

7-22-2015

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Citation of this paper:

Irwin, Jennifer D.; Johnson, Andrew M.; Vanderloo, Leigh M.; Burke, Shauna M.; and Tucker, Patricia, "Temperament and Objectively Measured Physical Activity and Sedentary Time among Canadian Preschoolers" (2015). *Paediatrics Publications*. 898.
<https://ir.lib.uwo.ca/paedpub/898>



Temperament and Objectively Measured Physical Activity and Sedentary Time among Canadian Preschoolers

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ARTICLE INFO

Available online 22 July 2015

Keywords:

Child temperament
Physical activity
Sedentary time
Preschoolers
Accelerometer

ABSTRACT

This study sought to assess the influence of preschoolers' temperament on their objectively measured physical activity and sedentary time. Actical™ accelerometers were used to measure preschoolers' from London, Canada's ($n = 216$; 2.5–5 years) physical activity and sedentary levels during childcare hours (5 consecutive days; 15 s epoch). The Child Temperament Questionnaire (CTQ) was used to assess child temperament via parent/guardian report. The six subscales of the CTQ (i.e., reaction to food, soothability, attention span, activity, sociability, and emotionality) were correlated with Actical data (i.e., sedentary time, moderate-to-vigorous physical activity, and total physical activity). The five items of the activity subscale were correlated with these three measures of sedentary time and physical activity. Pearson product–moment correlation coefficients were employed for both sets of analyses. Of the correlations examined, few had an absolute value greater than 0.10, and none were statistically significant after taking multiple comparison bias into account. The results of this work might provide additional indirect support for the conclusion that the childcare environment should be a primary focus with regard to the promotion of increased physical activity and decreased sedentary time among preschoolers. Additional research is required to confirm the relationship between preschoolers' temperament and levels of physical activity and sedentary time.

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Introduction

Regular physical activity is an important behavior contributing to the health of people of all ages (Warburton et al., 2006). Helping to establish physical activity as a normal part of daily life among young children is critical as activity levels tend to drop as individuals age (Bradley et al., 2011), while sedentary pursuits increase (Mitchell et al., 2012). Establishing an active lifestyle early on can help facilitate healthy activity levels and minimize sedentary pursuits over the long-term (Taylor et al., 2009). The value of regular physical activity for young children is well-established, including but not limited to: reducing the likelihood of overweight and obesity, type II diabetes, and cardiovascular disease, while at the same time enhancing academic achievement, self-efficacy, and self-esteem (Strong et al., 2005). Recent evidence also indicates that high levels of sedentary behaviors (such as watching television or playing video games) are positively associated with all-cause mortality as well as physical and psychological

challenges; independent from the risks associated with low levels of physical activity (Katzmarzyk et al., 2009). As such, increasing physical activity and reducing sedentary behaviors helps to promote overall health and lower health risks among children (Tremblay et al., 2011).

Although physical activity guidelines recommend that preschool-aged children (i.e., ages 2.5–5 years) engage in 180 min of any-intensity physical activity every day (Tremblay et al., 2012), there is mixed evidence regarding whether preschoolers are sufficiently active to meet such recommendations (Tucker, 2008; Colley et al., 2013). Furthermore, in a recent study of objectively measured physical activity among preschoolers attending center-based childcare, children engaged in about 133 min of total daily physical activity while in care, about 50 min short of the guideline (Vanderloo et al., 2014a). Even when physical activity levels seem to be sufficient, children's sedentary behaviors have remained high (Colley et al., 2013). For instance, although the Canadian Sedentary Behaviour Guidelines recommend that caregivers minimize the time that young children spend being sedentary (Canadian Society for Exercise Physiology, 2012), researchers have found that television viewing, computer use, playing video games, and other sedentary pursuits, occupy a large proportion of preschoolers' time while in childcare (Colley et al., 2013). While opportunities for additional physical activities are possible during post-childcare

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hours, researchers have previously found that parents rely on their children's childcare facility to ensure daily activity goals are met (Tucker et al., 2006). One concept worth investigating is *if*, and *whether*, a child's temperament influences his or her choices to engage in physical activity and/or sedentary pursuits.

