Active Transportation Environments Surrounding Canadian Schools

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ABSTRACT

Objectives: Walking or cycling to school represents an opportunity for children to engage in physical activity. The study objectives were to: 1) describe active transportation policies, programs, and built environments of Canadian schools and their surrounding neighbourhoods, and 2) document variations based on urban-rural location and school type (primary vs. secondary vs. mixed primary/secondary schools).

Methods: 397 schools from across Canada were studied. A school administrator completed a questionnaire and responses were used to assess schools' policies and programs related to active transportation and the safety and aesthetics of their respective neighbourhoods. Built environment features in a 1 km-radius circular buffer around each school were measured using geographic information systems.

Results: Greater than 70% of schools had passive policies (e.g., skateboards permitted on school grounds) and facilities (e.g., bicycle racks in secure area to avoid theft) to encourage bicycle and small-wheeled vehicle use. Less than 40% of schools had active programs designed to encourage active transportation, such as organized 'walk to school' days. Garbage in the streets, crime and substance abuse were barriers in most school neighbourhoods. Approximately 42% of schools were located on high-speed roads not amenable to active transportation and 14% did not have a sidewalk leading to the school. Secondary schools had less favourable active transportation policies/programs and neighbourhood safety/aesthetics compared to primary schools. Rural schools had less favourable built environments than urban schools.

Conclusion: Canadian children, particularly those from rural areas, face a number of impediments to active transportation as a method of travelling to school.

Key words: Walking; bicycling; schools; environment; policy

La traduction du résumé se trouve à la fin de l'article.

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Active transportation refers to using walking, bicycling or other human-powered modes of transportation for practical purposes such as commuting.¹ For children and youth, travelling to school represents an opportunity to engage in active transportation and to increase their overall physical activity. However, as recently reviewed, data from several countries indicate that the proportion of children who walk or bicycle to school has decreased in recent decades.² Cross-national comparisons also indicate that Canadian children are less likely to actively commute to school by comparison to other countries. For instance, while more than half of children from Australia, Scotland, England, Russia, and Sweden usually walk or bicycle to school,² regional data from Ontario and Prince Edward Island suggest that only one third of Canadian children do so.³ These are troubling statistics given the medical, economic and environmental benefits associated with active transportation.⁴⁻⁹ From a public health perspective, increased active transportation could help address the prevalence of obesity and related chronic illnesses.^{5,6,9-12}

The decision to engage in active transportation is complex and represents the joining of many factors, including the built environment.^{4,5} The built environment refers to our human-made surroundings. Several built environment features are correlated with active transportation, including the speed and connectivity of roads.^{5,10,11,13-18} Roads with high speed limits and roads that are poorly connected can make it unsafe and inefficient (i.e., long travel distances) for people to engage in active transportation.^{5,10,11,13-18}

Safety concerns around neighbourhood crime and violence can also negatively impact active transportation.^{5,6,13,19} Conversely, aesthetically pleasing environments may inspire people to engage in active transportation.^{13,20} Finally, policies and programs encouraging the use of built environment features can impact active transportation.^{6,9,18,21}

There is a dearth of Canadian and international research that characterizes active transportation environments relevant specifically to children.^{3,8} Characterization of these environments may inform the development of policies aimed at promoting physical activity. The primary purpose of our study was to describe the extent to which environments surrounding schools in Canada are

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conducive to active transportation. A secondary purpose was to examine variations in these environments by urban-rural geography and type of school (primary vs. secondary schools). The study was based upon administrator responses to the 2009/2010 Health Behaviour in School-aged Children (HBSC) survey and geographic measures of the neighbourhoods surrounding these schools.

METHOD

Schools in study sample

Our sample included primary and secondary schools that participated in the 2009/2010 Canadian HBSC. The HBSC involves a general health survey completed by students (with active or passive consent, as per jurisdictional requirements), and an administrator questionnaire completed by the principal or designate of each school. The present study relied on the administrator questionnaire, which was primarily completed between November 2009 and May 2010, and geographic measures of the built environment in the neighbourhood surrounding each school. The sample of schools is representative by school board type (public or separate), language of instruction, urban/rural geography, and regional geography. All provinces and territories were represented except for Prince Edward Island and New Brunswick.

