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An examination of how changing patterns of school travel mode impact moderate-to-vigorous physical activity among adolescents over time

Erica Y. Lau[a,*], Guy Faulkner[a], Negin Riazi[a], Wei Qian[b], Scott T. Leatherdale[b]

[a] School of Kinesiology, University of British Columbia, Vancouver, BC, Canada V6T 1Z3
[b] School of Public Health and Health System, University of Waterloo, Waterloo, ON, Canada N2L 3G1

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ABSTRACT

Background: This study examined temporal variations in school travel mode and whether these variations predicted changes in moderate-to-vigorous physical activity (MVPA) among adolescents (Grades 9 to 12).

Methods: We analyzed data from Years 1, 2 and 3 of the COMPASS study. Students included in the analysis were those who had provided information on sociodemographic factors, MVPA and school travel modes. A final longitudinal sample included 19,868 participants for the analyses related to travel mode to school (AM period) and 17,678 for the travel mode from school (PM period). The proportion of participants who changed their school travel modes between years was calculated to determine the stability of school travel mode. Linear-mixed models were used to examine whether changes in mode predicted changes in MVPA one year later. These models adjusted for sociodemographic factors as covariates and accounted for the clustering within schools.

Results: Stability in school travel mode was observed for both time periods. Across data collection waves, only 9.3% consistently used an active transportation mode in the AM period and 15.6% in the PM period. Only 2.5% switched from a passive to active mode in the AM period and 3.1% in the PM period, whereas 3.5% switched from an active to passive mode in the AM period and 5.2% in the PM period. No significant association was observed for the AM period. For the PM period, the decrease in MVPA was significantly greater in adolescents who switched from an active to a passive transportation mode than those who remained using a passive transportation mode across years.

Conclusion: School travel makes a contribution to the amount of MVPA youth accumulate during the school week although evidence for this was restricted to those shifting from active to passive modes in the afternoon period.

1. Introduction

Active school transportation (AST), including modes such as walking or cycling (Faulkner et al., 2009), has long been identified as a potential source of habitual physical activity (Tudor-Locke et al., 2001). Additionally, transportation is an integral part of everyday life. Through time, active travel practices may develop into an automatic behavior which is easier to sustain in the long term (Lally

* Correspondence to: Postdoctoral Research Fellow in Physical Activity and Applied Public Health University of British Columbia School of Kinesiology 2146 Health Sciences Mall, Room 4604, Vancouver, BC, Canada V6T 1Z3.

E-mail address: erica.lau@ubc.ca (E.Y. Lau).

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and Gardner, 2013). In the context of declining levels of physical activity among children and youth (Tremblay et al., 2016), an increasing number of studies have focused on the relationship between AST and physical activity, and on interventions to increase AST (Chillon et al., 2011).

Previous work has shown that AST makes direct contributions to children's overall physical activity. A systematic review has reported that accelerometer-measured overall physical activity levels were higher in children who use an active transportation mode for trips to/from schools than those who travel by car or public transport, with the differences of daily moderate-to-vigorous physical activity (MVPA) ranging from 0 to 45 minutes (Larouche et al., 2014). For example, in one recent study, New Zealand adolescent active school travellers accumulated 13 and 14 more minutes of MVPA on weekdays and weekend days, respectively (Stewart et al., 2016). However, most evidence is based on cross-sectional studies.

Another gap in the literature is that previous research has largely focused on elementary school children. This may reflect the typically smaller school catchment areas for elementary school children compared to secondary schools. In turn, this reduces the distance between home and school to a distance considered walkable (or feasible (D'Haese et al., 2011)) by parents and children and youth. Accordingly, research attention has perhaps concentrated on the elementary setting where potentially greater mode shifts to AST may be possible. Studying the effects of AST on physical activity among secondary school aged students is crucial because this is the time at which independent mobility tends to increase (O'Brien et al., 2000). Adolescents are provided with more autonomy to select travel modes to schools and other places, and of course adolescents can obtain a probationary licence to drive (typically at the age of 16 in Canada and 14 in the province of Alberta). Also, physical activity appears to track more strongly from adolescence to adulthood than from childhood to adulthood. Promoting AST during high school may be more influential to active travel practices in adulthood, and thus more likely sustained into early adulthood.

