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Differences in adolescents' physical activity from school-travel between urban and suburban neighbourhoods in Metro Vancouver, Canada

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ABSTRACT

Objective. To investigate differences in moderate-to-vigorous physical activity (MVPA) from school-travel between adolescents in urban and suburban neighbourhoods and to describe its relative contribution to MVPA on school days.

Methods. We measured 243 adolescents (51% male, grades 8–10) from Vancouver's walkable downtown core and its largely car-dependent suburb Surrey (fall 2011, 2013). We estimated mean school-travel MVPA from accelerometry (hour before/after school on ≥2 days; $n = 110$, 39% male) and compared school-travel MVPA by neighbourhood type and school-travel mode. The influence of mean school-travel MVPA on mean school-day MVPA (≥600 min valid wear time on ≥2 days) was examined by linear regression.

Results. Over half of students used active modes (urban: 63%, suburban: 53%). Those using active travel and living in the urban neighbourhood obtained the most school-travel MVPA (22.3 ± 8.0 min). Urban passive travellers used public transit and obtained more school-travel MVPA than suburban students (16.9 ± 6.2 vs. 8.0 ± 5.3, $p < 0.001$), who were primarily driven. Regardless of mode or neighbourhood type, over one-third of school-day MVPA was explained by school-travel MVPA ($R^2 = 0.38$, $p < 0.001$).

Conclusion. Urban dwelling may facilitate greater school-travel MVPA in adolescents. School-travel MVPA is an important contributor to adolescents' school-day MVPA. Where feasible, physically active options for school-travel should be promoted, including public transit.

Introduction

Physical activity (PA) is essential for healthy growth and development of children and youth (Janssen and Leblanc, 2010), yet the majority of young Canadians are insufficiently active (Colley et al., 2011). Active travel to school, such as walking or cycling, is an effective way to utilize routine behaviours to enhance levels of PA during the school-day (Tudor-Locke et al., 2001). Active travellers are more active during the commute (Cooper et al., 2003; Sirard et al., 2005) and tend to be more active throughout the school-day than those who use passive modes of travel, such as the car or bus (Larouche et al., 2014).

In recent decades, there has been a disturbing shift away from active modes and towards car travel (Buliung et al., 2009; McDonald, 2007). One influence may be city design (Cervero and Kockelman, 1997): well-connected street grids in urban centres tend to support pedestrian travel, while curvilinear and disconnected street networks commonly found in suburbs may lend themselves to car travel. However, the influence of neighbourhood type (e.g. urban, suburban) on school-travel is unclear. Only two previous studies compared PA from school-travel between neighbourhood types (Stevens and Brown, 2011; Van Dyck et al., 2009), and results were conflicting.

Therefore, our objectives were twofold: (1) to investigate differences in moderate-to-vigorous PA (MVPA) from school-travel ('school-travel MVPA') between adolescents residing in urban versus suburban parts of Metro Vancouver and (2) to assess the contribution of MVPA from school-travel to MVPA acquired during the school-day.

Methods

Participants and protocol

We drew samples from two school-based studies: Health Promoting Secondary Schools (Fall 2011) (Wharf Higgins et al., 2013) and Active Streets, Active People–Junior (Fall 2013). The 'suburban' group

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consisted of students attending three public high schools in Surrey, a Metro Vancouver suburb. Students in the 'urban' group attended the only public high school in downtown Vancouver. Overall, 243 students in grades 8–10 (15.0 ± 0.7 years, 51% male, ~20% response rate) participated. Institutional ethics committees approved the studies; we obtained informed parental consent and student assent.

Measures

To assess PA, students wore an accelerometer (GT1M/GT3X+, ActiGraph LLC, Pensacola, FL; 15 s epoch) over their right hip for one week. Students self-reported their usual school-travel mode, which we grouped into active (walk/cycle/skateboard) or passive (car/public transit) based on ≥6 trips/week. We assessed body mass index (BMI) using standardized methods, which was expressed as age-sex specific percentiles (de Onis et al., 2007).

