Contribution of the School Journey to Daily Physical Activity in Children Aged 11–12 Years

Elissa F. Southward, MSc, Angie S. Page, PhD, Benedict W. Wheeler, PhD, Ashley R. Cooper, PhD

Background: Active travel is a possible method to increase physical activity in children, but the precise contribution of walking to school to daily physical activity is unclear.

Purpose: To combine accelerometer and GPS data to quantify moderate-to-vigorous physical activity (MVPA) on the walk to and from school in relation to overall daily levels.

Methods: Participants were 141 children aged 11–12 years from the PEACH Project (Personal and Environmental Associated with Children’s Health) in Bristol, England, measured between 2008 and 2009. Eighty-four children met the inclusion criteria and were included in the final analysis. Accelerometers measured physical activity, GPS receivers recorded location, and mode of travel was self-reported. Data were analyzed between April and October 2011. Combined accelerometer and GPS data were mapped in a GIS. Minutes of MVPA were compared for school journeys taking place between 8:00AM and 9:00AM and between 3:00PM and 5:00PM and in relation to whole-day levels.

Results: Physical activity levels during journeys to and from school were highly similar, and contributed 22.2 minutes (33.7%) of total daily MVPA. In addition, MVPA on the journey did not differ between boys and girls, but because girls have lower levels of daily physical activity than boys, the journey contributed a greater proportion of their daily MVPA (35.6% vs 31.3%).

Conclusions: The journey to and from school is a significant contributor to MVPA in children aged 11–12 years. Combining GPS and accelerometer data within a GIS is a useful approach to quantifying specific journeys.

Introduction

Increasing physical activity in children is a primary objective for public health. Active travel to school is a potential method of increasing physical activity in children.1,2 However, identifying the contribution of the school journey to physical activity in the context of other activities taking place at a similar time presents a methodologic challenge, because the temporal pattern, location, and level of physical activity need to be measured. Combining GPS and accelerometer data is a relatively new method of assessing the location and level of children’s physical activity in the environment,3–6 but it has been used in only one previous study7 to investigate children’s active travel to school. This study7 showed that primary school children who walked to school recorded 3.8% of their daily moderate-to-vigorous physical activity (MVPA) during the journey to school but did not investigate after-school journeys. The aim of the present study was to use combined accelerometer and GPS data to investigate the contribution that the journey to and from school makes to the physical activity of secondary school-aged children.

Methods

Participants

Data were collected in 2008 and 2009 within the PEACH (Personal and Environmental Associations with Children’s Health) project, a longitudinal study investigating personal and environmental associations with children’s physical activity.8 A University of Bristol Ethics Committee approved the study, and written informed consent was obtained from a parent/guardian of all participating children. In PEACH, 953 adolescents (aged 11–12 years) were mea-
sured in their first year of secondary school, of whom 522 (55%) walked to school. Of these, 141 provided matched accelerometer and GPS data both before and after school, and provide the original sample for the current study; 84 were included in the final analysis.

Measures

Physical activity was measured using accelerometers (Actigraph GT1M) and location was measured using GPS receivers (Garmin Foretrex 201) worn for 3 school days. Both instruments recorded data at 10-second epochs. Travel mode to/from school (walk/cycle/car/bus) was reported in a travel diary. Accelerometer data were processed (Kinesoft v3.3.62) to provide values for total daily MVPA (7:00AM to 11:00PM) using the threshold of ≥2296 counts per minute.9,10 For weekday periods when the GPS was worn (8:00AM–9:00AM and 3:00PM–5:00PM), GPS data were date and time matched to accelerometer data.9 In both cases, continuous periods of 60 minutes of zero values, allowing for up to two interruptions, were classified as accelerometer nonwear time.11,12 A 2-hour window was used for the journey home to account for the varying finish times of the secondary schools.

Figure 1. Combined accelerometer and GPS data points comparing nine pupils’ journeys to and from one secondary school

Note: To-school journeys: 8:00AM–9:00AM; from-school journeys: 3:00PM–5:00PM
Mapping in GIS

Participants’ home and school locations were mapped in a GIS (ARCGIS 9.3) using postal codes. Individual traces from children who walked to school and provided matched accelerometer and GPS data before and after school were inspected visually in GIS (Figure 1 provides an example of nine children from one secondary school). The journey was defined as a continual sequence of data points allowing for an interruption of up to six epochs (1 minute) and with a clear origin and destination within 200 m of the pupils’ home and school. Data points comprising the journeys were segmented manually from “nonjourney” data points using the Select Features tool.

