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Direct observations of active school transportation and stroller use in kindergarten children

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ABSTRACT

Little is known about kindergarten students' active school transportation (AST) and stroller/wagon use as sedentary travel devices. The primary objective of this cross-sectional study was to determine the prevalence of kindergarten children arriving to school by active and sedentary modes, including strollers, in Toronto elementary schools and compare to students in kindergarten to grade 6 (K–6). The secondary objective was to examine factors associated with AST in kindergarten and K–6 students. School travel mode was counted using direct observations at elementary schools in the City of Toronto in 2015. Two samples were observed: 1) Kindergarten sample: a random sample of schools with separate kindergarten entrances ($n = 26$ schools, 1069 children); 2) Kindergarten to grade 6 sample: observations were conducted at arrival locations at 50% of eligible elementary schools for students of all ages ($n = 88$ schools, 17,224 children). Proportions arriving by different travel modes were compared using Chi-square analysis. Negative binomial regression was conducted to examine the association between school characteristics and AST. AST was lower in the kindergarten compared to the K–6 sample (60% versus 74%, $\chi^2 = 91.37$, $p < 0.001$). The predominant sedentary mode for kindergarten students was by vehicle (38%), with <2% using strollers/wagons. Recent immigrant status was related to higher AST in kindergarten students; higher social disadvantage, crossing guards, school population and collision rates were related to higher AST in the K–6 sample. Factors influencing AST in young students require further investigation to influence the development of healthy active lifestyles at an early age.

1. Introduction

Active school transportation (AST), including walking, cycling, scootering, skateboarding etc., is a form of physical activity (PA) that should be encouraged among children. Physical activity is not only associated with positive physiological health outcomes in children and youth but there is also evidence of positive impacts on physical health, cognitive function, academic performance and mental health (Active Healthy Kids Canada, 2013; Carson et al., 2014; Singh et al., 2012; Rasberry et al., 2011; Hillman et al., 2009). PA in childhood has also been related to PA in adulthood (Malina, 1996; Janz et al., 2000; Telama et al., 2005). AST is an ideal source of PA for children, as all children make the daily commute back and forth to school. Systematic literature reviews have found AST is associated with higher levels of PA (Faulkner et al., 2009; Larouche et al., 2014). Although the direct relationship between AST and health outcomes are difficult to establish in children as many of the benefits may not be apparent until years later, there is consistent support for positive effects of active travel generally on health over longer periods and distances (Saunders et al., 2013). AST in young kindergarten aged children is important, as lifelong PA and exercise attitudes and habits may be established in early childhood (Malina, 1996; Telama et al., 2005; Dennison et al., 1988). AST in kindergarten students has also been associated with healthy trajectories of BMI in early school years (Pabayo et al., 2010). In addition to the potential health benefits of AST, there are other transportation and societal benefits including; reduced traffic congestion, road traffic collisions, air and noise pollution and crime, and more community cohesion (Active Healthy Kids Canada, 2013; Saunders et al., 2013; Toronto Public Health, 2012).

Rates of self reported AST in Canadian children are low and have decreased over time (Active Healthy Kids Canada, 2013; Buliung et al.,

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2009). Only 24% of 5–17 year olds are reported to use only AST and 14% use both of active and inactive modes of transportation (Active Healthy Kids Canada, 2013). From 1986 to 2011, walking to school in 11–13 year olds in the Greater Toronto Area decreased from 59% to 45%; a decrease of 24% (Smart Commute, 2015). It is suspected that many kindergarten children travel to school by sedentary means including motor vehicles and strollers or wagons. Stroller use is of particular interest for young children, as the American Academy of Pediatrics, Canadian Society for Exercise Physiology and the Institute of Medicine have recommended young children have limited use of strollers, which are considered sedentary devices that restrain movement and limit PA (Canadian Society for Exercise Physiology, 2011; McCambridge et al., 2006; Birch et al., 2011; Gunner et al., 2005). The AAP guidelines specifically recommend that stroller use be limited in kindergarten age children (ages 4–6) (McCambridge et al., 2006).

