Commuting to School

Are Children Who Walk More Physically Active?

Ashley R. Cooper, PhD, Angie S. Page, PhD, Lucy J. Foster, MSc, Dina Qahwaji, MSc

Background: The journey to school is an opportunity for increasing children's daily physical activity. However, the contribution that active commuting to school makes to overall physical activity is unknown. This study used objective measurement to investigate the physical activity patterns of children by mode of travel to school.

Methods: Primary-school children wore an accelerometer programmed to record minute-by-minute physical activity for 7 days and completed a brief questionnaire describing their usual travel to school. The total volume of physical activity and the time spent in activity of at least moderate intensity, as recorded by the accelerometer, was estimated for weekdays and the weekend, and groups of children were compared by mode of transport to school. Data were collected in May/June 2002.

Results: Of the 114 children (59 boys, 55 girls; aged 10.4±0.8 years) who took part in the study, those who walked to school (65%) were significantly more active than those who traveled by car (712.0±206.7 vs 629.9±207.2 accelerometer counts per minute, $p=0.05$). Analysis by gender indicated that the major differences in physical activity between travel groups were seen only in boys. Hourly activity patterns demonstrated that boys who walked to school were more active after school and throughout the evening than were car users.

Conclusions: In boys, walking to school was associated with higher physical activity after school and during the evening. Active transport may contribute to a more physically active profile, at least for boys, supporting walk-to-school initiatives to increase children's physical activity.
(Am J Prev Med 2003;25(4):273–276)

Introduction

There is concern that low levels of physical activity may predispose children to the development of obesity and chronic disease in later life.[1,2] Increasing car use is perceived as a significant contributor to reduced children's daily activity. In the United Kingdom, the proportion of children younger than age 16 years traveling to school by car increased from 16% to 30% between 1985/1986 and 1997/1998, and 38% of primary-school children (aged 5–10 years) are now taken to school by car.[3] The journey to school is a potentially important opportunity for establishing daily physical activity,[4] and many schemes have been introduced at governmental, national, and local levels to promote active transport to school.[5,6] Despite the enthusiasm for such approaches, there is little evidence for the magnitude of the contribution that active commuting to school might make to children's overall physical activity.[7]

Objective monitoring of physical activity provides one approach to investigating this relationship and has recently been used to demonstrate that energy expenditure is greater in adolescents who use active commuting to school.[8] In this study, minute-by-minute accelerometry was used to investigate the physical activity patterns of children who walked to school compared with those who traveled by car.

Methods

Participants

Children for this study were recruited from five urban primary schools in Bristol, England. To provide a representative sample of children, ten schools located in areas of the city where the catchment area would be predominantly from either upper/middle or lower social classes were identified and invited to participate. Three schools were recruited from areas of upper/middle social class (82 children) and two schools from areas of lower social class (89 children). In each school, all children from a single-year group were invited to take part in the study, and written consent was obtained from the children's parent/guardian. Ethical approval was granted

From the University of Bristol, Department of Exercise and Health Sciences, Centre for Sport, Exercise and Health, Bristol, United Kingdom

Address correspondence and reprint requests to: Ashley R. Cooper, PhD, University of Bristol, Department of Exercise and Health Sciences, Centre for Sport, Exercise, and Health, Tyndall Avenue, Bristol BS8 1TP, United Kingdom. E-mail: ashley.cooper@bris.ac.uk.

0749-3797/03/$–see front matter
doi:10.1016/S0749-3797(03)00205-8

Table 1. Mean daily physical activity of primary-school children by mode of travel to school

	Mode of travel to school					
	Walk			Car		
	All (n=74)	Boys (n=37)	Girls (n=37)	All (n=40)	Boys (n=22)	Girls (n=18)
Weekday						
Accelerometer counts per minute	712.0 ± 206.7	813.3 ± 164.2	610.7 ± 196.4	629.9 ± 207.2	647.3 ± 224.9	608.7 ± 187.4
Total daily MVPA (mins)	175.0 ± 48.5	200.6 ± 37.5	149.3 ± 44.9	154.5 ± 53.2	155.7 ± 57.7	153.1 ± 48.8
Total MVPA 8 AM–9 AM (mins)	15.5 ± 6.4	17.0 ± 6.8	14.0 ± 5.7	9.9 ± 3.9	10.2 ± 4.7	9.6 ± 2.7
Weekend						
Accelerometer counts per minute	624.6 ± 306.9	681.8 ± 329.7	567.3 ± 274.9	593.1 ± 268.2	641.9 ± 255.1	533.4 ± 278.8
Total daily MVPA (mins)	160.9 ± 73.9	187.1 ± 81.2	135.6 ± 56.5	153.1 ± 68.5	164.9 ± 66.9	136.6 ± 69.6

MVPA, moderate-to-vigorous physical activity.

by the United Bristol Healthcare Trust Research Ethics Committee, and data were collected in May/June 2002.