We geocoded student homes using a Geographic Information System (ArcGIS™, v.10, ESRI®, Redlands, CA) and calculated shortest route to school along the street network. Using residential locations, we assigned median family income at the census dissemination area level (National Household Survey, 2011) and used Street Smart Walk Score® (www.walkscore.com), a composite score of proximity to amenities (e.g. grocery store, restaurants), block size and intersection density, to determine walkability.

Data processing and analyses

To assess school-travel MVPA, we included accelerometry data from the hour before and after school on ≥2 school days ($n = 110$ students, 15.2 ± 0.4 years, 39% male). We estimated school-day MVPA (min/day) for those with ≥600 min of accelerometry data (allowing non-wear ≤60 min of zeros, with ≤2 min spike allowance <100 counts per minute (cpm)) on ≥2 school days (ActiLife v. 6.3.3). Vertical acceleration counts were expressed as cpm and also converted to minutes of MVPA if ≥2296 cpm (Evenson et al., 2008).

We used two-way ANOVA or Kruskal–Wallis tests to investigate between-group differences by mode and neighbourhood type. We used linear regression to examine the contribution of school-travel MVPA to school-day MVPA, adjusting for sex, travel mode and neighbourhood type because of their independent associations with school-travel and/or school-day MVPA ($p < 0.05$; Stata v.10 StataCorp LP, College Station, TX).

Results and discussion

BMI, median family income, and mode were no different between included and excluded students (all $p > 0.05$), but more boys than girls ($\chi^2 = 10.7$, $p < 0.01$), and more urban than suburban students were excluded ($\chi^2 = 13.2$, $p < 0.001$). We provide descriptive statistics (mean ± SD or median and interquartile range) and between-group differences in Table 1.

Urban–suburban differences in school-travel MVPA

Urban students were more likely to report using active modes than suburban students (63% vs. 53%). Active travellers tended to live closer to school than did passive travellers (1.5 ± 1.0 vs. 3.1 ± 0.2 km). This aligns with findings from the Greater Toronto Area (Buliung et al., 2009). Active travellers also engaged in more school-travel MVPA and school-day MVPA than did passive travellers, which is similar to previous reports (Cooper et al., 2003; Sirard et al., 2005). On school days, urban active travellers acquired nearly one-third more MVPA (including school-travel MVPA) than suburban passive travellers (68.5 ± 25.7 vs. 46.7 ± 19.0 min).

Urban students accumulated more school-travel MVPA than suburban students, regardless of school-travel mode. School-travel MVPA among urban active travellers was nearly threefold the amount of suburban passive travellers (22.3 ± 8.0 vs. 8.0 ± 5.3 min), and in urban passive travellers, school-travel MVPA was roughly equivalent to suburban active travellers (16.9 ± 6.2 vs. 16.8 ± 9.7 min). Previous studies that examined school-travel PA and neighbourhood type found mixed results. A study from Utah reported that school-travel MVPA was greater when students lived in walkable compared with less walkable neighbourhoods (Stevens and Brown, 2011). A Belgian study found no differences between urban and suburban walkers (Van Dyck et al., 2009). However, the different composition of school-travel modes in Europe (Cooper et al., 2008; Van Dyck et al., 2010) hampers comparability between Europe and North America.

Table 1
Descriptives by main mode of travel to and from school and in urban vs. suburban neighbourhoods in Metro Vancouver.