Although there have been two previous studies of elementary school-age children examining AST using direct observational counts done, neither have specifically focused on kindergarten students or measured stroller use (Rothman et al., 2013; Sirard et al., 2005). There have also not been any previous such studies examining AST specifically in kindergarten students in Canada. There is a reported trend towards increased stroller use in older children; however, it is unknown how many older children use strollers specifically for school transport (Hutchison, 2011). Therefore, the primary objective of the study was to determine the prevalence of kindergarten children arriving to school by active modes and sedentary modes, including strollers, in Toronto elementary schools and compare this to students in K–6. The secondary objective was to examine covariates associated with AST in kindergarten and K–6 students.

2. Methods

A cross sectional observational study examining school transportation modes and stroller use was conducted in May–June 2015 at public kindergarten to grade 6 schools in the city of Toronto, Canada. Observational counts were conducted using similar methodology as a previous published observational cross-sectional study conducted in 2011; the first to establish the feasibility and reliability of using direct observational counts of children's mode of school transport (Rothman et al., 2013). Child travel mode counts were collected using a standardized checklist by trained observers during morning dropoff times. Active modes counted were walking, cycling, scootering, skateboarding etc. Sedentary modes counted were vehicles, strollers, wagons and bike seats. Data collection occurred during the 20 min before and 5 min after the school bell rang, on school days when there was no rain. Exclusion criteria for this study included; 1) school with grade combinations that include grades ≥7); 2), French immersion schools which accept children from outside the school's attendance boundaries 3) schools involved in other AST-related studies and; 4) children arriving by school bus who were excluded from the counts as they had met the Toronto District School Board's (TDSB) busing eligibility criteria due to their residence being further than board-identified walking distance from the school (grades JK–5 living ≥1.6 km, grades 5+ who live ≥3.2 km), or had mobility needs related to disability or a medical condition (Toronto District School Board, 2005). Our previous study of TDSB schools found that school attendance boundaries are small, with 75% of JK–6 school areas <1.3 km^2on average (Rothman et al., 2013), Generally, 95% of road within school attendance boundaries were within 1.6 km of the school along the road network (SD 0.10) (Rothman et al., 2013).

Two school samples were used for these analyses: 1. Kindergarten sample: a random sample of approximately 25% ($n = 50$) of eligible elementary schools with separate kindergarten entrances. Of these schools, only those where all modes of transportation could be observed were include in the analysis ($n = 26$). Transportation mode counts were conducted by a single trained observer outside the kindergarten entrances. 2. Kindergarten to grade 6 sample (K–6): the sample of schools in this study included schools from a larger case control study; case schools were identified as schools within the highest quartile of child pedestrian motor vehicle collisions within school attendance boundaries, and controls were within the lowest quartile. As a result transportation mode counts were conducted at approximately 50% of eligible elementary schools for all students (K–6). Two trained observers stood at two different locations to complete AST counts. These locations were identified by school administrators as optimal for viewing modes of transportation for all arriving students. Observers were instructed to position themselves at the locations to prevent counting the same students, and communicated with each other to indicate who should count students that were within both vantage points. Observers were requested to rate their level of confidence in their counts, and where confidence was <90% a second count was conducted on a separate day. This methodology was previously tested, and demonstrated high test-retest reliability (Pearson's $r = 0.96$) (Rothman et al., 2013) Schools that had 2 observers for K–6 and also an observer at separate kindergarten entrances and overlapped between the two samples were excluded from further analysis.

Principals from all eligible schools were sent an introductory letter with a consent for participation form. Ethics approval was obtained from the Hospital for Sick Children Research Ethics Board, The Toronto District School Board, and York University's Office of Research Ethics.

2.1. Prevalence estimates

The proportions of children using active school transportation (AST) versus sedentary means including strollers were calculated using the total number of students counted as the denominator.

2.2. Covariates

There were several school characteristics examined to determine their association with AST, including social disadvantage, immigration status, collision status, and presence of a school crossing guard Social disadvantage was measured by the TDSB using the learning opportunities index (LOI). This index is a composite index including parental income, education, immigration and housing. The score ranges from 0 to 1, with 0 indicating less social disadvantage (Toronto District School Board, 2014). Information regarding the total numbers of children attending a regular program at their home school (i.e. not special education), the proportions of children at the school who had immigrated 5 years or less prior was provided by the TDSB. The presence of a school crossing guard near the school was identified by Toronto Police school crossing guard data, which had been found to be an important predictor in our previous study (Rothman et al., 2013). Presence of a crossing guard was only assessed at the K–6 schools where there were several observers collecting data. A variable indicating high collision schools was created to control for collision rates in the K–6 models.