To date, only two investigations have examined longitudinal associations between AST and physical activity in adolescents (Carver et al., 2011; Heelan et al., 2005). These studies demonstrated a positive association between school travel modes and temporal changes in physical activity. One limitation is that both studies only used participants' school travel mode status at a specific time point to predict prospective physical activity. One Canadian study has reported that adolescents' engagement in active travel modes begins to decline after the age of 11 years (Pabayo et al., 2011). Therefore, it is important to account for this temporal variation in school travel modes when estimating the longitudinal associations between school travel modes and physical activity. The objectives of the current study are to examine 1) the prevalence and stability of school travel mode over a 1-year period, and 2) whether changes in AST status predict changes in physical activity across time.

2. Methods

2.1. Sample and population

The COMPASS study is an ongoing prospective cohort study (2012–2021) designed to examine longitudinal associations between school policies and programs with youth health behaviours (i.e. physical activity, healthy eating, smoking, and alcohol and marijuana use) (Leatherdale et al., 2014b). The study collects hierarchical longitudinal data from a convenience sample of secondary schools and the grade 9 to 12 students attending these schools. Extensive details on the COMPASS host study, including sampling, data collection and linkage process, are available online (www.compass.uwaterloo.ca).

The current study utilized linked student-level data from Year 1 (Y1: 2012–2013), Year 2 (Y2:2013-2014) and Year 3 (Y3:2014-2015) of the COMPASS host study. In Y1, data were collected from 24,173 students (80.2% response rate) from 43 Ontario schools. In Y2 (when COMPASS was expanded), data were collected from 45,298 students (80.1% participation rate) in 79 Ontario and 10 Alberta secondary schools (all 43 Y1 Ontario schools remained in Y2). In Y3, data were collected from 42,355 students (79.3% participation rate) in 78 Ontario and 9 Alberta schools who participated in Y2. All eligible grade 9 to 12 students attending these schools were invited to participate in the study and reported data by completing the COMPASS student questionnaire (Cq) annually. Missing respondents resulted primarily from scheduled spares or absenteeism at the time of the Cq, and minimally from student or parent refusal (< 1% annually). The COMPASS study was approved by the Human Research Ethics Board at the University of Waterloo and participating school board committees.

As described elsewhere (Qian et al., 2015), unique self-generated identification codes were used to link data sets for three years and create longitudinal data across Y1, Y2 and Y3. We considered participants who had completed the Cq for at least 2 consecutive years, which resulted in a longitudinal sample of 26,081 participants. Among this group, we further excluded participants who were missing data on PA or school transportation modes, or had inconsistent records on sex or ethnicity across years. A final longitudinal sample of 19,868 was included for the analyses related to transportation mode to school and 17,678 for transportation mode from school, respectively.

2.2. Measures

2.2.1. Physical activity

At each time point, participants were asked to respond to two items on the Cq about how many minutes of vigorous and moderate PA they had done on each of the last 7 days. Vigorous PA was defined as activities that "increase your heart rate and make you breathe hard and sweat," such as jogging, team sports, fast dancing or jump-rope. Moderate PA was defined as "lower intensity activities" such as walking, biking to school and recreational swimming. The responses were then used to construct two PA outcomes. The first was a continuous outcome: the average time spent in MVPA (minutes/day). This outcome was calculated as the total of combined vigorous and moderate PA time divided by 7 days. The second was a binary outcome: whether the participants met the Canadian PA guideline of at least 60 min of MVPA per day. These measures have demonstrated a satisfactory 1-week test-retest reliability (intraclass correlation [ICC] = 0.75). The measures were also significantly correlated with accelerometer-measured behaviours ($r = 0.31$, ICC = 0.25). While correlations between self-report and objective measures were low to modest, the results are comparable to most other studies using accelerometers to validate self-report PA (Leatherdale et al., 2014a).

2.2.2. Transportation modes to/from schools

At each year, participants reported transportation modes to/from school by responding to two questions: *"How do you usually travel to school"* and *"How do you usually travel from school" (If you use two or more modes of travel, choose the one that you spend most time doing)*. The responses options were *1 = "By car (as a passenger)", 2 = "By car (as a driver)" 3 = "By school bus", 4 = "By public bus, subway, or streetcar", 5 = "By walking", 6 = "By bicycling", 7 = "Other", 99 = "Not Stated"*. For each year, participants who responded 1, 2, 3, and 4, were assigned a score of 0 indicating a "passive" school transportation status; those responded 5 and 6 were assigned a score of 1 indicating an "active" school transportation status. Participants who responded 7 = "Other" or 99 = "Not Stated" or had missing values were excluded from the analysis. According to students' response to transportation mode to/from school between two consecutive years, we divided them into 4 school travel mode shifting groups. "0-0" represents the group of students remained using a passive mode across years, "0–1" for shifting from passive to active, "1-0" for shifting from active to passive, and "1-1" for those remained using an active mode across years.

