Human Movement Science 47 (2016) 159–165

Contents lists available at ScienceDirect

Human Movement Science

journal homepage: www.elsevier.com/locate/humov

Full Length Article

Longitudinal examination of objectively-measured physical activity and sedentary time among children with and without significant movement impairments

Matthew Y.W. Kwan [a,b,*], Sara King-Dowling [c], John A. Hay [d], Brent E. Faught [d], John Cairney [a,c,e]

[a] Department of Family Medicine, McMaster University, Hamilton, ON, Canada
[b] Michael G. DeGroote School of Medicine, Niagara Regional Campus, McMaster University, St. Catharines, ON, Canada
[c] Department of Kinesiology, McMaster University, Hamilton, ON, Canada
[d] Department of Health Sciences, Brock University, St. Catharines, ON, Canada
[e] Department of Psychiatry and Behavioural Neurosciences and Clinical Epidemiology and Biostatistics, CanChild Centre for Childhood Disability Research, and Offord Centre for Child Studies, McMaster University, Hamilton, ON, Canada

ARTICLE INFO

Article history:
Received 16 April 2015
Revised 2 February 2016
Accepted 4 March 2016
Available online 18 March 2016

Keywords:
DCD
Physical activity
MVPA
Sedentary
Accelerometry
Movement impairments

ABSTRACT

Background: Children with Developmental Coordination Disorder (DCD) tend to be less active than typically-developing (TD) children. Current evidence, however, is based on cross-sectional and self-reported activity, and little is known about sedentary time among children with significant movement impairments such as DCD. The current study examines the longitudinal patterns of objectively measured physical activity and sedentary time in children with and without possible DCD (pDCD).
Methods: Data is from a longitudinal nested case-control study, with 103 participants (n = 60 males ages = 12 and 13 at baseline). Participants averaging ⩽16th percentile on the Movement Assessment Battery for Children were considered having significant movement impairments and pDCD (n = 49). All participants wore accelerometers for seven days.
Results: There were significant main effects for time (Estimate = −23.98, $p < .01$) and gender (Estimate = 59.86, $p < .05$) on total physical activity, and time spent being sedentary (Estimate = 15.58, $p < .05$). Significant main effects for pDCD (Estimate = −5.38, $p < .05$) and gender (Estimate = 26.89, $p < .01$), and time by gender interaction (Estimate = −7.50, $p < .05$) were found for moderate-to-vigorous physical activity (MVPA). Sedentary time did not differ between children with and without DCD.
Conclusions: Results suggest children with pDCD engaged in less MVPA compared to TD children. Consistent patterns of MVPA over time, however, suggest that the divergence in MVPA occurs earlier in childhood. Further longitudinal research following a younger cohort is necessary to identify the specific point that differences in MVPA emerge.

1. Introduction

Childhood and adolescence are considered critical periods for establishing active lifestyles, yet population-level statistics indicate that only 7% of children and youth are meeting current physical activity recommendations (Colley et al., 2013). It is well established that physical activity itself is linked to various health outcomes such as increased bone mineral

* Corresponding author at: Department of Family Medicine, 100 Main St. W, DBHSC 5th floor, Hamilton, ON L8P 1H6, Canada.
E-mail address: kwanmy@mcmaster.ca (M.Y.W. Kwan).

http://dx.doi.org/10.1016/j.humov.2016.03.004
0167-9457/

density and decreased cardiovascular risk factors (Andersen et al., 2006; Bailey, Mckay, Mirwald, Crocker, & Faulkner, 1999). In addition to the high prevalence of inactivity and increasing cardiovascular risk factors observed in typically-developing (TD) children and adolescents, those with poor motor ability, including children with Developmental Coordination Disorder (DCD), tend to experience additional challenges engaging in physical activity. DCD is a diagnosis characterized by motor skill impairment unrelated to other physical and/or intellectual disorders as defined in the ICD-10 (American Psychiatric Association, 2013; WHO, 1992), with prevalence estimated between 1.8% and 5% (Lingam, Hunt, Golding, Jongmans, & Emond, 2009). Specific manifestations of the disorder are varied and pervasive, affecting both gross and fine motor skills, thus making activities of daily living such as tying shoelaces and handwriting and participating in physical activities extremely difficult. Occurring early in the developmental period, children with DCD have been consistently found to be less active than their TD peers, and are not a result of a lack of opportunity (Cairney, Hay, Faught, Wade, et al., 2005; Cairney, Hay, Faught, Mandigo, et al., 2005; Rivilis et al., 2011). The evidence suggests that physical activity deficits tend to persist throughout childhood and youth, further increasing the risk of future negative health outcomes later in life (Visser, Geuze, & Kalverboer, 1998).