		Active travel [a]		Passive travel [a]		
	All	Urban [b]	Suburban [b]	Urban [b]	Suburban [b]	
n (male/female)	110 (43/67)	12 (6/6)	48(20/28)	7(4/3)	43(13/30)	
Age (years)	15.2 ± 0.4	**14.8 ± 0.7**	**15.3 ± 0.4**	**15.0 ± 0.6**	**15.2 ± 0.3**	*,¥
BMI percentile [c]	60.5 ± 30.2	55.3 ± 32.5	61.8 ± 27.1	69.2 ± 28.3	59.1 ± 33.7	
Distance to school (km) [d]	1.7 (1.0-3.0)	**1.1 (1.0-1.5)**	**1.2 (0.9-2.0)**	**2.4 (1.9-8.5)**	**2.9 (1.5-3.7)**	***,†
Walk score [e]	49.5 ± 27.5	**95.3 ± 3.6**	**42.2 ± 19.0**	**91.4 ± 10.3**	**37.6 ± 18.8**	***,¥
Median family income (CDN)[f]	78 K (69 K-91 K)	81 K (76 K-95 K)	75 K (64 K-84 K)	99 K (53 K-123 K)	80 K (71 K-92 K)	
School-day PA intensity (cpm/day) [g]	432.8 ± 143.1	**488.2 ± 166.1**	**462.4 ± 137.9**	**421.5 ± 171.0**	**387.0 ± 130.4**	*
School-day MVPA (min/day) [h]	56.8 ± 23.7	**68.5 ± 25.7**	**63.5 ± 23.9**	**55.4 ± 27.6**	**46.7 ± 19.0**	**,†
School-travel PA intensity (cpm/day) [i]	704.6 ± 380.5	**1083.5 ± 314.2**	**817.3 ± 385.6**	**772.6 ± 243.5**	**462.0 ± 242.0**	***,¥,†
School-travel MVPA (min/day) [j]	13.9 ± 9.3	**22.3 ± 8.0**	**16.8 ± 9.7**	**16.9 ± 6.2**	**8.0 ± 5.3**	***,¥,†

Data are mean ± SD or median (interquartile range).*$p < 0.05$.** $p < 0.01$.*** $p < 0.001$.¥Main effect neighbourhood type (urban vs. suburban).†Main effect travel mode (active vs. passive). Bold in the table indicates significant associations.
[a] Main mode of travel to and from school (≥6 trips/week); active includes walk, bike and skateboard; passive includes car (passenger) and public transit.
[b] Urban: downtown Vancouver; Suburban: City of Surrey (Metro Vancouver region).
[c] BMI = body mass index ($kg \cdot m^{-2}$); percentiles calculated based on age- and sex-specific WHO 2007 reference charts (1).
[d] Shortest distance between residential address (parent-reported) and school along the street network, calculated using geographic information systems software (ArcGIS, ESRI).
[e] Street Smart version of Walks Score® (www.walkscore.com), scored between 0 and 100 (low to high walkability).
[f] Median Family Income at the Census Dissemination Area level (National Household Survey, 2011).
[g] PA intensity—physical activity intensity; cpm—counts per minute; ActiGraph accelerometry (GT3X+ (urban) or GT1M (suburban); worn on hip for 7 days; mean school-day PA calculated if ≥2 school days with ≥600 min valid wear time.
[h] MVPA—minutes spent in moderate-to-vigorous physical activity (Evenson et al., 2008).
[i] PA intensity—physical activity intensity; cpm—counts per minute; mean school-travel PA calculated if ≥2 school days with hour before and after school valid wear time.
[j] MVPA—minutes spent in moderate-to-vigorous physical activity (Evenson et al., 2008); mean school-travel PA calculated if ≥2 school days with hour before and after school valid wear time missing: $n = 1$ BMI; $n = 5$ distance to school, Walk Score® and Median Family Income (no/invalid residential address); $n = 8$ school-day MVPA (no or <2 days with ≥600 min valid wear time each).