2.3. Statistical analysis

2.3.1. Primary objective: prevalence estimates

Proportions of all children arriving by each mode of AST were compared between kindergarten and the K–6 samples using Chi-square statistics. Stroller and wagon counts were combined, as they represent similar modes of sedentary transportation that are not vehicles. The average number of stroller/wagons observed per school was compared between the kindergarten and K–6 samples. The association of stroller/wagon use with AST in both samples was assessed using Pearson product-moment correlation coefficients to determine whether schools that have higher stroller/wagon use generally have higher or lower AST. This provided some indication of whether stroller/wagon use acts as a facilitator or a barrier to AST.

2.3.2. Secondary objective: covariates of AST

Poisson regression was initially conducted to model the proportion of children using AST for each sample. It was determined that the goodness of fit chi-square tests were significant for both models indicating that there was an issue with overdispersion. Negative binomial regression was then conducted to account for the overdispersion, which had good model fit for both sample as was evident by goodness of fit chi-square tests that were not significant. All available covariates were entered into the model to produce final multivariate models for both samples. There were no missing data for any of the covariates.

3. Results

There were 408 junior schools, of which 263 were K–6 schools (Fig. 1) There were 65 exclusions due to French immersion, alternative schools, and participation on other AST-related studies, resulting in 198 eligible regular program K–6 elementary schools. The kindergarten sample (Sample 1) consisted of 50 schools; with all transportation modes visible in only 26 schools to which the analysis was restricted. The K–6 sample (Sample 2) consisted of 100 schools, all of which had all transportation modes visible. Twelve schools overlapped with the kindergarten sample and were excluded. The remaining 88 schools were included in the analysis.

3.1. Primary objective: prevalence estimates

There were 1069 kindergarten students and 17,244 K-6 students counted (Table 1). An average of 30.6% (5.5% SD), of students in K–6 6 schools were kindergarten students (range: 18.6%–51.2%). Kindergarten students used active modes significantly less than students in the kindergarten to grade 6 sample (60% versus 74%, chi-square = 91.37 $p < 0.001$, Table 2). There was a great deal of variability in active school travel between schools, which ranged from 18% to 100% (kindergarten) and 23% to 100% (K–6) children observed. Vehicle travel was the most frequent sedentary mode used (38% kindergarten, 26% K–6).

There were 18 (1.7%) strollers/wagons counted in the kindergarten sample. There was however, no difference in the average number of stroller/wagons observed per school in the two samples (kindergarten schools: 1.38, SD = 3.55, K-6 schools: 1.38, SD = 2.71). No significant association was found between the proportion of stroller/wagon use and overall school AST in either the kindergarten (Pearson's $r = 0.26$, $p = 0.20$) or the K-6 samples (Pearson's $r = -0.026$, $p = 0.80$).

Table 1
School transportation modes for kindergarten students and kindergarten to grade 6 students, Toronto Canada, 2015.

Travel mode	Kindergarten sample Schools ($n = 26$) Students ($n = 1069$)	Kindergarten to grade 6 sample Schools ($n = 88$) Students ($n = 17{,}224$)
Sedentary modes	426 (39.9%)	4554 (26.4%)
Vehicle	404 (37.8%)	4398 (25.5%)
Stroller	17 (1.7%)	95 (0.7%)
Wagon	1 (0.1%)	31 (0.2%)
Bike seat	4 (0.4%)	30 (0.2%)
Active modes	643 (60.1%)	12,670 (73.6%)
Pedestrian	602 (56.3%)	11,796 (68.5%)
Cycling	24 (2.2%)	433 (2.5%)
Scooter	17 (1.6%)	441 (2.6%)

3.2. Secondary objective: covariates of AST

Table 2 describes the characteristics of the kindergarten and the K–6 schools. The average school population was similar between the two samples. The LOI score of the kindergarten sample was slightly higher; however, as the LOI scale ranged from 0 to 1, the mean values of 0.59 and 0.51 meant that neither higher nor lower disadvantage schools were overrepresented in either of the samples. There were greater proportions of who immigrated to Canada within 5 years or less in the kindergarten versus the K–6 six sample. Only 40% of K–6 schools had crossing guards.