HBSC administrator's survey

The HBSC administrator's survey contained questions related to the school's size, demographics, facilities, policies, and neighbourhood environment. The inclusion of active transportation questions in the survey was guided by prior research examining the correlates of active transportation, as overviewed in the introduction to this article.

The school's policies, facilities and/or programs aimed at promoting active transportation were assessed using 8 questions, all with "yes" or "no" responses. The first 2 of these questions started by asking "Do the majority of students at your school have regular access to bicycle racks during school hours?" If a response of "yes" was provided, a follow-up question was asked: "Are the racks in a secure area to avoid theft?" The remaining 6 questions started by asking "Does your school promote active transportation to and from school in any of the following ways?" The 6 areas addressed under this question were: "Identify safe routes to use for walking and cycling to and from school (e.g., with signs, in newsletters, etc.)", "Designate a 'car free zone' to provide safe walking areas around the school", "Allow students to bring bicycles on school property", "Allow students to bring small-wheeled vehicles (e.g., inline skates, scooters, skateboards) on school property", "Encourage the use of helmets and safety gear for those who use bicycles and small wheel vehicles to get to school", and "Organize occasional 'walk to school' days, walking clubs, or walking school buses".

Five questions assessed the safety and aesthetics of the school's neighbourhood, as perceived by the school administrator who completed the questionnaire. These questions started by asking "How much of a problem are the following in the neighbourhood where this school is located?" The 5 areas addressed under this question were: "Garbage, litter, or broken glass in the street or road, on the sidewalks, or in yards", "Vacant or shabby houses and buildings", "Selling or using drugs or excessive drinking in public", "Crime in the neighbourhood", and "Heavy traffic". The responses were "major problem", "moderate problem", "minor problem", and "not a problem". Responses to the first 3 options were merged to create

a single dichotomous variable (yes or no) with regard to whether there was a problem.

Principal components factor analyses were used to develop composite scales based on the policy/program questions and the safety/aesthetics questions. Scale construction was guided by factor loadings, eigenvalues, and the scree plot. One program/policy and one safety/aesthetics factor were identified.

Geographic information systems measures

Features of the built environment were measured in a 1 km-radius circular buffer surrounding each school using ArcGIS version 9.3 geographic information systems (GIS) software and the CanMap RouteLogistics version 2009.4 (DMTI Spatial Inc., Markham, ON) GIS database. Roads within the 1 km buffer were described by speed limit (≤ 60 km/h vs. ≥ 61 km/h). We considered the speed limit of the road on which the school was located. We also considered the ratio of the length of roads with speed limits ≤ 60 km/h to the total length of roads within the buffer as a measure of what percentage of roads would be suitable for active transportation. In addition, we determined whether or not there was at least one recreational trail within the buffer. Finally, the connectivity of roads within the buffer was determined using a composite measure based on the connected node ratio (number of 3- or 4-way intersections / total number of intersections),^{22,23} intersection density (number of 3- or 4-way intersections / land area),^{22,23} and average block length (total road length / number of intersections).^{22,23} Schools were ranked for each connectivity measure, the ranks were summed, and schools were divided into quartiles based upon this sum.

We examined whether the road in front of the schools' main entrance had a sidewalk (yes or no), and the ratio of roads within the 1 km buffer with a sidewalk (length of roads in 1 km buffer with sidewalk / total road length). These measures were obtained using Google Maps Street View software (<http://maps.google.com/help/maps/streetview/index.html>), which were linked to the CanMap RouteLogistics street files. The Google street view images for Canada were primarily obtained in the non-winter months of 2009.

Statistical analysis

Characteristics of the schools and their environments were profiled using conventional descriptive statistics, according to: 1) geographic status (degree of urbanization), and 2) grades served by the school (primary: kindergarten to grade 8, secondary: grades 9 to 12, mixed: grades covered by primary and secondary schools). Degree of urbanization was determined using a census postal code analyzer (© 2010 CHASS, University of Toronto), which classified schools as rural (population density < 400 persons/km² or population $< 1,000$), small urban (population density > 400 persons/km² and population of 1,000-10,000), or large urban (population density > 400 persons/km² and population $> 10,000$). Fisher's exact tests determined the significance of differences in policies, safety/aesthetics, and built environment features according to geography and grade. Analysis of variance determined significant differences in ratio scores. All statistical analyses were performed using SAS statistical software (SAS Inc., Cary, NC).

