



## Original research

## Physical activity and sedentary time in relation to academic achievement in children



Eero A. Haapala<sup>a,b,\*</sup>, Juuso Väistö<sup>a,c</sup>, Niina Lintu<sup>a</sup>, Kate Westgate<sup>d</sup>, Ulf Ekelund<sup>d,e</sup>, Anna-Maija Poikkeus<sup>f</sup>, Soren Brage<sup>d</sup>, Timo A. Lakka<sup>a,g,h</sup>

<sup>a</sup> Institute of Biomedicine/Physiology, University of Eastern Finland, Kuopio Campus, Finland

<sup>b</sup> Childhood Health and Active Living Research Group, Department of Biology of Physical Activity, University of Jyväskylä, Finland

<sup>c</sup> Institute of Dentistry, University of Eastern Finland, Kuopio Campus, Finland

<sup>d</sup> MRC Epidemiology Unit, University of Cambridge, University of Cambridge School of Clinical Medicine, Institute of Metabolic Science, Cambridge Biomedical Campus, United Kingdom

<sup>e</sup> Department of Sport Medicine, Norwegian School of Sports Science, Norway

<sup>f</sup> Department of Teacher Education, University of Jyväskylä, Finland

<sup>g</sup> Department of Clinical Physiology and Nuclear Medicine, University of Eastern Finland, Kuopio Campus, Finland

<sup>h</sup> Kuopio Research Institute of Exercise Medicine, Finland

## ARTICLE INFO

## Article history:

Received 28 March 2016

Received in revised form 21 October 2016

Accepted 15 November 2016

Available online 23 November 2016

## Keywords:

Motor activity

Sedentary behavior

Academic performance

Cognition

Pediatrics

## ABSTRACT

**Objectives:** To investigate the independent and combined associations of objectively measured moderate-to-vigorous physical activity (MVPA) and sedentary time (ST) with reading and arithmetic skills.

**Design:** Cross-sectional/prospective.

**Methods:** Participants were 89 boys and 69 girls aged 6–8 years. MVPA and ST were measured using a combined heart rate and movement sensor and body fat percentage by dual-energy X-ray absorptiometry in Grade 1. Reading fluency, reading comprehension, and arithmetic skills were assessed using standardized tests in Grades 1–3. The data were analyzed using linear regression analyses and analyses of covariance with repeated measures.

**Results:** In boys, MVPA was directly and ST inversely associated with reading fluency in Grades 1–3 and arithmetic skills in Grade 1 ( $P < 0.05$ ). Higher levels of MVPA were also related to better reading comprehension in Grade 1 ( $P < 0.05$ ). Most of the associations of MVPA and ST with reading and arithmetic skills attenuated after mutual adjustment for MVPA or ST. Furthermore, boys with a combination of lower levels of MVPA and higher levels of ST had consistently poorer reading fluency ( $P = 0.002$ ) and reading comprehension ( $P = 0.027$ ) across Grades 1–3 than other boys. In girls, ST was directly associated with arithmetic skills in Grade 2 ( $P < 0.05$ ). However, this relationship of ST with arithmetic skills was no longer significant after adjustment for body fat percentage.

**Conclusions:** Lower levels of MVPA and higher levels of ST and particularly their combination were related to poorer reading skills in boys. In girls, higher levels of ST were related to better arithmetic skills.

© 2016 Sports Medicine Australia. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

Physical inactivity is a major public health problem in developed countries.<sup>1</sup> There is some evidence that higher levels of physical activity (PA) and lower levels of sedentary time (ST) are associated with better brain structures and functions in children.<sup>2,3</sup> Moreover, low levels of PA and high levels of ST, particularly TV watching, have been linked to poorer academic achievement in children.<sup>4,5</sup>

However, these relationships are mainly based on data from cross-sectional studies using self-reported PA and ST.<sup>4,6</sup> The ability of self-report to rank the level of PA correctly has been questioned, and self-reports are also prone to recall bias.<sup>7</sup> Therefore, evidence on the associations of objectively measured PA and ST with academic achievement in children is highly warranted.

Higher levels of objectively measured moderate-to-vigorous PA (MVPA) at the age of 11 were associated with better academic achievement at the ages of 11, 13, and 16 years<sup>8</sup> but with poorer academic achievement in children and adolescents aged 6–18 years.<sup>9</sup> Some studies have found no relationship between objectively measured MVPA and academic achievement in

\* Corresponding author.

E-mail address: [eero.haapala@uef.fi](mailto:eero.haapala@uef.fi) (E.A. Haapala).

children 10 years of age.<sup>5,10</sup> In recent studies, higher levels of PA have been associated with better academic achievement only among boys.<sup>11,12</sup> In contrast, some studies have observed an association between higher levels of PA and better cognitive performance in girls but not in boys.<sup>13,14</sup> There are studies on the associations of MVPA with academic achievement during childhood, although MVPA accounts only for a small proportion of daily PA among children.<sup>15</sup> However, there are no studies on the relationships of objectively measured light PA to academic achievement although children spent most of their physically active time in light PA.<sup>15</sup>

Few available studies on the associations of objectively measured ST with academic achievement suggest a weak positive or no relationship between ST and academic achievement in children<sup>5</sup> and adolescents.<sup>16,17</sup> These results are consistent with the observations indicating that some sedentary behaviors, such as TV watching, are inversely associated whereas some sedentary behaviors, such as reading, are directly associated with academic achievement in children that makes the interpretation of the associations between total ST and academic achievement difficult.<sup>4</sup>

The evidence on the independent and combined relationships of objectively measured PA and ST to academic achievement is limited. Furthermore, there are only a few studies on the longitudinal associations of PA and ST with academic achievement during the first school years. Therefore, we investigated the independent and combined associations of objectively measured MVPA, light PA, and ST in Grade 1 with reading and arithmetic skills in Grades 1–3 in Finnish boys and girls aged 6–8 years.