2.2.3. Sociodemographic variables

Students also reported age in years or grade, and ethnicity. Grade at year 1 was measured as a categorical variable with 4 categories. Ethnicity was a categorical variable with six categories: White, Black, Asian, Aboriginal (First Nations, Métis, Inuit), Latin American/Hispanic, and other. Urbanity was also included as one of the covariates as it has been found to be significantly associated with school transportation mode. Students were classified as living in rural, small urban, medium urban, and large urban area based on their school location. By linking school location to the 2011 Canadian Census data, we classified the participating schools into 1 = rural (with a population of less than 1000 or a density of less than 400 people per square kilometre), 2 = small urban (with a population of between 1000 and 29,999), 3 = medium urban (with a population of between 30,000 and 99,999) and 4 = large urban (with a population of 100,000 and over).

2.3. Statistical analysis

Descriptive statistics were calculated for all the study variables and the differences between participants included and excluded were compared. Preliminary analyses were conducted to explore the bivariate relationship between each covariate and the dependent variable, and all significant variables ($p < .05$), were retained for the longitudinal analyses.

The proportion of participants in the four mode shifting groups across years was calculated to determine the stability of AST status. Linear-mixed models were used to examine whether mode shifting predicted change in MVPA one year later. These models were stratified by time-period (i.e., morning = AM and afternoon = PM), with a 1-year change in MVPA entered as a dependent variable, mode shift group as the independent variable, and sociodemographic variables as covariates (i.e., sex, race/ethnicity and urbanity), and accounting for the clustering within schools. To meet the normality assumption, we performed a squared root transformation on the average MVPA minutes per day. All analyses were conducted using the statistical software package SAS 9.4 (Cary, NC). The procedure PROC MIXED was used for the linear mixed-effects models. Residual and studentized residual plots were used to confirm model assumptions and fit. Statistical significance was set at $p < 0.05$ for all analyses.

3. Results

Descriptive statistics of the study variables are presented in Table 1. The included sample is significantly different from the excluded sample in terms of age, gender, race/ethnicity, grade, urbanity, MVPA and school travel mode. Changes in travel mode over one year are presented in Table 2. Stability in travel mode over time observed for both time periods. Approximately 85% and 77% of the participants remained using a passive transportation mode across years in the AM and PM periods, respectively. Approximately 3% of the participants shifted from a passive to an active transportation mode and 4%-5% switched from an active to a passive transportation mode. Sociodemographic characteristics of participants in each group are shown in Table 3. Participants in all four groups in the AM period are similar in terms of composition of gender, race/ethnicity and urbanity. In each group, participants were more likely to be girls, white, and living in large urban areas. This pattern was consistent in the PM period.

Results for the mixed-effect models are presented in Table 4. For the AM period, there was no statistically significant association between travel mode group and changes in MVPA over a 1-year period after controlling for sociodemographic covariates (i.e., sex, race and urbanity). For the PM period, the decrease in MVPA decreased was significantly greater in adolescents who switched from an active to a passive transportation mode than those who remained using a passive transportation mode across years. In addition to dichotomizing school travel mode into active versus passive, post-hoc analyses were conducted to examine whether participants' switching between taking school bus and driving predicts changes in MVPA across time. Results from the post-hoc analyses revealed no statistically significant associations (data not presented).

Table 1
Differences in the year 2 characteristics of the included and excluded participants, COMPASS study 2012/13 to 2014/15, Mean ± SD or n (%).