RESULTS

Administrator questionnaire responses and GIS street measures were available for 397 schools (181 primary, 106 mixed, 110 sec-

Table 1. Active Transportation Policies and Programs Among Canadian Schools (n=397)

	Total % Responding 'Yes'	Urban/rural Status			p-value	Type of School			p-value
		Rural (n=134)	Small Urban (n=32)	Large Urban (n=231)		Primary (n=181)	Mixed (n=106)	Secondary (n=110)	
Identify safe routes for walking/cycling to school	28.0	25.8	18.8	30.6	0.29	35.9	24.5	18.4	0.004
Organize 'walk to school' days	31.7	34.4	25.0	31.2	0.57	39.8	30.5	19.4	0.002
Designate a 'car-free zone'	35.7	36.6	36.7	35.1	0.95	47.8	29.5	21.7	<0.001
Allow bicycles on school property	96.3	99.3	100.0	94.0	0.02	95.0	96.3	98.2	0.38
Have bicycle racks	86.7	79.6	90.3	90.4	0.01	86.6	87.5	86.2	0.96
Bicycle racks (if available) securely located	74.1	63.3	88.9	77.9	0.004	71.4	68.9	83.3	0.05
Allow small-wheeled vehicles on school property	71.3	71.2	68.8	71.7	0.94	62.4	79.8	78.0	0.002
Encourage use of safety gear	85.5	88.2	81.3	84.5	0.49	91.2	86.0	75.5	0.001
Summative policy score									
0 (worst)	20.2	20.2	25.0	19.5		16.6	26.4	19.8	
1	16.9	20.2	12.5	15.6		12.2	22.7	18.9	
2	22.9	25.4	21.9	21.7	0.33	20.4	26.4	23.6	0.006
3	19.9	12.7	28.1	22.9		25.4	11.8	18.9	
4 (best)	20.2	21.6	12.5	20.4		25.4	12.8	18.9	

Table 2. Perceived Safety and Aesthetics of Neighbourhoods Surrounding Canadian Schools (n=397)

	Total % Responding 'No'	Urban/rural Status			p-value	Type of School			p-value
		Rural (n=134)	Small Urban (n=32)	Large Urban (n=231)		Primary (n=181)	Mixed (n=106)	Secondary (n=110)	
Garbage/litter/broken glass in the street	31.1	28.6	34.4	32.2	0.71	36.1	29.4	24.5	0.11
Vacant/shabby houses and buildings	67.7	60.2	75.0	71.0	0.07	67.8	77.3	57.6	0.008
Selling/using drugs, excessive drinking in public	33.6	30.1	41.9	34.5	0.41	45.8	22.0	24.8	<0.001
Neighbourhood crime	42.9	50.4	50.0	37.6	0.04	45.3	42.7	39.1	0.59
Heavy traffic	52.4	79.0	43.8	38.3	<0.001	52.5	44.6	60.4	0.07
Summative safety/aesthetic score									
0 (worst)	19.1	23.1	28.1	15.6		25.4	8.5	19.1	
1	21.2	20.9	21.9	21.2		20.4	23.6	20.0	
2	23.4	23.1	9.4	25.5	0.08	19.9	34.0	19.1	0.001
3	13.6	8.5	21.9	16.0		11.1	9.4	21.8	
4 (best)	22.7	25.4	18.8	21.6		23.2	24.5	20.0	

ondary). For the sidewalk measures, 102 schools were excluded due to lack of Google imaging data. These 102 schools were located in rural and remote areas, and the sidewalk data should not be considered representative of the 397 schools.

Responses to the active transportation features and policies questions are summarized in Table 1. Greater than 70% of schools allowed bicycles and small-wheeled vehicles (e.g., skateboards, rollerblades) on school property, had bicycle racks, and encouraged students to use safety gear while bicycling or using small-wheeled vehicles. Less than 40% of schools identified safe active transportation routes for their students to use, organized 'walk to school' days or similar initiatives, and had a designated car-free zone at the school. There were significant urban-rural differences for the 3 bicycle-specific measures, with more favourable scores in urban schools. There were several significant differences between primary, mixed, and secondary schools; primary schools had more favourable policies and programs.

