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Original research

Longitudinal levels and bouts of objectively measured sedentary time among young Australian children in the HAPPY study

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ABSTRACT

Objectives: To examine differences in sedentary time and bouts during and outside of childcare/school periods, and changes in sedentary time and bouts over 1-year among children who remained in childcare (childcare subsample) and among those who transitioned to school (school transition subsample).
Design: Longitudinal study.
Methods: Results are based on 177 children aged 3–5 years at baseline from the Healthy Active Preschool and Primary Years study in Melbourne, Australia. Sedentary time and sedentary bouts (1–4, 5–9, ≥10 min) for total days and during/outside of childcare/school on weekdays were accelerometer-derived at baseline (2008) and 1-year follow-up (2009), when 57% of participants had transitioned to school. Repeated-measures ANCOVAs adjusting for wear time were conducted.
Results: Compared to the outside of childcare/school period, children in the school transition subsample spent more time (0.5 min/day or 0.9% wear time) in ≥10 min sedentary bouts at baseline, participated in 26 more min/day of sedentary time at follow-up, and all participants spent less time (2–16 min/day or 2–3% of wear time) in 5–9 min sedentary bouts at baseline and follow-up during the childcare/school period ($P < 0.05$). Increases in sedentary time (34–54 min/day or 2–3% wear time) and time spent in 1–4 min sedentary bouts (18–29 min/day or 1–2% of wear time) were observed from baseline to follow-up in both the total sample and school transition sub-sample, for total days and during the childcare/school period ($P < 0.05$).
Conclusions: School transition was marked by increased sedentary time. School practices, policies, and environments to reduce sedentary time should be explored.

1. Introduction

Sedentary behavior is defined as any waking behavior characterized by an energy expenditure ≤1.5 METs occurring in a sitting or reclining posture.[1] Accumulating evidence indicates that sedentary behavior is associated with a variety of undesirable health outcomes among preschool children.[2] For example, a recent systematic review found sedentary behavior, primarily screen-based sedentary behavior, was detrimentally associated with adiposity and psychosocial and cognitive development in preschool children (aged 3.0–4.9 years).[2] Thus, targeting sedentary behavior reduction among preschool children has important implications for healthy growth and development.

Sedentary behavior research in preschool children has primarily focused on television viewing[2,3] measured via parental report.[4] While television viewing is a dominant sedentary behavior in young children,[5] it should not be used as a proxy for total sedentary time.[6,7] Low correlations have been reported between television viewing and total sedentary time measured objectively with an accelerometer in older children.[8,9] To date, few studies have assessed accelerometry-derived sedentary time among preschool children.[10] Early evidence suggests preschool children are spending a large proportion of their day sedentary (74–84%), despite assumptions children are naturally active.[11–13] However, it is unknown how preschool children accumulate sedentary time. This is important to understand as emerging research in adults indicates short versus prolonged sedentary bouts may have implications on health, independent of total sedentary time.[14,15] How sedentary time is accumulated may vary by setting, such as the home or the childcare setting.

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Many preschool children attend some form of childcare, including day care and preschool programs. In 2011, 85% of Australian children aged 4–5 years attended a preschool that provides educational and development programs and 40–54% of children aged 2–4 years attended formal care or regulated care outside of the child's home.[16] Similar statistics have been reported in other developed countries.[17] However, neither sedentary time nor sedentary bouts during childcare compared to outside the childcare setting have been reported. This knowledge could inform potential interventions targeting sedentary behavior in preschool children. For instance, if sedentary time is high and is accumulated in prolonged bouts within childcare, future interventions and initiatives should focus on the childcare setting.

The current evidence for sedentary time among preschool children is further limited by the primarily cross-sectional nature of studies.[11,18] Observing increases as well as tracking of sedentary time and sedentary bouts over time would further support the importance of targeting sedentary behavior among preschool children. It is also important to understand how the childcare to school transition impacts young children's sedentary time and sedentary bouts. Sedentary time has been shown to increase during elementary[19] and middle school.[20] Therefore, this knowledge could provide further insight into this behavioral trajectory and the influence of different settings (e.g., childcare vs. school).

The primary objectives of this study were to examine (1) differences in average sedentary time and sedentary bouts during and outside of childcare/school periods and (2) changes in average sedentary time and sedentary bouts over 1-year among children who remain in childcare (childcare subsample) and among those who transition to elementary school (school transition subsample). A secondary objective was to examine the stability of sedentary time and sedentary bouts over 1-year among these two subsamples.

