Sedentary behaviours of schoolchildren using mobile technology in the classroom
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1. Introduction

Children’s exposure to Information and Communication Technology (ICT) is becoming commonplace in school and at home. Many activities using ICT involve sedentary behaviour, wherein energy expenditure is ≤1.5 METs (Hardy et al. 2013), and are associated with potential negative health outcomes. Time spent in moderate to vigorous physical activity (MVPA) is independent of time in sedentary behaviour, and so children with high MVPA can still be excessively sedentary (Healy et al. 2008). Current research suggests that minimising total sedentary time, and breaking up prolonged uninterrupted sedentary periods may provide musculoskeletal and cardio-metabolic benefits for children (Abbot, Straker and Mathiasssen 2013; Healy et al. 2008).

Currently, there is no single method to objectively and simultaneously capture the context and time of ICT-related sedentary behaviours. The aim of this study was quantify the time and context of sedentary behaviours among school children using 1:1 (i.e. one tablet for each child) tablet devices in a classroom, by combining data from three metrics: an automated camera, an accelerometer, and a one-day time-use diary.

2. Methods

2.1 Study Design

This descriptive study objectively measured school children’s sedentary behaviours with an accelerometer and an automated camera during one school day between 8:40am and 3pm. Participants self-reported activities performed via a time-use diary. A purposive sample of 38 Australian school children aged 9-10 years (in Year 5) was recruited from a non-government school that had a 1:1 tablet program.

2.2 Instruments

An automated camera (Autographer) mounted on the classroom wall collected still photographic images from a bird’s eye view of the participant’s gross postures (e.g. sitting, standing, walking) whilst in the classroom. Actical accelerometers worn on the right hip measured movements of participants whilst both in and out of the classroom during the data collection period. Activity counts were stored in 15-second epochs and time in different intensities of activities (e.g. sedentary, light, moderate and vigorous) was derived using published count per minute thresholds for children (Evenson, 2008).

Participants completed a one-day time-use diary at the end of the school day. Data were reported in 15-minute increments and included: (i) school activities performed; (ii) ICT used during activities; and (iii) physical activity performed (e.g. walking, running, jumping) while in class and out of class.

2.3 Data Analysis

Autographer images were manually coded for type of ICT used (tablet, paper/pencil, no ICT) and gross posture using Multimodal Analysis (Multimodal Analysis Lab, Singapore), and summary statistics determined total durations and percentages of time spent in different postures and when using the tablet. Accelerometer data were processed using Exposure Variation Analysis (EVA) to determine time spent in class at different activity levels. Estimates of time in sedentary and physical activity and tablet use reported in the time-use diaries were determined by averaging the sum of the 15 minute intervals for each participant.

3. Results

3.1 Time spent using ICT in class

The Autographer data identified that tasks involving no form of ICT comprised around 42% of total in class time. Paper-based tasks comprised about 33% of class time, and tablets were used for 26% of class time. At times participants used the tablets in combination with paper and pencil media.
3.2 **Total sedentary behaviour**

Participants engaged in sedentary behaviours during the school day for a mean (SD) total time of 176 (43) minutes; representing 53% of the school day, as measured by the accelerometer. Self-reported sedentary time was 226 (64) minutes; representing 60% of the school day. Autographer data identified the tablets were used on average for 26% of time spent in the classroom. This was consistent with the self-reported time-use diary data (26%). Accelerometer data confirmed participants were sedentary for 97% of the time using the tablet devices.

3.3 **Total physical activity**

Participants engaged mostly in light physical activity (mean (SD) =138 (27) minutes); representing 41% of the school day, as measured by the accelerometer. Mean (SD) total time in MVPA by accelerometer was 19 (15) minutes. Only one participant met the recommended 60+ minutes per day of MVPA (World Health Organization, 2011) during their school day.

3.4 **Variation within physical activity levels**

Summary statistics for EVA identified that over the whole school day participants mostly engaged in 5-10 minute periods of light physical activity (total of 79 minutes; 24% of total time). Conversely, MVPA was for a mean total of 19 minutes (5% of total time) and the majority of MVPA occurred in short bursts of <5 minutes. Although around 50% of sedentary time was spent in short bursts of ≤5 minutes or 5≤10 minutes, sedentariness for durations of ≥20 minutes were also recorded. Figure 1. shows the EVA matrix for the total proportion of time spent in epochs within each physical activity level.

![Figure 1. Proportion of time spent in each epoch within the sedentary, light and moderate-vigorous physical activity levels.](image)

4. **Discussion**

This study confirmed that these school children spent over half the time in school in sedentary behaviours, which, while high, was less than the 64% of time being sedentary reported in a prior study of 10-12 year olds (n=53)(Abbott et al. 2013). The majority of time in physical activity was at a light level and MVPA was mostly for short bursts; however, sedentary behaviours were demonstrated for epochs of ≥20 minutes. Despite having 1:1 tablet devices available, the majority of in-class time was spent using no ICT, followed by paper-based and then tablet tasks; suggesting a variety of teaching methods and learning tools were utilised in the classroom. Although data collection did not extend beyond time at school, only one of the 38 participants met the guidelines for MVPA during the school day.

The Autographer demonstrated good potential for providing rich information about the nature of the tasks performed by each participant when in sedentary, light and MVPA. Together with self-reported activities and ICT use in the time-use diary, these data provided a context for the physical activity levels measured by the accelerometer among this small sample. However, the Autographer is likely to not be
feasible for large scale studies due to the labour-intensive manual coding of each image captured over the course of the school day.

5. Conclusion
Increasing levels of sedentary behaviour among children who regularly use ICT may result in negative health outcomes. This study utilised three complementary methods to capture the time and context of sedentary behaviours of school children using 1:1 tablet devices in a classroom. These primary school-aged participants engaged in a range of ICT and non-ICT based learning activities in the classroom. Sedentary behaviours extended for periods >20 minute durations, while MVPA was mostly in short bursts. More research is needed to quantify and qualify children’s physical activity and sedentary behaviours to inform future health policy and interventions to minimise health risks.

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References