Rothbart and Bates described a child's temperament as his or her individual behavioral style that is noticeable very early in life (Rothbart and Bates, 1998). Previously published research on childcare providers' views suggested that children's personalities might influence their activity choices and levels (Tucker et al., 2011). In addition, research by Anderson et al. on 8–12 year old girls indicated that those with high activity temperaments tended to use more energy and were leaner, emphasizing the relationship between temperament and both activity and body composition (Anderson et al., 2004). Understanding how temperament is associated with physical activity and sedentary behaviors (i.e., predisposing for or against) can allow early years' researchers to work with childcare providers and parents to develop and identify strategies that can be used with children of different temperaments. This may include helping children to better manage temperament-related challenges, being more aware of the relationship between children's temperaments and their caregivers' reactions, and developing opportunities for parents and teachers to find nurturing options that are suitable for a child's temperament (Zentner and Bates, 2008). Although the small amount of research that has been conducted on this topic suggests child temperament and physical activity might be related (Anderson et al., 2004) a thorough search of the literature revealed no published studies exploring the relationship between preschoolers' temperament and their physical activity and/or sedentary levels. Therefore, the purpose of this study was to assess the influence of preschoolers' temperament on their objectively measured physical activity and sedentary time.

Methods

Study design and participants

The current study was part of the larger 2-year, descriptive cross-sectional *Learning Environments' Activity Potential for Preschoolers* (LEAPP) study, and the methods have been published elsewhere in detail (Tucker et al., 2013). Ethical approval for the study's protocol was received from the Health Sciences Research Ethics Board at Western University.

Preschoolers between the ages of 2.5 and 5 years were eligible to participate. Using a cluster recruitment strategy, a geographically diverse sample of early learning facilities were invited to participate. A total of 19 facilities (center-, home-based childcare, and full-day kindergarten) in London, Canada agreed to assist with recruitment, and children with parent or guardian consent participated.

Measures

Participating children's parents/guardians were asked to complete a demographic questionnaire prior to data collection. As outlined elsewhere (Tucker et al., 2013), the *Child Temperament Questionnaire* (CTQ) was developed based on the Colorado Child Temperament Inventory (CCTI) by Rowe and Plomin (Rowe and Plomin, 1977). Typically administered to children aged 1–6 years, the CTQ was used to assess child temperament via parent/guardian report. The scale has been found to have good internal consistency and test–retest reliability (Rowe and Plomin, 1977). Specifically, this 30-item tool evaluates the following six subscales: reaction to food, soothability, attention span, activity, sociability, and emotionality.

Activity data were collected by *Actical™ accelerometers* (MiniMitter, Bend, OR, USA), using a 15 s epoch length. These omnidirectional devices provided detailed information on movement counts and activity intensities. Participants ($n = 293$) were fitted with a device for 5 days

during childcare hours, with the accelerometers being securely fastened to the children's right hip at the start of the day and removed prior to their departure from the childcare facility or kindergarten classroom.

Statistical analyses

As has been previously reported (Tucker et al., 2013), accelerometry data were downloaded using Actical-specific software. In KineSoft software (version 3.3.62; KineSoft Saskatchewan Canada), activity data were compared against the cut-points described by Pfeiffer et al. (Pfeiffer et al., 2006), (sedentary [<50 counts per 15-s epoch], light [$>50 \leq 714$ counts per 15-s epoch], moderate [$\geq 715 \leq 1410$ counts per 15-s epoch], vigorous [$\geq 1,411$ counts per 15-s epoch]), and then summed into minutes of daily activity. In line with previous research (Colley et al., 2013), participants who did not wear their accelerometer for a minimum of three valid wear days (where "one valid day" was defined as a minimum of 5 h of wear time) were excluded from the analyses. Physical activity per hour of wear time was calculated to account for the varying lengths of time participants spent in childcare/school (Vanderloo et al., 2014a).

All analyses were performed using R version 3.2.1. According to Buss and Plomin (Buss and Plomin, 1984), items within the *activity* subscale assess the vigor and intensity of gross motor movement among young children. Therefore, the *activity* subscale was primarily used in the analysis for comparison with the objectively measured physical activity and sedentary data of participating preschoolers. Two sets of analyses were conducted in service of determining the relationship between temperament and Actical-measured physical activity and sedentary time. In the first analysis, the six subscales of the CTQ (i.e., reaction to food, soothability, attention span, activity, sociability, and emotionality) were correlated with Actical measurements of time spent in sedentary time, moderate-to-vigorous physical activity (MVPA), and total physical activity (TPA; i.e., light and moderate-to-vigorous physical activity). In the second analysis, the five items of the *activity* subscale were correlated with these three measures of physical activity. Zero-order Pearson product–moment correlation coefficients were employed for both sets of analyses, and 95% confidence intervals were computed for each correlation coefficient. All correlation coefficients were calculated across the entire dataset, and separately for each sex. Multiple comparison bias was controlled through an application of a Holm–Bonferroni correction factor for each analysis (i.e., within the analysis of the whole dataset, and within each of the sex analyses).