2. Methods

Participants were part of the Healthy Active Preschool and Primary Years (HAPPY) Study. Baseline recruitment and data collection occurred in two waves: July to November, 2008 and May to October, 2009. The present study is based on the 2008 wave, which was followed-up 1-year later in August to December, 2009. For participant recruitment in the 2008 wave, six local government areas were randomly selected in Melbourne, Australia. Two of the areas were in the lowest socio-economic quintile, two were medium, and two were high based on the Socio-Economic Indexes for Areas (SEIFA).[21] A total of 115 centers (including day care and preschools) were randomly selected within these areas and 65 (56.5%) centers agreed to participate. From these centers, 516 parents of 3–5 year old children consented to participate, resulting in a 10.5% response rate. Ethics approval was obtained from the Deakin University Human Research Ethics Committee and the Victorian Department of Education and Early Childhood Development. Informed, written consent was obtained from participating center managers and parents.

Of the 516 participants at baseline, 386 (75%) parents agreed to be contacted regarding further follow-up and 277 (72%) consented for their child to participate in the 1-year follow-up study. There were no significant baseline differences in age, sex, or sedentary time between those who participated and did not participate at follow-up ($P > 0.05$). However, children whose mothers were university educated (66%) were more likely to complete follow-up compared to children whose mothers had not completed secondary school (42%). Also, children whose main caregivers were born in Australia (64%) were more likely to complete follow-up compared to children whose main caregivers were born elsewhere (42%). Follow-up was marked by a transition to elementary school for approximately half the sample.

Demographic characteristics were assessed through a parental questionnaire. Children's age and sex were recorded at both baseline and follow-up. Parental education was assessed at baseline by asking parents what their highest level of schooling was. There were 7 response options ranging from 'no formal qualifications' to 'postgraduate qualifications'. Participants were categorized into three groups: <13 years of schooling, 13 years, and University. Parents' country of birth was also assessed at baseline. Participants were categorized into two groups: Australia and other.

Children's sedentary time was objectively assessed using Actigraph Model GT1M accelerometers. At baseline and follow-up, children were asked to wear the accelerometers during waking hours on a belt positioned over their right hip for seven consecutive days, except when the accelerometer could get wet. Data were collected in 15-s epochs. Non-wear time was defined as ≥10 min of consecutive zeros.[22] Only participants with at least three valid days of data were included in the analyses. A day was considered valid if there was ≥6 h of wear time recorded.[22] A cut point of <100 counts/min or <25 counts/15-s was used to define sedentary time.[23] Sedentary time and sedentary bouts were calculated for total days (weekdays and weekend days). A bout was defined as any continuous, uninterrupted period of sedentary time (<100 counts/min or <25 counts/15-s). Three bout lengths were calculated: 1–4, 5–9, and ≥10 min. Additionally, sedentary time and sedentary bouts were calculated for two periods on weekdays: during childcare/school and outside of childcare/school. Participants were required to have 50% of wear time for the during childcare/school period.

Statistical analyses were completed using SAS version 9.3 [SAS Institute Inc., Cary, NC] and took into account the clustered nature of the data. Repeated-measures ANCOVAs were conducted to examine differences in sedentary time and sedentary bouts between childcare/school periods and outside of childcare/school periods at both baseline and follow-up. Repeated-measures ANCOVAs were also conducted to examine changes in sedentary time and sedentary bouts over the two measurement periods. All ANCOVAs adjusted for wear time when the unit of sedentary time and sedentary bouts was min/day. Finally, the tracking of sedentary time and sedentary bouts were examined by ranking participants at baseline and follow-up and calculating Spearman rank-order correlation coefficients. All analyses were performed for the total sample and sub-samples based on whether participants attended childcare (childcare subsample) or elementary school (school transition subsample) at follow-up. Statistical significance for the ANCOVAs was set at $P < 0.05$.

3. Results

Of the 277 participants who completed follow-up assessments, 177 had sufficient data at both baseline and follow-up to be included in the study. There were no significant baseline differences in age, sex, parental education, or country of birth between participants with complete and incomplete accelerometer data. Participant characteristics are presented in Table 1. The average age was 4.2 (0.7 SE) years at baseline and 5.2 (0.9 SE) years at follow-up. At follow-up, 101(57%) children had transitioned to school.

Wear time was significantly lower at baseline compared to follow-up for total days (636 min/day vs. 676 min/day) and for the childcare/school period (265 min/day vs. 336 min/day) but there were no significant differences for the outside of childcare/school period.

Sedentary time for total days, during childcare/school on weekdays, and outside of childcare/school levels on weekdays for both