disorder (DCD) is a neurodevelopmental disorder affecting motor coordination, which negatively impacts activities of daily living and scholastic achievement (American Psychiatric Association [APA], 2013). The prevalence of DCD is between 1.8% and 6% (Cairney, Hay, Fought, & Hawes, 2005a; Gibbs, Appleton, & Appleton, 2007; Lingam, Hunt, Golding, Jongmans, & Emond, 2009). Despite the relatively high prevalence of this condition, it is often not diagnosed in children (Missiuna et al., 2008).

As a result of poor motor coordination, children with DCD often face embarrassment and ridicule from their peers, and are less likely to participate in active physical free play and in organized sport and physical activities (Cairney et al., 2005b, 2007; Hands, 2008; Schott, Alof, Hultsch, & Meermann, 2007). This is troubling, given the many positive social, physical, and mental effects associated with being physically active (Strong et al., 2005). Physical inactivity has also been identified as one of the core risk factors associated with the pediatric obesity epidemic in North America, and in other parts of the developed world (Janssen et al., 2005).

Simply recommending increased levels of physical activity in children with DCD is likely to be ineffective as they do not have sufficiently proficient fundamental motor skills needed to participate in these activities or to engage in active play. Bar-Or (1983) described an activity deficit hypothesis which posits that children with movement difficulties are less physically active compared with their movement-competent peers. Previous studies support the activity deficit hypothesis in children with poor motor coordination (Beutum, Cordier, & Bundy, 2012; Bouffard, Watkinson, Thompson, Causgrove Dunn, & Romanow, 1996; Cairney et al., 2005b; Cantell, Crawford, & Doyle-Baker, 2008; Poulsen, 2008; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006).

Over time, reduced physical activity leads to an increased risk of overweight/obesity (Hands & Larkin, 2002). Therefore, it has been hypothesized that physical inactivity in children with DCD places them at higher risk for unhealthy weight gain (Cairney & Veldhuizen, 2013; Cairney et al., 2005a). According to a recent systematic review, 13 of 18 studies examining the relationship between motor proficiency and body composition found that children with poor motor proficiency had significantly higher BMI, waist circumference, and percent body fat compared to their peers (Rivilis et al., 2011). Longitudinal research

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