Results

After removing individuals with less than three valid accelerometer wear days, our total sample size was 216 preschoolers. Correlations from the first set of analyses (i.e., between the six subscale scores and the measures of physical activity) are presented in Table 1, and correlations from the second set of analyses (i.e., between the items on the *activity* subscale and the measures of physical activity) are presented in Table 2. Of the correlations presented in these tables, none were statistically significant after taking multiple comparison bias into account.

Discussion

The findings from this work suggest that the domains of temperament assessed by the CTQ were not relevant to the prediction of physical activity or sedentary time among preschool children in our study. This may, however, be an artifact of the measurement tool (e.g., it is a parent-report instrument, and the questionnaire itself is several decades old), and so the results should be interpreted with caution. Furthermore, the activity data were collected during childcare hours only, a time that has been suggested to be quite sedentary for preschool-aged children (Pate et al., 2004; Vanderloo et al., 2014b); this restricted time frame may have attenuated the correlation with temperament.

Table 1
Zero-order correlations and 95% confidence intervals between unit-weighted scale scores from the Child Temperament Questionnaire and measures of objectively measured physical activity and sedentary time.

	TPA			MVPA			Sedentary		
	Lower	<i>r</i>	Upper	Lower	<i>r</i>	Upper	Lower	<i>r</i>	Upper
<i>All participants</i>									
Sociability	−0.14	−0.01	0.12	−0.14	−0.01	0.12	−0.15	−0.01	0.12
Emotionality	−0.04	0.09	0.22	−0.10	0.03	0.16	−0.22	−0.09	0.04
Activity	−0.05	0.09	0.22	−0.17	−0.04	0.10	−0.23	−0.10	0.04
Attention span	0.00	0.13	0.26	−0.12	0.01	0.15	−0.27	−0.14	0.00
Reaction to food	−0.15	−0.02	0.12	−0.05	0.08	0.21	−0.14	0.00	0.13
Soothability	−0.21	−0.07	0.06	−0.15	−0.01	0.12	−0.06	0.07	0.21
<i>Boys only</i>									
Sociability	−0.10	0.10	0.29	−0.11	0.08	0.27	−0.33	−0.14	0.06
Emotionality	−0.06	0.13	0.32	−0.04	0.16	0.34	−0.31	−0.12	0.07
Activity	−0.07	0.12	0.31	−0.17	0.03	0.22	−0.32	−0.13	0.06
Attention span	−0.09	0.11	0.30	−0.16	0.03	0.23	−0.29	−0.10	0.10
Reaction to food	−0.12	0.08	0.27	−0.10	0.10	0.29	−0.26	−0.07	0.12
Soothability	−0.22	−0.03	0.17	−0.22	−0.03	0.17	−0.16	0.04	0.23
<i>Girls only</i>									
Sociability	−0.25	−0.07	0.12	−0.26	−0.08	0.10	−0.12	0.06	0.24
Emotionality	−0.18	0.01	0.19	−0.29	−0.11	0.08	−0.20	−0.01	0.17
Activity	−0.19	0.00	0.18	−0.29	−0.11	0.07	−0.18	0.00	0.18
Attention span	−0.10	0.09	0.27	−0.22	−0.04	0.15	−0.29	−0.11	0.07
Reaction to food	−0.30	−0.13	0.06	−0.12	0.07	0.25	−0.11	0.07	0.25
Soothability	−0.27	−0.09	0.10	−0.17	0.02	0.20	−0.11	0.08	0.26

Note. MVPA = moderate-to-vigorous physical activity; TPA = total physical activity.

More specifically, had activity data been captured over the duration of the entire day, it is possible that an association between temperament and physical activity may have been more evident in the home environment (and in the care of their parents).

This is the first study to assess the relationship between preschoolers' temperament and their objectively measured physical activity and sedentary time during childcare hours. Considered within the context of previous literature highlighting the importance of the childcare environment in the prediction of physical activity levels and sedentary behaviors among preschoolers (Tucker et al., 2013; Vanderloo et al., 2014b), the current (lack of) findings with regard to the individual-level temperament variable may not be illogical. In fact, these results might provide additional indirect support for the conclusion that the childcare environment and practices such as positive

staff behaviors, the presence of portable play equipment, reduced sedentary opportunities, and sufficient outdoor play time (Tucker et al., 2013; Vanderloo et al., 2014b) should be a primary focus with regard to the promotion of increased physical activity and decreased sedentary time among preschool-aged children.

