Active transportation to school in Canadian youth: should injury be a concern?

Kathleen Gropp,[1] Ian Janssen,[1,2] William Pickett[1,3]

[1]Department of Community Health and Epidemiology, Queen's University, Kingston, Ontario, Canada
[2]School of Kinesiology and Health Studies, Queen's University, Kingston, Ontario, Canada
[3]Department of Emergency Medicine, Queen's University, Kingston, Ontario, Canada

Correspondence to
Dr William Pickett, Emergency Medicine Research, Queen's University, Clinical Research Centre, Angada 3, Kingston General Hospital, 76 Stuart St, Kingston, ON K7L 2V7, Canada; will.pickett@queensu.ca

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ABSTRACT

Active transportation to school provides a means for youth to incorporate physical activity into their daily routines, and this has obvious benefits for child health. Studies of active transportation have rarely focused on the negative health effects in terms of injury. This cross-sectional study is based on the 2009/10 Canadian Health Behaviour in School-Aged Children survey. A sample of children aged 11–15 years (n=20 076) was studied. Multi-level logistic regression was used to examine associations between walking or bicycling to school and related injury. Regular active transportation to school at larger distances (approximately >1.6 km; 1.0 miles) was associated with higher relative odds of active transportation injury (OR: 1.52; 95% CI 1.08 to 2.15), with a suggestion of a dose–response relationship between longer travel distances and injury (p=0.02). Physical activity interventions for youth should encourage participation in active transportation to school, while also recognising the potential for unintentional injury.

Active transportation is the engagement in physical activity specifically for travel and includes activities such as walking and bicycling.[1] This mode of transportation provides the means by which children and youth can incorporate physical activity into their daily routines. Indeed, children and youth who walk or bicycle to school have higher overall levels of physical activity, better cardiorespiratory fitness levels and a healthier body composition.[2 3]

Studies of active transportation in youth have focused on its positive contributions to the maintenance of a healthy body weight and overall physical activity (for a recent synopsis, see Lee *et al*);[4] however, negative effects of active transportation are also possible. One concern is the occurrence of unintentional injury. Injury is the leading cause of death in Canadian children, accounting for more deaths than all other causes combined.[5] Negative side effects of active transportation to school have not been thoroughly examined in populations of young people.

The objective of this brief report was therefore to evaluate regular active transportation to school and its effects on injury in a large and contemporary national sample of Canadian youth. No a priori hypotheses were assumed. The study base was the 2009/10 Health Behaviour in School-Aged Children study.

METHODS

Overview of study design and measures

Health Behaviour in School-Aged Children is a general health survey of preadolescent and adolescent children conducted in affiliation with WHO.[6] In Canada, Cycle 6 of this survey (2009/10) involved administration of both student- (n=26 078) and school-level administrator (n=436) questionnaires. We combined these data with environmental measures describing school neighbourhoods that were obtained using geographic information systems.

Participants

The survey involved a systematic multi-stage cluster sample design that involved students and schools from 11 of 13 Canadian territories and provinces.[6] The sample available for the current analysis was 19 576 students with complete data (weighted sample 20 076) from 419 schools. Implicit or explicit consent to participate was obtained from school boards, individual schools, parents/guardians and students, as per local jurisdictional requirements. The study protocol was approved by the General Research Ethics Board of Queen's University (study approval number: GEDUC-430-09).

Key measures

Based upon a standard self-report module, reports of active transportation injuries were identified for all participants for a 12-month period prior to survey administration.[6] Injuries that required medical attention and which occurred: (1) in the 'street/road/parking lot' or while (2) 'biking/cycling' or 'walking/running (not for a sports team or exercise)' were operationally defined as active transportation injuries.

Three levels of active transportation to school were identified: (1) youth who did not regularly engage in active transportation; (2) youth who regularly engaged and lived near their school; and (3) youth who regularly engaged but lived far from school. Participants who reported that their usual mode of transportation to school was 'bus, train, streetcar, subway, or boat/ferry' or 'car, motorcycle, or moped' were placed in category 1. Students who reported regular active transportation (by walking or bicycling) with travel times either <5 min for cycling or <15 min for walking were placed in category 2. Those reporting greater lengths of time for walking or bicycling were placed in category 3. Participants who answered 'other' were excluded.

Both individual- and area-level variables were considered as potential confounders. Potential individual-level confounders were gender, age, ethnicity, perceived family socioeconomic status, perceived residential neighbourhood safety and participation in organised sports. Potential area-level confounders describing the school neighbourhood were: urban/rural geographic status, average precipitation levels as reported by Environment Canada, summary measures of total road lengths, street or road connectivity,[7] speed limits in the 1 km buffer surrounding each school, and Canada Census of Population estimates of median household incomes for 2006 (PCensus for MapPoint; Tetrad Computer Applications Inc., Vancouver, BC, Canada).

