



Dose-response effects of exercise on behavioral health in children and adolescents



April Bowling^{a, b, *}, James Slavet^c, Daniel P. Miller^d, Sebastien Haneuse^b,
William Beardslee^{c, e, f}, Kirsten Davison^b

^a Merrimack College, North Andover, MA, United States

^b Harvard T.H. Chan School of Public Health, Boston, MA, United States

^c Manville School, Judge Baker Children's Center, Boston, MA, United States

^d Boston University School of Social Work, Boston, MA, United States

^e Children's Hospital, Boston, MA, United States

^f Harvard Medical School, Boston, MA, United States

ARTICLE INFO

Article history:

Received 5 December 2016

Received in revised form

30 March 2017

Accepted 31 March 2017

Available online 2 April 2017

Keywords:

ADHD

Heart rate

Exercise duration

ABSTRACT

Purpose: Aerobic exercise may positively affect behavior in children but little research has been conducted among those with behavioral health disorders (BHD). This study is a secondary exploration of data originally collected from an RCT that tested effects of a cybercycling intervention on behavior in children with BHD. We examine dose-response relationships between duration and intensity of cybercycling and minutes of disciplinary time spent out of class (TOC) and self-regulation scores (SRS); additionally we examine potential effect modification by Attention-Deficit/Hyperactivity Disorder (ADHD) diagnosis.

Methods: We extracted data from study days on which participants (N = 103, 83.5% male, age 11.8 ± 2.3) cybercycled during physical education classes. Minutes of riding and average heart rate for each session were collected via the bicycles. The Conners Abbreviated Teacher Rating Scale (SRS) and minutes of TOC were recorded daily. Ride duration and average heart rate were treated as continuous predictors of outcomes using mixed-effects linear regression.

Results: For every 10 min of riding, children had an associated decline of 10.7 min of TOC (p < 0.001) and 1.2 points improvement in self-regulation score (p = 0.001). For each increase of 10 beats per minute average heart rate children had an associated decline of 1.3 min (p = 0.05) and 0.21 points (p < 0.05). Children with ADHD experienced 12.9 min less time out of class (p < 0.05) for each 10 additional minutes of riding.

Conclusion: Duration in particular had significant, linear relationships with improved behavioral outcomes among children with a variety of BHD; children with ADHD may experience the greatest benefits.

© 2017 Elsevier Ltd. All rights reserved.

1. Background

Childhood behavioral health disorders are common and increasing in prevalence in the United States and many other countries (Merikangas et al., 2010; Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015). The neurodevelopmental diagnosis Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common, but behavioral health diagnoses in children also include autism

spectrum disorders, depression, bipolar, and disruptive behavior disorders among others (Perou et al., 2013). According to the Center for Disease Control's most recent report on pediatric mental health surveillance, 13%–20% of children living in the United States experience a diagnosable behavioral health disorder in a given year, and lifetime rates of comorbid mental health diagnoses may exceed 40% (Perou et al., 2013).

There is a growing body of evidence that exercise exposures may positively affect behavior, mood and cognition in children both with and without behavioral health disorders (Lees, 2013). A recent systematic review of 8 randomized controlled trials found generally positive, if somewhat weak effects of exercise on psychosocial

* Corresponding author. Department of Health Sciences, Merrimack College, 315 Turnpike Street, North Andover, MA 01845, United States.

E-mail address: bowlinga@merrimack.edu (A. Bowling).

functioning in children (Lees, 2013). A meta-analysis of 19 studies investigating effects of physical activity on executive function in children, adolescents and adults found a significant moderate effect size for acute exercise exposures (Verburgh, Königs, Scherder, & Oosterlaan, 2013).

While a comprehensive review of pathways is beyond the scope of this article, research suggests that acute exercise affects neurotransmitter secretion and reuptake and is associated with changes in neural activation patterns and cognitive processes; the nature of these changes appear to depend on duration and intensity of exercise, with evidence that executive function and attentional improvements may particularly improve following medium duration and moderate intensity exercise (McMorris, 2016; Meeusen & De Meirleir, 1995). Although studies are sparse, there is also evidence that children with ADHD may selectively experience certain benefits to executive function and decreased impulsivity from exercise (Pontifex, 2013; Pontifex, Saliba, Raine, Picchiatti, & Hillman, 2013). This would make sense, since there is evidence that exercise affects catecholamine pathways targeted by stimulant medication to produce attentional and behavioral improvements (McMorris, 2016).

Unfortunately, there is also mounting evidence that like children with other types of disabilities, those with behavioral health disorders are less likely to engage in aerobic exercise and/or moderate to vigorous physical activity (MVPA; hereafter simply described as exercise) and thus are less likely to experience these potential benefits (Mangerud, Bjerkeset, Lydersen, & Indredavik, 2014). A variety of barriers to exercise have been documented in these populations including exclusion from traditional sporting leagues due to behavioral problems, oppositional responses to attempts by parents to manage health behaviors, sensory disorders and anxiety that discourage exercise engagement, comorbid gross motor delays, and weight gain and perceived exertion changes associated with certain psychiatric medications (Rimmer, Rowland, & Yamaki, 2007).