Procedure

Physical activity was objectively measured for 7 days using an accelerometer (Manufacturing Technologies Inc. [formerly Computer Science and Applications Inc] model 7164 [MTI/CSA]) programmed to record data every minute. The MTI/CSA is a valid and reliable measure of physical activity in children[9,10] and was worn on an adjustable elastic belt around the waist, positioned above the right hip. Children were asked to wear the monitor during waking hours, except when swimming or bathing. At the end of the measurement period, the accelerometers were downloaded into a personal computer for analysis. Daily travel to school was measured using a brief questionnaire asking how the children usually traveled to and from school (car/cycle/bus/walk) and how long the journey took. Weight was measured using analog scales (SECA) and height using a stadiometer, with the children wearing light indoor clothing and shoes removed.

Data Reduction

Physical activity volume (MTI/CSA counts per minute) and minutes of moderate or greater intensity physical activity (>3 metabolic equivalents [METs]; moderate-to-vigorous physical activity [MVPA]) was calculated for each hour that the accelerometer was worn between 7 AM and 9 PM, since the MTI/CSA was worn infrequently outside of these times. MVPA was calculated using established age-dependent cutpoints for children.[11] To provide a representative picture of weekday activity, including travel to school, children recording fewer than 12 hours of measurement or not recording data between 8 AM and 9 AM on any weekday, or recording fewer than 10 hours on a weekend day, were excluded from the day's computation. Four days of measurement have been shown to be necessary to reliably assess usual physical activity in children, and those with less than three full weekdays and one weekend day of measurement were excluded from all analyses.[10]

Results

All children who were asked to participate in the study (n=171) volunteered to do so, and 141 children completed all measurements. Two accelerometers were found to be faulty, and of the remaining children, 114 (59 boys, 55 girls) fulfilled the criteria for wearing the MTI/CSA. The mean age of the children was 10.4±0.8 years, and this did not differ between travel or gender groups. No significant differences in height or body mass index (BMI) were found between any groups (Boys: height 142.7±7.3 cm; BMI 18.3±2.8; Girls: height 142.1±9.0 cm; BMI 18.7±3.7). Analyzed separately by gender to account for different proportions of the sexes in each school, no significant differences in physical activity (CSA counts per minute) were found between children from each of the schools. Each school contributed children to both of the travel groups, with the proportion traveling by foot ranging between 50% and 78%. None of the schools had a walk-to-school scheme. Children recorded an average of 13.6±0.4 hours of measurement on weekdays and 12.3±1.1 hours at the weekend, with no significant differences between any groups.

Seventy-three children (64%) walked to school, one child cycled, and the remainder traveled by car. The child who cycled to school was classified as using active transport and placed into the "walk" group for analysis. No children in this population traveled to school by bus or train. Three children returned home from school in a different way to that used to travel to school, and were classified by the mode of journey to school. Of those who walked, 42% had a journey of less than 5 minutes, while the majority (81%) of children had a walk of less than 15 minutes. Ninety-seven percent of car journeys were less than 15 minutes, and 53% less than 5 minutes.

Physical activity data are shown in Table 1. Analysis of variance showed that children who walked to school on weekdays were significantly more physically active than those who traveled by car (p=0.05) and also recorded more MVPA (p=0.04). At the weekend, no significant differences were found between the two groups. A significant gender × travel interaction for total physical activity during the week (p=0.03) revealed a large difference in activity levels between boys who walked or traveled by car that was not present in girls.