Variable	AM			PM		
	Included (n = 19,868)	Excluded (n = 6213)	*p*-value*	Included (n = 17,678)	Excluded (n = 8403)	*p*-value*
Age, Mean ± SD	15.40 ± 1.18	15.43 ± 1.12	0.1840	15.40 ± 1.1	15.45 ± 1.18	0.0002
Sex[a], n (%)			< .0001			< .0001
Girls	10,786(54.3)	2905(47.1)		9766(55.2)	3925(46.9)	
Boys	9082(45.7)	3268(52.9)		7912(44.8)	4438(53.1)	
Race/Ethnicity, n (%)			< .0001			< .0001
White	15,453(77.8)	4508(72.6)		13,760(77.8)	6202(73.7)	
Black	608(3.1)	306(4.9)		497(2.8)	417(5.0)	
Asian	1016(5.1)	335(5.4)		942(5.3)	409(4.9)	
Aboriginal	483(2.4)	207(3.3)		397(2.3)	293(3.5)	
L. Am./Hisp.	360(1.8)	148(2.4)		329(1.9)	179(2.1)	
Others/Mixed/Missing	1948(9.8)	708(11.4)		1753(9.9)	903(10.8)	
Grade, n (%)			< .0001			< .0001
9	5641(28.4)	1851(29.8)		5059(28.6)	2433(29.0)	
10	6246(31.4)	1860(29.9)		5617(31.8)	2489(29.6)	
11	5387(27.1)	1548(24.8)		4756(26.9)	2179(25.9)	
12	25.94(13.1)	954(15.5)		2246(12.7)	1302(15.5)	
Urbanity			0.1278			0.0011
Large	10,602(53.4)	3355(54.0)		9579(54.2)	4378(52.1)	
Medium	3152(15.7)	911(14.7)		2742(15.5)	1294(15.4)	
Small /Rural	6141(30.9)	1947(31.3)		5357(30.3)	2731(32.5)	
MVPA (min/d), Mean ± SD	59.64 47.0	37.0448.74	< .0001	59.0 ± 46.6	45.49 ± 50.63	< .0001
School travel mode			< .0001			< .0001
AM[b], n (%)						
Passive	17,352(87.3)	4897(89.7)		15,294(87.2)	6955(89.3)	
Active	2516(12.7)	562(10.3)		2246(12.8)	832(10.7)	
PM[c], n (%)			< .0001			< .0001
Passive	14,760(80.0)	4320(84.4)		14,092(79.7)	4988(84.6)	
Active	3700(20.0)	796(15.6)		3586(20.3)	910(15.4)	

Abbreviations: AM = morning period; L. Am./Hisp = Latin American/Hispanic; min/d = minutes per day; MVPA = moderate-to-vigorous physical activity; PA = physical activity; PM = afternoon period.
[a] 40 students were not included because of missing or inconsistent sex information.
[b] 754 students did not have AST-AM information in 2013/2014.
[c] 2505 students did not have AST-PM information in 2013/2014
* *p*-value < 0.05 indicates the included and excluded participants were significantly different in a given variable.

4. Discussion

As expected in the Canadian context (Barnes et al., 2016), only a minority of youth in the sample engaged in AST to (15%) or from school (23%). The prevalence was lower than a 2009 provincially representative survey of 3633 students in grades 7 through 12 in Ontario. The corresponding figures were 23% and 32% for secondary school students (Wong et al., 2011). As a North American comparison, these rates of AST are higher than those reported in the United States. McDonald et al. (2011) reported that 7.5% of grades 9–12 students walked or biked to school in 2009. Notably, school travel mode was very stable in the current sample suggesting school travel mode has been firmly established by grade 9, and this may have other repercussions for reduced active travel beyond the school context (Stewart et al., 2016).

Although mode shifting over the year was relatively rare (3–5%), our findings contribute to the evidence base that school travel is a meaningful source of physical activity. In this case, there was a significant decrease in MVPA among youth who shifted to passive modes of school travel in the afternoon period. The finding that this association was only in the afternoon period is likely related to the morning-afternoon mode shift typically seen in the literature where more children and youth use active travel in the afternoon period (e.g., Wong et al., 2011). As caregivers may be employed there may be a need to find an alternative way to get home with

Table 2
Distribution of shifts in school travel mode over a 1-year period.

School travel mode shifting groups		AM n = 23180	PM n = 20468
Passive-Passive	(0-0)	84.7%	76.1%
Passive-Active	(0–1)	2.5%	3.1%
Active-Active	(1-1)	9.3%	15.6%
Active-Passive	(1-0)	3.5%	5.2%

Abbreviations: AM = morning period, PM = afternoon period

Table 3
Distribution of students in gender, urbanity and ethnicity, by school travel mode shifting groups.