Data Analysis

Independent sample t-tests were used to assess differences in physical activity between genders and distance (<3 km and >3 km). Paired sample t-tests were used to test for differences in physical activity between the journey to school versus the journey from school. Data were analyzed using PASW, version 18.0 (IBM SPSS), between April and October 2011.

Results

Of the 141 participants who provided some matched accelerometer and GPS data before and after school, 84 had data from at least one journey both to and from school that met the accelerometer/GPS inclusion criteria. Overall, 272 journeys to and from school were included in analyses.

Contribution of Journeys to Physical Activity

Based on visual assessment of journeys in GIS, the route taken from home to school was direct, in all but three instances. Similarly, the return journeys followed nearly the same route home as those taken to school in most (130) instances with only minor deviations. There was no difference in MVPA between the journey to and from school (Table 1), with approximately 50% of both journeys being MVPA (10.5 of 20.3 minutes and 11.7 of 22.9 minutes, respectively) and each journey contributing 16%–18% of daily MVPA.

There was no difference in physical activity by gender to and from school. However, all-day MVPA differed between boys and girls (p=0.007; Table 1), and thus the journey contributed a greater proportion to daily MVPA for girls compared with boys (35.6% vs 31.3%). A linear relationship was found between distance walked and MVPA (Figure 2). Children with a round trip of >3 km to school (41%) had higher overall daily MVPA (p<0.001; 73.8 minutes vs 60.2 minutes), and the journey contributed a greater proportion to that daily MVPA (39% vs 28.6%) than those with shorter journeys.

Discussion

The present study shows that in this sample of children aged 11–12 years, walking to school provides an important contribution to weekday MVPA. The contribution of the journey to daily MVPA was greater in the present study than in a previous study in primary school children from London7 (16% vs 3.8%), probably because of the greater distance traveled by the urban, secondary school children in the present sample (0.9 miles vs 0.4 miles). Although distance has been identified as a barrier to active travel,13–15 walking longer distances to school can contribute a greater proportion to weekday MVPA, and a linear association was found between distance walked and MVPA. Overall, the journey to school appeared to be purposeful and direct in secondary school children, similar to the pattern reported in primary school children.

Table 1. Weekday MVPA levels (M [SD]) of secondary school children

<table>
<thead>
<tr>
<th></th>
<th>All day (7:00AM–11:00PM)</th>
<th>To school (8:00AM–9:00AM)</th>
<th>From school (3:00PM–5:00PM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>Total (total MVPA [minutes])</td>
<td>65.7 (25.0)</td>
<td>73.2 (31.4)</td>
<td>61.5 (19.5)</td>
</tr>
<tr>
<td>Journey (total MVPA [minutes])</td>
<td>—</td>
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<td>—</td>
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</tbody>
</table>

MVPA, moderate-to-vigorous physical activity
Although the activity gained during the journey was the same for boys and girls, the contribution walking to school makes to daily physical activity was greater in girls as their daily physical activity was lower than boys. Levels of active travel to school decline through adolescence, and these findings suggest that strategies to maintain or increase active travel to school may be an important public health approach to reducing the decline in physical activity levels seen throughout adolescence but may be particularly important for girls, where the decline is greatest.

To our knowledge, this is the first study to use accelerometry, GPS, and GIS to quantify physical activity during the journey both to and from school. However, there are potential limitations to using GPS. Children were instructed to switch the GPS receivers off at night in order to conserve battery life, and some may have failed to switch the unit on before they left for school or left them switched on, which would have drained the battery. In addition, there is a lag between the GPS connecting with satellites when a person leaves a building, and the GPS signal also may be interrupted by buildings or tree cover. These issues resulted in 30% of participants failing to provide useable journey data and therefore underestimation of journey duration.

**Conclusion**

Combining accelerometry, GPS, and GIS can be used to quantify the duration and physical activity levels of journeys to and from school. The journey to/from school is a major contributor to children’s daily physical activity levels, particularly for girls, highlighting the importance of supporting active travel in secondary school–aged children.

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**References**