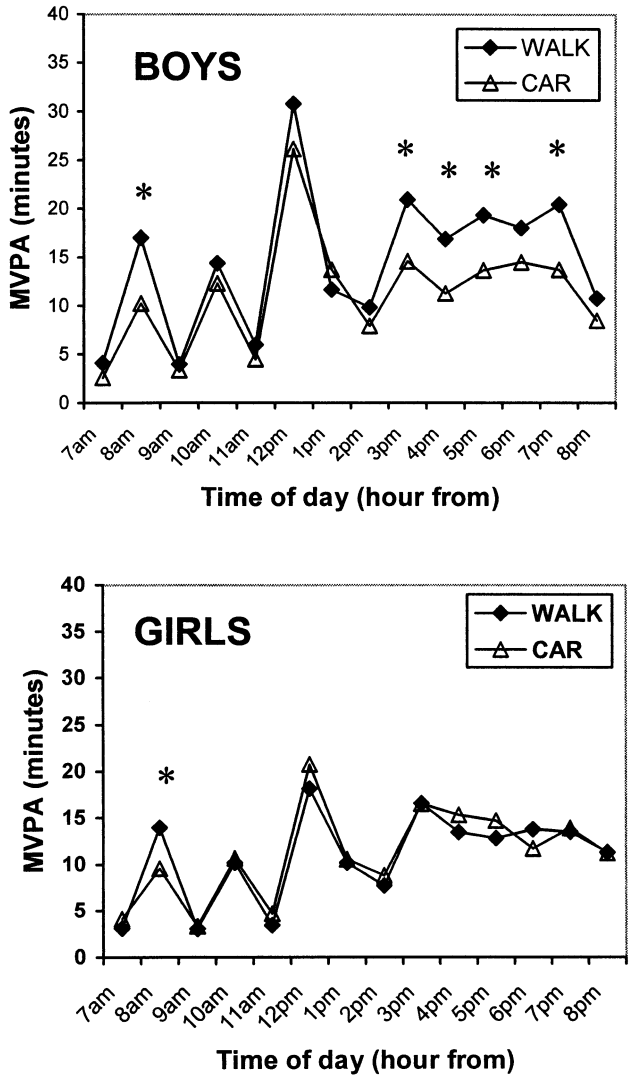

Figure 1. Mean hourly pattern of moderate-to-vigorous physical activity (MVPA) during the week for boys and girls by mode of travel to school.

*Times at which the difference between walk and car groups are statistically significant ($p<0.05$).

The difference in volume of physical activity and in minutes of MVPA between the two groups is greater than accounted for by the journey to and from school. Hourly MTI/CSA data were used to investigate where this difference occurs. Between 8 AM and 9 AM, when the children traveled to school, those who walked recorded approximately 50% more MVPA than those who traveled by car. During the school day (9 AM – 3 PM), no difference in MVPA was found between the groups (64.6±21.3 vs 63.8±23.7 minutes). But after school and during the evening (3 PM – 8 PM), children who walked to school recorded significantly more MVPA (82.8±27.4 vs 69.7±28.4 minutes; $p=0.017$) than those who were driven.

Gender differences in the hourly pattern of MVPA are shown in Figure 1. Both boys and girls who walked to school were significantly more active between 8 AM and 9 AM than those who traveled by car. No significant differences were found between the travel groups during the school day for either gender. However, between 3 PM and 8 PM, boys who walked to school were significantly more active than the car users, recording an additional 30 minutes of MVPA (95.6±24.4 vs 67.7±28.1 minutes; $p=0.000$) while no difference was found between the travel groups for the girls.

Of the children who recorded ≥5 days of measurement ($n=94$), 97.9% of boys and 82.6% of girls met UK physical activity guidelines (at least 60 minutes of MVPA on at least 5 days of the week).[12,13] No difference was found between travel groups in the proportion of children meeting the guidelines.

Discussion

This study is the first to use objective minute-by-minute measurement to investigate differences in the pattern of physical activity between children who walk or are driven to school. In both boys and girls, MVPA was significantly greater between 8 AM and 9 AM in the children who walked to school, the journey to and from school contributing 8–14 minutes per day of MVPA. During school hours, no difference was indicated between the groups for either gender, but a marked gender difference was seen after school. Boys who walked to school accumulated an additional 30 minutes of MVPA per day after school and during the evening compared with those who traveled by car. In contrast, no difference in activity was seen for girls in this period.

The reasons underlying the difference in activity between children who walked to school or traveled by car were not investigated in the present study, and cause and effect cannot be inferred. It is possible that the more highly active boys chose to walk to school, although no difference in physical activity was found between the walkers and nonwalkers at the weekend; further, in this age group, travel decisions are likely to be made by parents. An alternative and intriguing possibility is that active travel may prompt the boys to be more active. This idea is supported by a study using the MTI/CSA accelerometer in 9-year-old children, where after-school activity (3 PM – 7.30 PM) was found to be significantly lower than normal when the children's opportunities for activity during school hours were restricted.[14] Together these data suggest that encouraging physical activity as part of the school day, including the journey to and from school, may also promote higher levels of physical activity after school and in the evening.

The gender difference in this study was surprising. In agreement with previous descriptive studies[15] and studies using the CSA accelerometer,[10,13] the girls in this sample were less physically active than the boys by approximately 20%, and thus differences between

travel groups might be expected to be less pronounced. However, since no difference was seen between travel groups for girls, this may also reflect the different types of activity that boys and girls pursue, with boys taking part in more active play than girls,[16] or may arise through girls having less license to be active. Further investigation is required to describe the after-school and evening activity of children and the social context in which they do these activities.