Table 3 provides the results of the multivariate analyses for each sample. Social disadvantage had the strongest positive association with AST in the K–6 sample (IRR 1.27, 95% CI 1.18, 1.36). Presence of a school crossing guard, the number of total regular program students, and being a high collision school were related to higher AST. Immigration to Canada in the previous five years was associated with more AST in the kindergarten sample (IRR 8.06, 95% CI 2.91, 22.32).

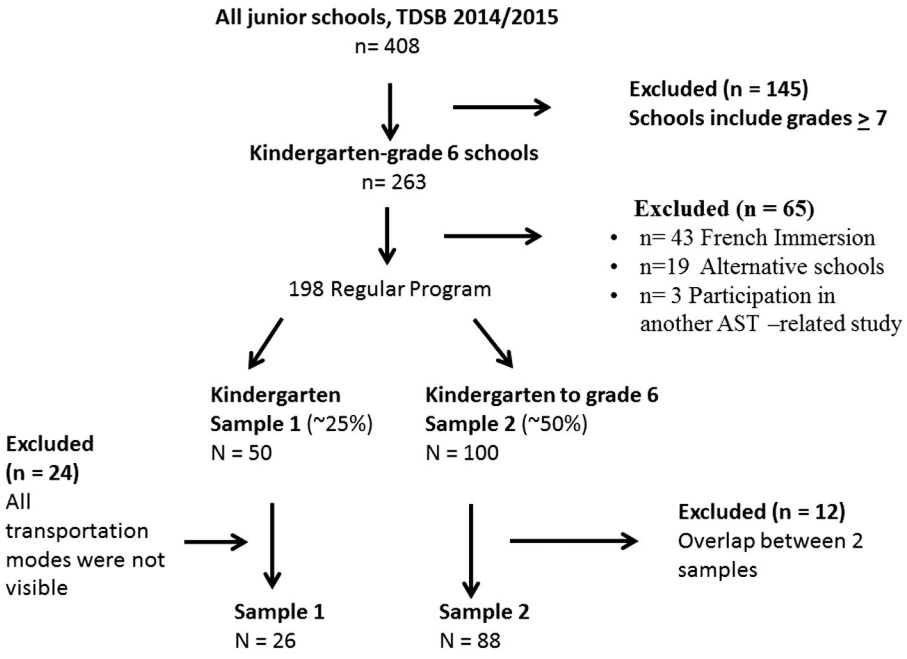

Fig. 1. Flow chart of school participation, Toronto, Canada, 2015.

Table 2
Characteristics of kindergarten and kindergarten–grade six sample schools.

	Kindergarten schools ($n = 26$)	K–6 schools ($n = 88$)
Regular home school population (mean n, SD)	255 (SD 133.9)	239.7 (SD 145.9)
Social disadvantage (mean LOI Score, SD)	0.59 (0.21)	0.51 (0.30)
Immigrant ≤5 years (mean %, SD)	16.3% (SD 11.5%)	11.7% (SD 8.7%)
Presence of a school crossing guard (n, %)	n/a	35 (39.8%)

4. Discussion

This study was the first to examine the prevalence of AST and stroller use using direct observational counts of kindergarten children travelling to school. Observed AST was significantly lower in kindergarten students compared to all ages from K–6, with vehicle travel being the most used sedentary mode. The prevalence of stroller/wagon use in kindergarten students for school transportation was low at 1.7%. Stroller/wagon use was unrelated to overall AST observed at schools. In kindergarten schools, recent immigrant status was associated with higher AST in K schools. In the K–6 schools, social disadvantage was most strongly associated with higher AST, with collision rates, presence of a school crossing guard school size also being associated with higher AST.

Direct observational data from this study confirmed previous studies using caregiver reported data that younger children used AST less often than school-aged children (DiGuiseppi et al., 1998; Timperio et al., 2006; Yelavich et al., 2008). Younger children do not have the cognitive or perceptual skills to cross roads and walk to school independently and require adult supervision when walking, compared to older children (Tabibi and Pfeffer, 2003; Barton, 2006; Barton and Schwebel, 2007). Parents may also drive younger children more often, as it is faster and more convenient (McMillan, 2007; Faulkner et al., 2010).