Given these challenging barriers to exercise engagement, it is crucial to examine whether exposures of shorter duration and lower intensity improve behavioral health outcomes in order to improve both efficacy and feasibility of interventions and exercise prescriptions. While many studies have shown overall treatment effects on behavioral outcomes from specific exercise and physical activity interventions among children with behavioral health disorders, effects have varied significantly across different treatment modalities and intervention approaches (Best, 2010; Castelli, Hillman, Hirsch, Hirsch, & Drollette, 2011; Hansen, Stevens, & Coast, 2001).

For example, Davis et al (Davis et al., 2011). and Hillman et al (Hillman et al., 2009). both used 20 min bouts of MVPA and found significant effects on self-regulation among typically developing children. Among children with ADHD, Gawrilow et al (Gawrilow, Stadler, Langguth, Naumann, & Boeck, 2013). found improvements to response inhibition after acute trampoline jumping bouts of only 5 min, Pontifex et al., (2013) found improvements to a variety of neurocognitive and executive function measures after 20 min of MVPA on a treadmill, and Chang et al (Chang, Liu, Yu, & Lee, 2012). found similar results after 30 min of running. In contrast, Oriel et al (Oriel, George, Peckus, & Semon, 2011). found that 15 min of running was not associated with improved classroom functioning in children with autism spectrum disorders. Many studies of exercise and classroom behavioral outcomes use exercise exposures of 45–60 min, a difficult amount to achieve given the barriers to exercise engagement in this population.

Also of importance, most current research has primarily focused on typically developing children or those with a single behavioral health diagnosis, and thus lacks generalizability to children with

multiple behavioral health challenges. This also contributes to the existing inability to advise parents and clinicians whether shorter and less intense exercise exposures elicit behavioral improvements for diverse populations, despite a demand for such knowledge (Williams, Klinepeter, Palmes, Pulley, & Foy, 2004). The lack of understanding of real-world dose-response relationships constitutes a critical evidence gap that negatively affects the treatment of these disorders and inhibits the design of effective programming in therapeutic schools, special education classrooms and clinical settings.

The positive treatment effects among children with heterogeneous behavioral health disorders who participated in the Manville School Cybercycling and Behavior Randomized Controlled Trial (Manville Moves - Clinical trials number NCT02766101) has been reported elsewhere (Bowling et al., 2017). Manville Moves was designed to examine if an aerobic cybercycling PE intervention was linked to improvements in behavioral self-regulation and classroom functioning relative to a control condition among 103 children with behavioral health disorders (Davison et al., 2016). The RCT found that participation in the intervention resulted in greatly reduced clinically disruptive behaviors and learning disruptive disciplinary time out of class among children compared to the control condition (Bowling et al., 2017). This article reports an exploratory follow-up investigation of the dose-response relationship between acute exercise duration and intensity and behavioral outcomes post-exercise observed during the course of that study.

Using data collected during and after cybercycling bouts, in the current study we examine relationships between participants' behavioral outcomes and continuous measures of exercise duration and intensity. Based on previous research, we hypothesized that both increased exercise duration and intensity would have inverse relationships with negative behaviors. Also, while Manville Moves was not designed or powered to examine modification by individual child behavioral health characteristics, it provides an opportunity to conduct hypotheses-generating analyses into possible effect modification of exercise-behavior relationships by children's ADHD diagnosis status, which as described previously, may plausibly alter neurological and endocrine responses to exercise.

2. Methods

2.1. Setting and participants

The study design and fidelity of implementation of the Manville Moves RCT has been described extensively in other publications (Bowling et al., 2016; Davison et al., 2016). A total of 103 children attending a therapeutic day school participated in the study. Participants ranged from 7 to 16 years of age, and all had at least one diagnosed behavioral health disorder, with the most prevalent diagnoses being ADHD, autism and anxiety. The study protocol was reviewed and approved by the Harvard T.H. Chan School of Public Health Institutional Review Board. The school integrated the PE curriculum into school programming; thus, the study used an opt-out consent process, and all children enrolled in the school participated in the study with the exception of one child who had a medical exemption from PE class. Following an active consent process, caretakers of the participants filled out a survey, offered both online and via hard copy, which collected data on their child's baseline physical activity levels, diagnoses, medication types, and family demographics. Surveys were returned for 80 (77.7%) participants.

Download English Version:

<https://daneshyari.com/en/article/5039470>

Download Persian Version:

<https://daneshyari.com/article/5039470>

[Daneshyari.com](https://daneshyari.com)