The accumulation of an extra 45 minutes daily of MVPA by the boys who walked to school is equivalent to approximately 80 kcal per day, assuming a minimum intensity for MVPA of 3 METs and mean weight of 36 kg for the boys. This difference in energy expenditure might be expected to lead to differences in body mass between the two groups over time, but at this age no such difference was seen. Allowing for the strong age-related decline in physical activity reported in other studies,[13,17] the additional energy expenditure by boys who walked to school is similar in magnitude to the 44.2 kcal per day measured with the Caltrac accelerometer in adolescent male Filipino students who used active commuting.[8] In contrast to the present study, female adolescents who used active travel to school were more active than those who used passive means, although the magnitude of difference was smaller.

The evidence that this effect is significant in boys and not girls is potentially important but needs to be verified in larger studies. Although a relatively small sample, the travel patterns of the children in this study were very similar to national figures,[3] with 35% of children being taken to school by car compared with 38% of primary-age children nationally and negligible levels of bicycle use. Similarly, 81% of children in this study had a journey of <15 minutes to school comparable to the national figure of 82% of children having a journey of <1 mile. The large majority of children in this study met UK national guidelines for physical activity, with the proportion meeting these guidelines very similar to that for grades 4–6 children in the United States measured with the MTI/CSA accelerometer.[13] The majority of children exceeded the amount of daily MVPA to the extent that mode of travel to school made no difference to achievement of guidelines. However, as children get older they become less active, raising the possibility that active commuting may be a more-important contributor to daily physical activity in older children and adolescents.

These findings provide evidence that active transport may be reflected in a more physically active profile, at least for boys. Such evidence has been lacking to date and supports walk-to-school initiatives to increase children's physical activity.

This study was supported by a grant from the Health Education Authority of England.

References

1. Goran MI, Reynolds KD, Lindquist CH. Role of physical activity in the prevention of obesity in children. Int J Obes 1999;23(suppl 3):S18–S33.
2. Boreham C, Riddoch C. The physical activity, fitness and health of children. J Sport Sci 2001;19:915–29.
3. Department of the Environment, Transport and the Regions. National travel survey: update 1997/99. London: Her Majesty's Stationary Office, 2000.
4. Sleap M, Warburton P. Are primary school children gaining heart health benefits from their journeys to school? Child Care Health Dev 1993;19:99–108.
5. Rowland D, DiGuiseppi C, Gross M, et al. Randomised controlled trial of site specific advice on school travel patterns. Arch Dis Child 2003;88:8–11.
6. Department of the Environment, Transport and the Regions. School travel strategies and plans: a best practice guide for local authorities. London: Her Majesty's Stationary Office, 1999.
7. Tudor-Locke C, Ainsworth BE, Popkin BM. Active commuting to school. An overlooked source of children's physical activity? Sports Med 2001;31: 309–13.
8. Tudor-Locke C, Ainsworth BE, Adair LS, et al. Objective physical activity of Filipino youth stratified for commuting mode to school. Med Sci Sports Exerc 2003;35:465–71.
9. Trost SG, Ward DS, Moorehead SM, et al. Validity of the Computer Science and Applications (CSA) activity monitor in children. Med Sci Sports Exerc 1998;30:629–33.
10. Trost SG, Pate RR, Freedson PS, et al. Using objective physical activity measures with youth: How many days of monitoring are needed? Med Sci Sports Exerc 2000;32:426–31.
11. Trost SG, Kerr LM, Ward DS, et al. Physical activity and determinants of physical activity in obese and non-obese children. Int J Obes 2001;25:822–9.
12. Biddle S, Sallis JF, Cavill NA. Young and active? Young people and health enhancing physical activity. Evidence and implication. London: Health Education Authority, 1998.
13. Pate RR, Freedson PS, Sallis JF, et al. Compliance with physical activity guidelines: prevalence in a population of children and youth. Ann Epidemiol 2002;12:303–8.
14. Dale D, Corbin CB, Dale KS. Restricting opportunities to be active during school time: do children compensate by increasing physical activity levels after school? Res Q Exerc Sport 2000;71:240–8.
15. Pate RR, Long BJ, Heath GW. Descriptive epidemiology of physical activity in adolescents. Pediatr Exerc Sci 1994;6:434–47.
16. Fox KR, Riddoch C. Charting the physical activity patterns of contemporary children and adolescents. Proc Nutr Soc 2000;59:497–504.
17. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. Med Sci Sports Exerc 2000;32:963–75.