Rethinking active travel to school

Among passive travellers, all urban students used public transit, while most suburban students were driven. The urban school catchment was substantially smaller than suburban catchments (4.8 km^2 vs. 12.0–18.4 km^2), and more students lived within urban catchment boundaries (94% vs. 70%). Vancouver's downtown core has been characterized as a walker's paradise (mean Walk Score®: 96) with abundant access to public transit (Transit Score®: 98). Easy access to public transit for urban-dwelling students likely replaced the need for car travel among passive travellers. In contrast, the suburb in our study is generally comprised of more dispersed, car-dependent neighbourhoods (mean Walk Score®: 51, Transit Score®: 44). The greater distance to school likely explains the higher proportion of passive travel. Thus, neighbourhood design and limited access to public transit likely contributed to their higher rates of car travel. Public transit use might be considered a 'walk-interrupted' as per previous reports of higher levels of MVPA in transit than car users during school-travel (Owen et al., 2012). Thus, public transit may represent an 'active' alternative to car travel for students who live greater distances from school.

Contribution of school-travel MVPA to school-day MVPA

Each additional minute of school-travel MVPA was associated with an additional 1.3 minutes of total daily MVPA ($\beta = 1.3$, 95% 0.9–1.8, $p < 0.001$; $R^2 = 0.38$) after controlling for sex, travel mode, and neighbourhood type (Fig. 1; unadjusted model $\beta = 1.5$, 95% 1.1–1.9, $p < 0.001$; $R^2 = 0.33$). Aligned with previous work (van Sluijs et al., 2009), our findings indicate that school-travel MVPA may contribute meaningfully to school-day PA and may support young people meeting PA recommendations in Canada (Colley et al., 2011) and elsewhere.

Strengths and limitations

This is the first study in Western Canada to examine neighbourhood differences in school-travel PA. We acknowledge several limitations. The cross-sectional design prohibited inferring causality; parents may have selected into a certain neighbourhood type. Our relatively small sample size limited our ability to compare MVPA in car versus transit users. Our sample was highly active, which may be due to selection bias. However, if so, self-selection into the study would be similar between neighbourhoods. We did not investigate psychosocial factors, such as motivation, that are likely important for school-travel patterns.

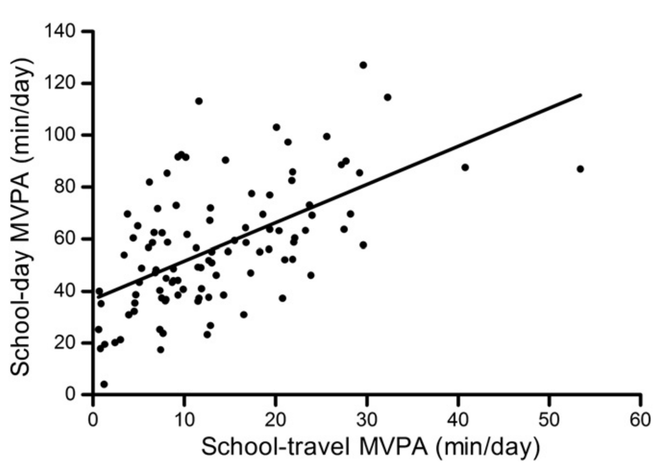

Fig. 1. Relative contribution of school-travel MVPA§ to mean school-day MVPA‡ (includes school-travel MVPA). §School-travel MVPA—minutes spent in moderate-to-vigorous physical activity during school-travel (Evenson et al., 2008); calculated if ≥2 school days with hour before and after school valid wear time. ‡School-day MVPA—minutes spent in moderate-to-vigorous physical activity during the school-day (Evenson et al., 2008); mean school-day PA calculated if ≥2 school days with ≥600 min valid wear time (ActiGraph accelerometry (GT3X+ (urban) or GT1M (suburban); worn on hip for 7 days).

Conclusion

Living in an urban setting may facilitate greater school-travel MVPA in adolescents. Although it is unlikely that neighbourhood type *per se* is solely responsible, it may play a role in the association between school-travel PA and mode choice, specifically relating to public transit use. Regardless, MVPA from school-travel may contribute meaningfully to the total amount of MVPA young people accrue during the school-day. Thus, the school community, including policy makers, should renew efforts to promote active options for school-travel, including public transit.

Conflict of interest

The authors declare that there are no conflicts of interest.

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