Of course, it is also possible that a different measure of temperament administered by trained behaviorists observing children in a variety of environments may more accurately capture if child preferences influence physical activity and sedentary time. Given the potential importance of the relationship between temperament and physical activity and sedentary behaviors (i.e., for programming to facilitate higher rates of physical activity and lower levels of sedentary behaviors in childcare), it may be premature to abandon research on this topic. Rather, we would encourage the utilization of additional temperament

Table 2
Zero-order correlations and 95% confidence intervals between items on the Activity subscale from the Child Temperament Questionnaire and measures of objectively measured physical activity and sedentary time.

	TPA			MVPA			Sedentary		
	Lower	<i>r</i>	Upper	Lower	<i>r</i>	Upper	Lower	<i>r</i>	Upper
<i>All participants</i>									
Very energetic	−0.15	−0.02	0.12	−0.31	−0.19	−0.05	−0.13	0.00	0.14
Always on the go	−0.05	0.09	0.22	−0.23	−0.10	0.04	−0.22	−0.09	0.04
Prefers quiet inactive games to more active ones	−0.17	−0.04	0.10	−0.19	−0.06	0.08	−0.12	0.01	0.15
Is off and running as soon as he/she wakes up in the morning	−0.06	0.07	0.20	−0.09	0.05	0.18	−0.22	−0.09	0.05
Moves slowly when he/she is moving about	−0.18	−0.05	0.08	−0.21	−0.08	0.06	−0.08	0.06	0.19
<i>Boys only</i>									
Very energetic	−0.19	0.01	0.20	−0.36	−0.17	0.02	−0.23	−0.04	0.16
Always on the go	0.01	0.21	0.38	−0.19	0.00	0.20	−0.40	−0.23	−0.04
Prefers quiet inactive games to more active ones	−0.17	0.03	0.22	−0.22	−0.03	0.17	−0.28	−0.09	0.11
Is off and running as soon as he/she wakes up in the morning	−0.12	0.08	0.27	−0.06	0.14	0.33	−0.30	−0.11	0.09
Moves slowly when he/she is moving about	−0.25	−0.06	0.14	−0.25	−0.05	0.14	−0.13	0.06	0.26
<i>Girls only</i>									
Very energetic	−0.27	−0.09	0.10	−0.39	−0.22	−0.04	−0.10	0.09	0.27
Always on the go	−0.22	−0.04	0.15	−0.36	−0.19	−0.01	−0.14	0.05	0.23
Prefers quiet inactive games to more active ones	−0.26	−0.08	0.11	−0.26	−0.07	0.11	−0.10	0.09	0.27
Is off and running as soon as he/she wakes up in the morning	−0.17	0.02	0.20	−0.22	−0.04	0.15	−0.21	−0.03	0.15
Moves slowly when he/she is moving about	−0.20	−0.02	0.17	−0.26	−0.08	0.10	−0.17	0.01	0.20

Note. MVPA = moderate-to-vigorous physical activity; TPA = total physical activity.

measurement tools, assessed in conjunction with a more widely variable physical activity measure (perhaps through the inclusion of a variety of settings and times), and to also include an assessment that identifies children's individual preferences for different types of physical activities. By identifying which temperaments are related to physical activity and sedentary time (be it positively or negatively), researchers will be better positioned to find strategies of appropriately engaging children in active behaviors. Moreover, the findings of such work may suggest ways in which activities (particularly those offered to and/or made available to preschoolers during childcare hours) can be modified based on a young child's personal preferences and personality in order to promote/support active behaviors.

Conflict of interest statement

The authors declare that they have no conflict of interest.

Acknowledgments

This research was supported by the Canadian Institutes of Health Research, the Heart and Stroke Foundation of Canada, and the Public Health Agency of Canada (CIHR Award # GIR 112690 – the funding source had no involvement in the study design, data collection, analysis, or manuscript development). The researchers would like to thank the preschoolers and their parents/guardians who participated in the study and acknowledge the schools, childcare facilities, and their staff for all their assistance with carrying out this project. Thanks are also extended to Dr. Courtney Newnham-Kanas (project management and data collection/verification), Olivia Martyniuk (data collection), and Emie Angeles (data entry).

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