## 2. Methods

### 2.1. Study design and study population

Data for the present analyses were obtained from the Physical Activity and Nutrition in Children (PANIC) Study and the First Steps Study, two independent studies that are being conducted simultaneously among primary school children in the City of Kuopio, Finland.<sup>18</sup> Altogether 207 children from the City of Kuopio participated in both the PANIC Study and the First Steps Study. Data on PA, ST, and confounding factors were derived from the PANIC Study in Grade 1 and data on reading and arithmetic skills at the end of Grades 1–3 were received from the First Steps Study. Complete data on variables used in the present analyses were available for 153 children (89 boys, 64 girls) in Grade 1, 149 children (87 boys, 62 girls) in Grade 2, and 145 children (86 boys, 59 girls) in Grade 3. Children who were excluded from the present analyses because of incomplete data had higher levels of MVPA, lower levels of ST, and higher maximal workload per lean body mass in maximal cycle ergometer exercise test than the children who were included ( $P < 0.05$ ). There were no differences in other characteristics between children in the study sample and the excluded children. The PANIC Study protocol was approved by the Research Ethics Committee of the Hospital District of Northern Savo, Kuopio, and the First Steps Study protocol was approved by the Research Ethics Committee of the University of Jyväskylä. All participating children and their parents provided written informed consent. The funding sources had no role in the collection, analysis, or interpretation of the data or in the approval or disapproval of the publication.

### 2.2. Assessment of academic achievement

Reading fluency was assessed using a group-administered subtest of the nationally normed reading achievement test battery for primary schools called *Ala-asteen lukutesti* (ALLU) in Finnish.<sup>19</sup> The test score was the number of correct answers, ranging from 0 to 80, during a 2-min time limit for items that involved identifying the

correct word from four phonologically similar alternatives linked to an adjoining picture.

Reading comprehension was assessed with a group-administered subtest from the ALLU test battery.<sup>19</sup> After reading a short text, children were asked to answer to 12 multiple-choice questions relating to facts, causal relationships, interpretations, or conclusions drawn from the text. The test score was the number of correct answers, ranging from 0 to 12, during the 30-min test period when children were allowed to refer to the original text.

Arithmetic skills were assessed using a basic arithmetic test with a set of visually presented addition and subtraction tasks.<sup>20</sup> Children were asked to perform as many calculations as they could during the 3-min time limit. The test score was the number of correct answers, ranging from 0 to 28.

### 2.3. Assessment of physical activity and sedentary time

PA was objectively assessed using a combined heart rate and movement sensor (Actiheart<sup>®</sup>, CamNtech Ltd., Papworth, UK)<sup>21</sup> which was attached to the children's chest with two standard ECG electrodes. The children were asked to wear the sensor continuously for a minimum of four days (including sleep and water-based activities) without changing their usual behavior. The heart rate data were individually calibrated with data from a maximal cycle ergometer exercise test. We defined MVPA as activities exceeding the intensity of 4 metabolic equivalents (METs), light PA as activities that were performed at the intensity of 1.5–4 metabolic equivalents (METs), and ST as activities that were performed below the intensity of 1.5 METs. We included data on children who had at least 48 h (32 h during weekdays, 16 h during weekend days, represented by  $\geq 12$  h of morning, noon, afternoon, and evening wear time) of valid activity recording in the analyses.<sup>22</sup>

### 2.4. Other assessments

Body height and body weight were measured by standard procedures.<sup>23</sup> Pubertal status was assessed using the five stage criteria described by Tanner.<sup>24</sup> Body fat mass, body fat percentage, and lean body mass were measured using the Lunar Prodigy Advance<sup>®</sup> DXA device.<sup>25</sup> Cardiovascular fitness (maximal workload per lean body mass) was assessed by a maximal cycle ergometer test and motor performance by 50-m shuttle run test time.<sup>25</sup> Parental education, household income, PA at different settings including unsupervised PA, organized sports, other supervised exercise, PA at recess, and physically active school transportation, habitual time spent watching TV, using computer, and reading were assessed by a questionnaire.<sup>26</sup> The risk of reading disability was assessed in the First Steps Study as described earlier.<sup>27</sup> Children's wellbeing was assessed by a questionnaire that was filled out by the parents and included 37 questions on the frequency of the components of physical, psychological, and social wellbeing scored between 1 (never) and 5 (every day or almost every day). Overall wellbeing score was computed as a sum of all these measures that ranged between 37 and 185, lower score indicating better overall wellbeing.

### 2.5. Statistical methods

We performed all data analyses using SPSS Statistics, Version 21.0 (IBM Corp., Armonk, NY, USA). Basic characteristics between boys and girls were compared using the Student's *t*-test, the Mann–Whitney *U*-test, or the chi square-test. The associations of MVPA, light PA, and ST in Grade 1 with reading fluency, reading comprehension, and arithmetic skills in Grades 1–3 were studied using linear regression analyses. MVPA, Light PA, and ST were entered into the model one by one and data were adjusted for age, sex, and sensor wear time. The data were mutually adjusted for

Download English Version:

<https://daneshyari.com/en/article/5574015>

Download Persian Version:

<https://daneshyari.com/article/5574015>

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