Table 2 describes the safety and aesthetics of neighbourhoods surrounding schools as perceived by the school administrators. Only 31% of the administrators felt that there was no garbage/litter in the streets, only 34% felt that there was not an issue with selling/using drugs or excessive drinking in public, and only 43% felt that there was not an issue with neighbourhood crime. About half (52%) did not consider the vehicle traffic in the neighbourhood surrounding their school to be heavy. The only significant differences in safety and aesthetics by rural/urban status were for neighbourhood crime and vehicle traffic, which were less of an issue in rural areas. In comparison to neighbourhoods surrounding secondary schools, neighbourhoods surrounding primary schools were less likely to report drug/alcohol problems and the presence of vacant/shabby houses and buildings.

Features of the built environment in neighbourhoods surrounding schools that may facilitate active transportation are described in Table 3. Approximately 58% of the schools were located on a road with a speed limit ≤ 60 km/h. Similarly, 57% of the roads within the 1 km buffer surrounding the schools had speed limits ≤ 60 km/h. Less than half (45%) of the schools had at least one recreational trail within 1 km. Most (86%) had a sidewalk leading to the school; however, only 53% of the roads in the buffer had a sidewalk. As one might expect, schools in urban areas were more likely than schools in rural areas to have well-connected street networks, be on a road with a speed limit ≤ 60 km/h, be on a road with a sidewalk, and be in close proximity to a recreational trail. Primary schools were more likely to be located on a low speed road than secondary schools.

DISCUSSION

Our objective was to describe active transportation policies and built environments of Canadian schools. A key finding is that schools were more likely to implement *passive* active transportation policies than they were to develop *active* programs. To illustrate, while 96% of schools permitted bicycles on their property, only 28% identified safe routes for students to follow when traveling to school. The findings also suggest that school neighbourhoods pose several barriers for active transportation. For example, 91% of schools in rural areas were located on high-speed roads that may negate students from actively commuting to school, and the principals of 62% of the schools in large urban areas felt that neighbourhood crime was a safety issue.

The present study is novel in design in that it is national in scope. Comparisons to past studies are possible for some findings. Dellinger surveyed 611 American households to determine active

Table 3. Built Environment Features in Neighbourhoods Surrounding Canadian Schools (n=397 or 295)

	Total %	By Geographic Status				By Type of School			
		Rural (n=134 or 123)	Small Urban (n=32)	Large Urban (n=231)	p-value	Primary (n=181 or 179)	Mixed (n=106 or 19)	Secondary (n=110 or 97)	p-value
Street connectivity measure (n=397)									
0 (lowest)	24.9	54.5	21.9	9.5		22.4	22.7	32.0	
1	25.1	26.0	28.1	24.2	<0.001	25.7	25.5	23.7	0.42
2	25.1	13.0	25.0	31.6		29.1	24.6	18.6	
3 (highest)	24.9	6.5	25.0	31.6		22.9	27.3	25.8	
Located on road ≤60 km/h (n=397)	58.3	8.8	12.5	91.3	<0.001	63.9	60.0	45.9	0.013
% of roads within buffer ≤60 km/h* (n=397)	57.3	13.3	14.8	88.7	<0.001	60.8	47.4	61.0	0.03
Have recreational trail(s) within buffer (n=397)	44.8	20.9	34.4	60.2	<0.001	44.8	48.2	41.5	0.62
Located on a street with sidewalk (n=295)	86.4	62.3	94.7	92.6	<0.001	87.5	91.7	76.2	0.02
% of roads within buffer with sidewalk (n=295)†	52.9	26.3	38.4	61.5	<0.001	51.6	55.5	52.0	0.57

* Calculated as length of roads ≤60 km/h speed limit divided by length of all roads within 1 km buffer.

† Calculated as length of roads with sidewalk divided by length of all roads within 1 km buffer.

Note: only 295 schools were included for the sidewalk measures due to the absence of Google street view data for 102 schools.

transportation barriers, and found that the most common barriers for children were traffic (40%) and crime (18%).²⁴ Two smaller studies also examined traffic volume and found it to be a less prevalent issue, at 34% in Australia²⁵ and 23% in Oregon.²⁶ In our Canadian study, concerns around traffic (48% in total, 21% in rural areas, 62% in large urban areas) and neighbourhood crime (57% in total, 50% in rural areas, 62% in large urban areas) were common. Divergent findings between our findings and those of other countries were also found for programs that would encourage active transportation. In a study of 91 schools from Norfolk county in England, 85% of schools had a travel plan (our findings were 28% in total, 26% in rural areas, 31% in large urban areas) and 69% had walk-to-school initiatives (our findings were 32% in total, 34% in rural areas, 31% in urban areas).²⁷ Differences in the nature of variables, reliance on child and parental questionnaires in past studies versus administrator questionnaires in this study, and a focus on urban regions in past studies versus a broader geographic representation in this study may account for discrepant findings.