Although AST was lower in kindergarten students, results of this study are encouraging, observing 60% of kindergarten and 74% of K–6 students using active modes for school travel. These observed proportions were similar to those found in the 2011 observational study where 67% of kindergarten–grade 6 students walked to school (Rothman et al., 2013). These proportions are higher than those typically reported in the literature which is likely because these samples only included children who lived in walking distance to school; previous Canadian estimates which indicated lower walking rates were not restricted to children living within walking distance (Active Healthy Kids Canada, 2013; Buliung et al., 2009; Cragg et al., 2006).

A limitation of the study was that the K–6 sample counts likely also included kindergarten students, as it was impossible to identify specific student ages or grades when observing at general school entrances. As sedentary travel counts in the kindergarten sample was higher, the actual proportion of children using AST in the K–6 sample was likely an underestimate for older children grades 1–6, and therefore the difference reported between the two samples was likely conservative. The kindergarten sample was also small, as several schools were excluded because of the location of the kindergarten and non-kindergarten entrances, making it impossible to observe both entrances simultaneously with one observer. There was also a high degree of variability in the proportion of younger children using active modes by school in this study. Factors that play an important role in the variability in AST in school aged populations including those related to the built environment and socioeconomic status, have not been examined specifically for kindergarten children (Rothman et al., 2013; Sirard et al., 2005; Sirard and Slater, 2008; Wong et al., 2011).

Although the small kindergarten sample limited the ability to examine many potential explanatory variables related to the variability in AST, we were able to examine the association with several school characteristics as described in Table 3. The proportion of new immigrants (≤5 years) was the only variable that was related to higher AST in kindergarten students. There are a few studies that have reported small effects of culture and ethnicity on active transportation to school and this is an area that requires further study (Schlossberg et al., 2006; McDonald, 2008; Kerr et al., 2007).

In the K–6 sample, we found that higher school disadvantage, the presence of a school crossing guard, larger schools and higher area-collision rates were associated with higher proportions of AST. This study found a small effect of school crossing guards and higher AST in the kindergarten–6 sample; our previous work with a similar sample found that school crossing guards had an important association with higher walking proportions, in that they acted as an effect modifier between the built environment and walking (Rothman et al., 2013). The relationship between socioeconomic status and AST has not yet been clearly defined as there have been mixed results reported (Rothman et al., 2013; Sirard and Slater, 2008; Davison et al., 2008). Finally, univariate analyses in our previous work demonstrated walking proportions were related to higher collision rates near schools; however, this relationship disappeared once we controlled for the built environment (Rothman et al., 2014). The small kindergarten sample did not allow us to investigate the role of the built environment in AST in this study. However, the results of the multivariate analyses in this study suggest that there may be different factors at play affecting AST in kindergarten compared to older students.

The results of this study provide new information that can help inform current guidelines regarding stroller use in young students, as well as providing AST prevalence estimates for young kindergarten students. The low prevalence of stroller/wagon use in this study suggests that their use as sedentary transportation devices to school does not appear to be common for this age group in Toronto. Almost 40% of kindergarten students were transported in vehicles, which may be due to convenience or concerns regarding traffic safety. This study also identified important associations with AST related to school characteristics. The roles of new immigrant status and higher socioeconomic disadvantage appeared to be important in influencing AST. Therefore, interventions should be designed recognizing the potential role of culturalization and social disadvantage in influencing school transportation modes. The results also suggest that there may be differences in what influences AST in younger versus older students. Further work needs to be done examining the built environment associations with AST specifically for kindergarten students, and examining the longitudinal relationship between AST and child age using direct observational data. The results may have important implications for AST promotion directed specifically at kindergarten students, in order to potential influence lifelong habits related to healthy active living.

Table 3
Multivariable negative binomial model estimates of factors related to of the proportion of children using AST by sample (IRR = incident rate ratio, 95% CI = confidence interval).

	Kindergarten to grade 6 schools	Kindergarten schools
Variable	Adjusted IRR (95% CI)	Adjusted IRR (95% CI)
Social disadvantage (LOI score)	1.23 (1.15, 1.31)*	0.83 (0.61, 1.16)
School crossing guard (Y/N)	1.08 (1.04, 1.12)*	N/A
Total regular program students (/100)	1.03 (1.02, 1.04)*	0.97 (0.91, 1.03)
Immigrant ≤5 years	0.83 (0.66, 1.01)	7.21 (3.31, 15.72)*
High collision school	1.08 (1.04, 1.13)*	N/A

* Statistically significant $p < 0.01$.

Conflict of interest

The authors have no conflicts of interest to disclose.

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