Analysis

Statistical analyses were performed using SAS V.9.2 (SAS Inc.). An initial descriptive analysis was used to characterise the study sample using proportions and measures of central tendency. Modelling was then performed. Examination of the clustered and nested structure of the data revealed an intraclass correlation of 2.6% (0.026) at the school-level.[8] We therefore modelled effects at individual- and school-levels while accounting for this clustering. Multi-level logistic regression modelling was used with random intercepts permitted for each school. Standardised weights (mean=1.00) were calculated and applied to account for the fact that children from different provinces and territories, school board types, languages of instruction, and urban/rural geographic status had different probabilities of entering the sample.

Following bivariate analyses, multi-level models were built as follows: (1) the active transportation variable and all individual-level factors were entered as risk factors (Multivariate Model 1); (2) backwards selection methods were performed using a change in estimate of >10% for retention of individual-level variables[9]; then area-level variables were added to the retained individual-level factors (Multivariate Model 2); and (3) backwards selection was reperformed for the final model, using the same change-in-estimate approach (Multivariate Model 3). Conservatively, any covariate whose removal from the model caused a change in the estimate greater than 10% or was statistically significant ($p<0.05$) was retained in Model 3. Finally, the modelling process was repeated for two specific active transportation injury outcomes: (1) walking or running injuries and (2) cycling injuries. A priori, the study was powered to identify an OR of 1.2 with >80% power ($\alpha=0.05$) for the main analysis.

RESULTS

A weighted sample of 20 076 students from 419 schools with complete data was available for analysis. About a third (33.6%) of the sample engaged in active transportation to school and 357 (1.8% of the sample) incurred an active transportation injury (table 1). Of these injuries, 68.9% occurred while cycling, 31.1% occurred while walking or running, 45.1% required medical treatment (eg, placement of a cast or stitches) and 40.6% caused the participant to miss at least 1 day of school or usual extra-curricular activities. Approximately one injury was reported for every 2900 h of exposure to active transportation.

Table 2 summarises bivariate, then adjusted models that describe the association between engagement in active transportation and the occurrence of related injury. ORs can be interpreted as relative risks.[10] Model 3 provides final estimates for this relationship while controlling for potential confounders. A statistically significant positive association that followed a graded trend ($p_{trend}=0.02$) was observed, with an adjusted 1.52-fold increase (95% CI 1.08 to 2.15) in the relative odds of active transportation injury for youth who regularly engage in active transportation over longer distances. These effects were observed consistently for the two specific active transportation injury outcomes. Two covariates were retained in the final model: age group (OR: 0.75; 95% CI 0.57 to 0.97 for ages 14–15 vs 11–13) and urban/rural status (OR: 1.64; 95% CI 1.14 to 2.36 for urban vs rural communities; $p_{trend}=0.008$).

Table 1 Description of sample demographics, engagement in active transportation and the occurrence of active transportation injuries (N=20 076)

Demographic characteristics	Weighted N	% Engaged in active transportation	p Value
Gender			
Male	9531	36.4	<0.0001
Female	10 545	31.0	
Age			
11–13	11 671	39.1	<0.0001
14–15	8405	27.2	
Ethnicity			
White only	14 315	31.1	
White and other	974	36.6	0.95
Aboriginal	1120	38.5	0.22
Other	3667	40.8	0.004
Family socioeconomic status			
Well-off	11 490	32.5	<0.0001
Average	6771	34.1	
Not well-off	1815	38.0	

Active transportation injuries	N	% of population	% of active transportation injuries
Total injuries	357	1.8	
Gender			
Male	183	1.9	
Female	174	1.7	
Age group			
11–12	234	2.0	
13–15	123	1.5	
Activity at time of injury			
Walking/running	111		31.1
Cycling	246		68.9
Required medical treatment	161		45.1
Loss of 1+ days of activity	145		40.6

DISCUSSION

The most important finding from this study was that as young people engaged in active transportation for longer distances, their risks for active transportation injury increased irrespective of their mode of active transportation.

Many health promotion interventions aim to increase participation in active transportation to school due to its inherent benefits to health.[11] However, these same interventions do not necessarily consider the negative outcomes of active transportation to school such as injury. Our findings therefore contribute to a more comprehensive understanding of this public health issue and associated health promotion messages.