Our findings have policy implications. They suggest a need to make school environments more amenable to active transportation and for schools to develop more policies and programs. A promising example is that of California's safe routes to school (SR2S) legislation. SR2S features both built environment (e.g., construction of sidewalks) and policy interventions (e.g., education on active transportation benefits) targeted at increasing active transportation among schoolchildren.¹⁴ Children exposed to SR2S were three times more likely to start walking or cycling to school.¹⁴

Rural and secondary schools represent priorities for intervention. Rural schools are faced with high traffic speeds, lower street connectivity, and reduced sidewalk access, suggesting a need for traffic calming and future attempts to construct schools away from highways in neighbourhoods with a better sidewalk infrastructure. A Swiss study found that non-urban students from neighbourhoods with low traffic and adequate sidewalks were more likely to cycle to school than urban students.¹² Nonetheless, changes to active transportation policies and built environments surrounding rural schools would not benefit all children attending those schools because a large percentage of them live too far from their school to make active transportation feasible.

Limitations of this study include the subjective nature and distinct perspective of the persons responsible for completing the administrator questionnaire, and the fact that the validity and reliability of the questionnaire items are unknown. Additionally, edu-

cation ministries and schools in New Brunswick and Prince Edward Island declined to participate, limiting the study representativeness. The road and sidewalk measures were objective. However, a lack of imaging data to measure sidewalks for many schools in rural and remote areas precluded their inclusion for those measures. Findings from the administrator questionnaire and GIS road measures suggest that schools in these areas have the highest needs.

This national study provides descriptive information on active transportation environments and policies of Canadian schools. Children, particularly those from rural areas and those attending secondary schools, face a number of impediments to active transportation as a method of travelling to school.

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RÉSUMÉ

Objectifs : La marche et le vélo sont des occasions pour les enfants de faire de l'activité physique. Les objectifs de cette étude sont de : 1) décrire les politiques et les programmes de transport actif, l'environnement bâti et les quartiers environnants des écoles canadiennes et 2) documenter les variations basées sur l'emplacement urbain ou rural et le genre d'école (primaire, secondaire ou mixte primaire/secondaire).

Méthode : Nous avons étudié 397 écoles au Canada. Dans chaque école, un administrateur scolaire a rempli un questionnaire, et ses réponses ont été utilisées pour évaluer les politiques et les programmes de l'école reliés au transport actif, ainsi que la sécurité et l'esthétique du quartier. Les caractéristiques de l'environnement bâti dans une zone de 1 km autour de chaque école ont été mesurées en utilisant des systèmes d'information géographique.

Résultats : Plus de 70 % des écoles avaient des politiques passives (p. ex., autorisation des planches à roulettes sur le terrain de l'école) et/ou des installations passives (p. ex., porte-vélos dans des endroits sécurisés pour prévenir le vol) pour encourager l'utilisation du vélo et des véhicules à petites roues. Moins de 40 % des écoles avaient des programmes spécifiquement conçus pour encourager le transport actif, comme des journées organisées pour marcher à l'école. Les déchets dans la rue, la criminalité et la toxicomanie étaient des obstacles dans la plupart des quartiers environnants. Environ 42 % des écoles étaient situées sur des rues à grande vitesse qui ne conviennent pas au transport actif, et 14 % n'avaient pas de trottoir menant à l'école. Les politiques/programmes et le quartier/la sécurité/l'esthétique étaient moins favorables dans les écoles secondaires que dans les écoles primaires. L'environnement bâti était moins favorable dans les écoles rurales que dans les écoles urbaines.

Conclusion : Les enfants canadiens, particulièrement ceux qui vivent en milieu rural, font face à de nombreux obstacles en ce qui a trait au transport actif comme méthode pour se rendre à l'école.

Mots clés : marche; cyclisme; école; environnement; politique