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

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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

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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