This analysis has limitations. It is difficult to establish temporality in our observed effects due to the cross-sectional design. Our use of self-reported measures of injury and active transportation may have contributed to non-differential misclassification leading to bias of the ORs towards no effect. For example, it is quite possible that some of the events that were classified as active transportation injuries were actually recreational. Our lack of detailed information about some relevant contextual factors (eg, bicycle helmet laws, cycling infrastructure, pedestrian guards and crossings) are a further limitation, and the analysis also does not account for the timing of injuries and whether they were experienced outside of school commuting times. Finally, there is the possibility of selection

Table 2 Results of multi-level logistic regression analysis examining potential risks for active transportation injury associated with engagement in active transportation to school (N=20 076)

Injury type: active transportation level	N	% Injured	Bivariate model, OR (95% CI)	Model 1*, OR (95% CI)	Model 2†, OR (95% CI)	Model 3‡, OR (95% CI)
Active transportation injuries						
No	13 488	1.5	1.00	1.00	1.00	1.00
Yes: short distance	5049	2.1	1.17 (0.92 to 1.50)	1.13 (0.88 to 1.45)	1.12 (0.87 to 1.44)	1.13 (0.88 to 1.44)
Yes: long distance	1539	2.7	1.56 (1.10 to 2.21)	1.53 (1.08 to 2.17)	1.55 (1.09 to 2.20)	1.52 (1.08 to 2.15)
p Trend			0.01	0.02	0.02	0.02
Walking/running injuries						
No	13 488	0.4	1.00	1.00	1.00	1.00
Yes: short distance	5049	0.8	1.54 (1.01 to 2.35)	1.59 (1.04 to 2.44)	1.52 (0.99 to 2.34)	1.49 (0.98 to 2.29)
Yes: long distance	1539	0.8	1.47 (0.78 to 2.79)	1.52 (0.80 to 2.88)	1.44 (0.76 to 2.73)	1.43 (0.76 to 2.70)
p Trend			0.06	0.05	0.08	0.08
Bicyling injuries						
No	13 488	1.1	1.00	1.00	1.00	1.00
Yes: short distance	5049	1.3	1.02 (0.76 to 1.39)	0.95 (0.70 to 1.29)	0.95 (0.70 to 1.31)	0.98 (0.72 to 1.33)
Yes: long distance	1539	1.9	1.59 (1.05 to 2.40)	1.49 (0.98 to 2.25)	1.59 (1.05 to 2.41)	1.55 (1.03 to 2.35)
p Trend			0.08	0.20	0.13	0.13

*Adjusted for individual-level variables (gender, age, ethnicity, family socioeconomic status, perceived neighbourhood safety and participation in organised sports).
†Adjusted for retained individual-level variables (age) and area-level variables (urban/rural geographic status, street connectivity, speed limit surrounding school, % roads with speed limit ≤60 km/h, total length of roads, school neighbourhood median family income, total rain and total snow).
‡Adjusted for retained individual (age) and area-level (urban/rural geographic status) variables.

bias, such that youth not attending school on the day of survey administration may have been more likely to have active transportation injuries which in turn are differentially related to more active transportation to school. If this bias existed, it would again bias our OR estimates towards no effect.

The two main strengths of this research were our use of a large nationally representative sample of students as well as our focus on the negative side effects of an important public health topic with obvious benefits to health. Findings should be generalisable to urban populations in Canada and countries with like transportation infrastructures. Negative health outcomes of active transportation remain understudied in the adolescent health promotion literature, and there is a need for future studies to evaluate the relative benefits (eg, reduced obesity) and potential harms (eg, increased injury) within the same analyses.

Public health interventions targeted at increasing active transportation to school in Canadian youth should consider possible unintentional injury outcomes of active transportation. Interventions aimed at increasing physical activity should not lose sight of possible injury-related outcomes. Examples of interventions include the walking school bus where children travel together in large groups[12] and environmental solutions that foster improvements to walking and cycling infrastructure.[13] If well designed, these population health interventions could have a very positive impact on the physical health of Canadian youth overall, while limiting the potential for associated injuries.

What is already known on the subject

- Engagement in active transportation to school represents one possible strategy of promoting physical activity in groups of young people.
- While the positive effects of active transportation are obvious, possible negative effects of such practices in terms of unintentional injury have rarely been examined.

What this study adds

- This national study of young people from across Canada aimed to understand the effects of engagement in active transportation to school on the risks for related injury.
- Modest increases in risk for active transportation injury were evident, rising in accordance to distance travelled to school.
- Injury does represent one possible negative consequence of what in general is a positive behaviour for the health of young people.

CONCLUSION

The relationship between active transportation to school and active transportation injury was examined in a nationally representative sample of Canadian youth using multi-level analytical methods. We found a dose−response relationship between active transportation to school and active transportation injury across increasing travel distances. We suggest that new and existing interventions promoting active transportation to school should further incorporate injury control strategies in order to continue encouraging physical activity in the safest possible manner.

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Competing interests None.

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