	AM n (%)				PM n (%)			
	0-0 (n = 19624)	0–1 (n = 576)	1-0 (n = 815)	1-1 (n = 2165)	0-0 (n = 15573)	0–1 (n = 624)	1-0 (n = 1074)	1-1 (n = 3197)
Gender								
Girls	10,950(55.8)	295(51.2)	390(47.9)	1059(48.9)	8892(57.1)	324(51.9)	559(52.1)	1639(51.3)
Boys	8674(44.2)	281(48.8)	425(52.1)	1106(51.1)	6681(42.9)	300(48.1)	515(48.0)	1558(48.7)
Urbanity								
Large	10,923(55.7)	319(55.4)	390(47.9)	1190(55)	8751(56.2)	354(56.7)	531(49.4)	1845(57.7)
Medium	3043(15.5)	69(12.0)	129(15.8)	280(12.9)	2440(15.7)	69(11.1)	155(14.4)	395(12.4)
Small/Rural	5658(28.8)	188(32.6)	296(36.3)	695(32.1)	4382(28.1)	201(32.2)	388(36.1)	957(29.9)
Race/Ethnicity								
White	15,489(78.9)	375(65.1)	595(73.0)	1590(73.4)	12,358(65.9)	411(74.4)	799(74.0)	2366(74.0)
Black	538(2.7)	29(5.0)	35(4.3)	101(4.7)	365(3.9)	24(4.1)	44(4.2)	134(4.2)
Asian	913(4.7)	58(10.1)	61(7.5)	194(9.0)	716(10.3)	64(6.2)	67(8.9)	285(8.9)
Aboriginal	418(2.1)	20(3.5)	29(3.6)	62(2.9)	318(4.0)	25(2.3)	25(2.0)	65(2.0)
L.Am./Hisp.	361(1.8)	15(2.6)	14(1.7)	30(1.4)	289(2.7)	17(1.9)	20(1.7)	54(1.7)
Others/Mixed	1905(9.7)	79(13.7)	81(9.9)	188(8.7)	1527(13.3)	83(11.1)	119(9.2)	293(9.2)

Abbreviation: AM = morning period, L. Am./Hisp = Latin American/Hispanic; L. Urban = Large Urban; M. Urban = Medium Urban; S. Urban = Small Urban PM = afternoon period;
Note: School travel mode shifting group: 0-0 = Passive-Passive, 0–1 = Passive-Active; 1-1 = Active-Active; 1-0 = Active-Passive

some children and youth adopting active modes of travel home when the distance is feasible. These factors contribute to an increase in AST commonly seen in Ontario of at least 10% as we report and others have found (Wong et al., 2011). When youth shift to passive modes, in this case, for unknown reasons, then this source of physical activity is removed from the day, which we speculate is the reason for the significant decline in MVPA. More broadly, the present study reinforces the need to consider the temporality of school travel, the mode shift, as interventions might be more effective when targeting either the morning or afternoon periods.

Taken together, our findings suggest that there is a missed opportunity in not attempting to intervene at the secondary school context. The most recent systematic review of AST interventions identified 14 interventions that all focused on children (from age 5 to 12 years) and were set in elementary schools (Chillon et al., 2011) although one study also included adolescents from middle school to age 15 years (Staunton et al., 2003). Given the spatial, temporal and age-related variations in school travel mode it is unlikely that 'one size fits all' interventions will be effective in promoting AST in this context (Wong et al., 2011). Rather, the use of school travel planning may be appropriate. School travel planning is a multi-disciplinary, multi-sectoral, school-specific intervention that engages

Table 4
Longitudinal associations between school travel mode shifting group and moderate-to-vigorous physical activity over a 1-year period.

	AM			PM		
Effect	Est	SE	Pr > |t|	Est	SE	Pr > |t|
Intercept	−0.14	0.05	0.0099	−0.16	0.05	0.0049
School travel mode shifting group						
0–1	0.24	0.14	0.0774	0.17	0.13	0.2021
1-0	−0.20	0.12	0.0793	**−0.21**	**0.10**	**0.039***
1-1	0.11	0.07	0.1581	0.08	0.06	0.2369
0-0	REF	–	–	REF	–	–
Sex						
Girls	0.14	0.04	0.0009	0.11	0.05	0.013
Boys	REF	–	–	REF	–	–
Race/Ethnicity						
Black	−0.27	0.13	0.0369	−0.24	0.14	0.0921
Asian	−0.13	0.10	0.1847	−0.14	0.10	0.1727
Aboriginal	−0.22	0.15	0.1401	−0.19	0.16	0.2279
L. Am./Hisp	−0.17	0.16	0.2963	−0.15	0.17	0.3659
Others/Mixed	0.03	0.07	0.7217	0.09	0.08	0.2292
White	REF	–	–	REF	–	–
Urbanity						
Small/Rural	0.08	0.07	0.2434	0.11	0.07	0.1405
Medium	0.25	0.09	0.0048	0.26	0.09	0.0053
Large	REF	–	–	REF	–	–