Often undiagnosed, these children are typically viewed as unmotivated or lazy, and the common belief is that their motoric difficulties they exhibit are not serious enough to warrant intervention, or that children with coordination problems will out-grow their 'clumsiness' (Hay & Missiuna, 1998; Losse et al., 1991). While children and youth with DCD are at much greater risk for poorer health outcomes, it is recognized that it may be exacerbated by inactive lifestyles established during youth (Cantell, Smyth, & Ahonen, 1994; Hellgren, Gillberg, Gillberg, & Enerskog, 1993). The extant literature regarding the relationship between DCD and physical activity, however, has been limited in several ways, most notably a reliance on self-reported physical activity measures and cross-sectional designs.

Much of our current knowledge has been based on children being observed at different ages, and assessed only at one point in time (Rivilis et al., 2011). Indeed, the studies have consistently found children with DCD being significantly less active than TD children. Yet, it is unclear if there are differences in the patterns of physical activity over time based on motor proficiency. The broader literature thus far supports a persistence model, whereby the differences in physical activity between DCD and TD children tend to be stable over time (Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2010). However, some studies have found physical activity widening or diminishing over time, depending on the type of activity examined (Cairney et al., 2010; Visser et al., 1998). Like most cross-sectional studies, these longitudinal studies relied on self-reported physical activity measures, which are prone to social desirability biases and recall errors. To our knowledge, no longitudinal study has examined the effect of DCD on physical activity using objective measurements of physical activity.

There is increasing recognition of the importance of sedentary behavior as a related, yet discrete behavior to physical activity. Evidence suggests that children and youth spend a large majority of their discretionary time in sedentary pursuits (e.g., watching television, playing video games). Studies have consistently found children spending on average 6–9 h of their waking day being sedentary (Colley et al., 2011; Matthews et al., 2008). There is accumulating evidence showing a positive relationship between sedentary time and a variety of negative health outcomes (Tremblay et al., 2011). It is unclear, however, how sedentary behaviors may be impacted by motor coordination difficulties in children. Given that children with DCD are presumed to be less active over time, it stands to reason that these children may be displacing their time in movement activities for more sedentary pursuits requiring little to no movement.

To further the understanding of the health risks associated with children with significant motor impairments, research must examine sedentary time in addition to physical activity, identifying ways to get children to sit less and move more. The current study will further our knowledge on children with these significant motor impairments by examining patterns of objectively measured physical activity over time in children with and without possible DCD (pDCD). The term pDCD will be used in this study going forward, as not all criteria of the Leeds consensus (Sugden, 2006) were measured for a clinical DCD diagnosis. We will also examine whether there are gender differences, and if gender moderates the relationship between pDCD and physical activity levels. Furthermore, the study will examine sedentary time to determine whether there are differences in this health behavior over time between children with and without pDCD.

2. Methods

2.1. Participants and procedures

The current study is a longitudinal investigation of a subset of children participating in a larger, 6-year prospective cohort study examining the healthy growth and development of children, called Physical Health and Activity Study Team (PHAST) (Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2009). A group of children were selected from PHAST, and invited to participate in a longitudinal nested case-control study. Specifically, the current investigation is based on data collected in the final two years of the study, consisting of 126 participants selected from the PHAST study based on their motor proficiency scores. Children with the lowest motor proficiency scores were matched with a sample of children with higher motor proficiency scores. Included in the analyses were 103 of these participants (n = 60 males, 59%) that completed a minimum of one of the follow-ups.