Abbreviation: AM = morning period, L. Am. /Hisp = Latin American/Hispanic; PM = afternoon period
Note: School travel mode shifting group: 0-0 = Passive-Passive, 0–1 = Passive-Active; 1-1 = Active-Active; 1-0 = Active-Passive
Models adjusted sex, race/ethnicity and urbanity as covariates and accounting for the clustering within schools.
Bold-faced indicated significantly different from the reference group
* Statistical significance was set at $p < 0.05$

key stakeholders (e.g., STP facilitator, public health, police officials, municipal planners and traffic engineers, school boards, parents, youth, school administrators and teachers) in the survey, implementation and evaluation of school travel issues (Green Committee Canada, 2007). Such an approach has been successfully implemented in elementary schools in Canada (Mammen et al., 2014a; Mammen et al., 2014b), and has been piloted in 7 secondary schools in Ottawa, Canada (Green Communities Canada, 2012). Given the greater distances between home and school for secondary students (e.g., average distance of 3.6 miles for elementary children and 5.5 miles for high school students in the United States (McDonald et al., 2011)), it is likely that such plans will need to incorporate transit-related activity (Durand et al., 2016; Voss et al., 2015) and approaches to encourage and support safe cycling (Yang et al., 2010).

There are a number of limitations to the study. First, dichotomizing mode share into active and passive is a limitation as the determinants and consequences of different modes (e.g., walking versus cycling; taking public transit versus being driven) are important. For example, it is likely that the use of public transit is associated with similar levels of activity accrued through just walking trips (Voss et al., 2015). In our post-hoc analyses, we investigated whether participants' switching between taking school bus and driving predicts changes in MVPA across time, but no statistically significant association was found. Second, the study was limited in that all measures were self-reported and physical activity assessment is particularly prone to reporting error. These limitations should be considered in light of the strengths of the study. With a longitudinal study design, any potential reporting bias is expected to be consistent between waves, so we should still be able to make valid conclusions. The large sample size of this study increased the precision of population parameter estimations, which is important for informing public health policies.

School travel makes a contribution to the amount of MVPA youth accumulate during the school week although evidence for this was restricted to those shifting from active to passive modes in the afternoon period. Surprisingly little research has addressed how high school students get to and from school nor implemented and evaluated interventions to promote AST. This is an important policy and practice gap that needs closer attention in supporting more active and sustainable transport choices that could carry on into early adulthood.

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References

Barnes, J.D., Cameron, C., Carson, V., Chaput, J.P., Faulkner, G.E., Janson, K., Janssen, I., Kramers, R., LeBlanc, A.G., Spence, J.C., Tremblay, M.S., 2016. Results from Canada's 2016 ParticipACTION report card on physical activity for children and youth. J. Phys. Act. Health 13, S110–S116.
Green Committee Canada, 2007. Active and Safe Route to School: School Travel Planning Toolkit.
Carver, A., Timperio, A.F., Hesketh, K.D., Ridgers, N.D., Salmon, J.L., Crawford, D.A., 2011. How is active transport associated with children's and adolescents' physical activity over time? Int. J. Behav. Nutr. Phys. Act. 8, 126.
Chillon, P., Evenson, K.R., Vaughn, A., Ward, D.S., 2011. A systematic review of interventions for promoting active transportation to school. Int. J. Behav. Nutr. Phys. Act. 8, 10.
D'Haese, S., De Meester, F., De Bourdeaudhuij, I., Deforche, B., Cardon, G., 2011. Criterion distances and environmental correlates of active commuting to school in children. Int. J. Behav. Nutr. Phys. Act. 8, 88.
Durand, C.P., Pettee Gabriel, K.K., Hoelscher, D.M., Kohl 3rd, H.W., 2016. Transit use by children and adolescents: an overlooked source of and opportunity for physical activity? J. Phys. Act. Health. 13, 861–866.
Faulkner, G.E., Buliung, R.N., Flora, P.K., Fusco, C., 2009. Active school transport, physical activity levels and body weight of children and youth: a systematic review. Prev. Med. 48, 3–8.
Green Communities Canada, 2012. High School Pilot Project.
Heelan, K.A., Donnelly, J.E., Jacobsen, D.J., Mayo, M.S., Washburn, R., Greene, L., 2005. Active commuting to and from school and BMI in elementary school children-preliminary data. Child Care Health Dev. 31, 341–349.
Lally, P., Gardner, B., 2013. Promoting habit formation. Health Psychol. Rev. 7, S137–S158.
Larouche, R., Saunders, T.J., Faulkner, G., Colley, R., Tremblay, M., 2014. Associations between active school transport and physical activity, body composition, and cardiovascular fitness: a systematic review of 68 studies. J. Phys. Act. Health. 11, 206–227.
Leatherdale, S., Laxer, R., Faulkner, G., 2014a. Reliability and validity of physical activity and sedentary behavior measures in the COMPASS study, COMPASS Technical Report Series. Waterloo, ON.
Leatherdale, S.T., Brown, K.S., Carson, V., Childs, R.A., Dubin, J.A., Elliott, S.J., Faulkner, G., Hammond, D., Manske, S., Sabiston, C.M., Laxer, R.E., Bredin, C., Thompson-Haile, A., 2014b. The COMPASS study: a longitudinal hierarchical research platform for evaluating natural experiments related to changes in school-level programs, policies and built environment resources. BMC Public Health 14, 331.
Mammen, G., Stone, M.R., Buliung, R., Faulkner, G., 2014a. School travel planning in Canada: identifying child, family, and school-level characteristics associated with travel mode shift from driving to active school travel. J. Transp. Health 1, 288–294.
Mammen, G., Stone, M.R., Faulkner, G., Ramanathan, S., Buliung, R., O'Brien, C., Kennedy, J., 2014b. Active school travel: an evaluation of the Canadian school travel planning intervention. Prev. Med. 60, 55–59.
McDonald, N.C., Brown, A.L., Marchetti, L.M., Pedroso, M.S., 2011. U.S. school travel, 2009 an assessment of trends. Am. J. Prev. Med. 41, 146–151.
O'Brien, M., Jones, D., Sloan, D., Rustin, M., 2000. Children's independent spatial mobility in the urban public realm. Childhood 7, 257–277.
Pabayo, R., Gauvin, L., Barnett, T.A., 2011. Longitudinal changes in active transportation to school in canadian youth aged 6 through 16 years. Pediatrics 128, e404–e413.
Qian, W., Battista, K., Bredin, C., Brown, K.S., Leatherdale, S.T., 2015. Assessing longitudinal data linkage results in the COMPASS study, COMPASS Technical Report Series. University of Waterloo, Waterloo, Ontario.
Staunton, C.E., Hubsmith, D., Kallins, W., 2003. Promoting safe walking and biking to school: the Marin County success story. Am. J. Public Health. 93, 1431–1434.

Stewart, T., Duncan, S., Schipperijn, J., 2016. Adolescents who engage in active school transport are also more active in other contexts: a space-time investigation. Health Place 43, 25–32.
Tremblay, M.S., Barnes, J.D., Gonzalez, S.A., Katzmarzyk, P.T., Onywera, V.O., Reilly, J.J., Tomkinson, G.R., 2016. Global matrix 2.0: report card grades on the physical activity of children and youth comparing 38 countries. J. Phys. Act. Health. 13, S343–S366.
Tudor-Locke, C., Ainsworth, B.E., Popkin, B.M., 2001. Active commuting to school. Sports Med. 31, 309–313.
Voss, C., Winters, M., Frazer, A., McKay, H., 2015. School-travel by public transit: rethinking active transportation. Prev. Med. Rep. 2, 65–70.
Wong, B.Y., Faulkner, G., Buliung, R., Irving, H., 2011. Mode shifting in school travel mode: examining the prevalence and correlates of active school transport in Ontario, Canada. BMC Public Health 11, 618.
Yang, L., Sahlqvist, S., McMinn, A., Griffin, S.J., Ogilvie, D., 2010. Interventions to promote cycling: systematic review. BMJ 341, c5293.