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Youth and Sustainable Transportation
A Review of the Literature

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1. Background

In recent years, there has been a growing awareness that public health may be positively or adversely affected by the manner in which we plan our communities, towns and cities. Relevant research literature had focused primarily on adults, with some attention given to young people on their trip to school. Concerns regarding trends in obesity and physical inactivity in this sector of the population have led to greater attention to barriers and opportunities for enhancing health and well-being through the built environment. Gilbert and O'Brien [1] recognized that there was a need to raise the profile of children and youth with respect to land use and transport planning and developed guidelines to contribute to policy and practice. The *Child and Youth Friendly Land Use and Transport Planning Guidelines* that were developed for the province of Ontario (Canada) have been endorsed by the Ontario Professional Planners Institute. A similar set of guidelines is being developed for every Canadian province. These guidelines provide the rationale for considering the needs and aspirations of children and youth with respect to how communities are planned and the policies that influence the travel of young people. Information about the Guidelines may be found at http://cst.uwinnipeg.ca/.

The initial version of the guidelines presented research evidence for children (up to 12 years old) and youth (ages 12-18), though the bulk of available research at that time addressed the younger age group. The following review of literature is a further step towards understanding the travel needs and perspectives of girls and boys in the youth age-range. This information will be useful for all levels of government, public health practitioners, school boards, and organizations that are working towards creating healthy, active living environments.

The research team was led by Catherine O'Brien from the School of Education, Health and Wellness at Cape Breton University. Other members of the research team included Subha Ramanathan, Dalla Lana School of Public Health at the University of Toronto, Richard Gilbert, Centre for Sustainable Transportation, and Arthur Orsini of Urbanthinkers. We set out to consider the questions listed below.

- Where do youth typically travel and what modes do they use?
- What barriers do youth face for active transportation?
- Are the barriers and trends different for female and male youth?
- How are parental attitudes affecting youth transportation choices?
- Is car ownership affecting youth transportation choices?
- How is transportation affecting youth emotional and physical well-being?
- Are there trends regarding youth obesity, mode of transport, and urban form?
- How is air quality affecting youth health, particularly with respect to in-vehicle air quality in cars and buses?

1.1 Search criteria

Relevant literature was identified through searching the following electronic English-language abstract databases: ISI Web of Science, SAGE database and Google Scholar. Reference lists of all collected literatures were scanned (i.e. backward reference searches), and relevant articles were gathered. Next, forward reference searches were done to review all articles that cited important articles. Finally, backward author searches were also conducted for authors who had contributed to at least two relevant articles from the keyword searches.

When searching for scholarly journal articles in abstract databases, combinations of the following search terms were used: active commuting, active transportation, youth, children, adolescents, youth transportation, youth mobility, air quality and youth, transportation, and Canada.

The review contains studies that are primarily from 2000-2009 though some earlier studies that were deemed relevant have been included. The age range for girls and boys in this review was defined as 12-18 years of age. Many studies included both children and youth and were thus retained. In some circumstances, studies on children only have been included to indicate where information seems to correspond or differ from studies of adolescents. We felt that this additional information helped to examine stage-of-youth or developmental trends.

For the purposes of a comprehensive literature review grey literatures were also included (e.g. community reports, magazine articles, and sustainable transportation and environmental programs and resources). Nearly 200 academics and program coordinators across North America, Australia, New Zealand and the U.K. were contacted by email to facilitate the search for grey literature.

1.2 Search results

One hundred and twenty-four articles and documents were identified through the searches and also met criteria for dates, age, and relevance.

2. Why focus on youth and sustainable transportation?

> *Unless effective population-level interventions to reduce obesity are developed, the steady rise in life expectancy observed in the modern era may soon come to an end and the youth of today may, on average, live less healthy and possibly even shorter lives than their parents (p.1143) [2].*

This literature review was prompted by disturbing trends with respect to the health and well-being of Canadian children and youth. These trends include decreasing levels of physical activity, increasing levels of obesity, traffic fatalities, increasing exposure to air pollution, reduced independent mobility for youth and subsequent concerns over their well-being. The Centre for Sustainable Transportation has been documenting these trends and identifying the links to transport and land-use planning.

For example, children and youth appear to be travelling much more by car, reducing their opportunities for exercise via walking or bicycling to their destinations (Section 3). Furthermore, decreased independent mobility and increased reliance on automobile use may be associated with weight gain and compromised emotional development for youth (Sections 7.1 and 7.5).

Compared to adults, young people are especially vulnerable to the adverse health effects of motorized traffic, including poor air quality inside vehicles and poor air quality outdoors that results from motorized traffic in the community (Section 7.2).

The transport needs of young people differ from those of adults, partly because their destinations are different and partly because they travel using different modes. On schooldays, for example, the majority of walking and cycling trips are still made by young people notwithstanding the notable increases in travel by car (Section 4). Thus, facilities for non-motorized modes are much more important for young people's travel than they are for adults.

Overall, about 20 per cent of all local trips may be made by young people, a significant share that necessitates attention to their transport needs. As detailed within this document, there are compelling reasons to be concerned about transport, young people and land use. The following list briefly touches upon several issues of concern:

- Young people appear to be spending more time in cars.
- Car travel is replacing walking and cycling, removing critical opportunities for physical activity.
- Some car travel has replaced transit use, reducing both the present and the future viability of transit systems, and further reducing young people's opportunities for physical activity.
- Growth in young people's travel by car may contribute to growth in the overall amount of motorized transport activity and thus increased emissions of globally active pollutants, including those associated with climate change.
- Being in cars can be harmful, because in-car air quality can be lower than ambient air quality and because travel by car can limit opportunities for youth to explore and become acquainted with the physical geography and environment of their local communities.
- Increased car travel (and car idling) around schools and other places where youth congregate will lead to increases in air pollution within these vicinities.

- Whether or not young people travel by car, they are more susceptible than adults to increased pollution resulting from traffic growth.
- Reducing motorized transportation is a central goal of most climate change strategies and will contribute to healthier environments for young people today as well as future generations.

2.1 Setting the context: transport and land use

How land is used is a key factor in how people and freight move. The more that neighbourhoods and settlements are spread out, the more cars are likely to be used, for two reasons. The first, which applies to most communities, is that when settlements are spread out, distances can be too far to access using non-motorized modes. The second is that low densities in larger urban areas make transit alternatives, e.g. public buses and trains, financially difficult to sustain.

There are also two potential processes whereby car use reinforces itself. The first process is the fundamental synergy between the automobile and low-density development. Specifically, increased reliance on vehicles has made low-density development possible; otherwise, there would be no ready access to such developments. Once constructed, low-density developments encourage car-use that in turn reinforces the place of cars in society, making more low-density development feasible and likely. The second mechanism, self-reinforcement, arises from the way that cars take over the landscape. Where there is heavy car traffic, travel by foot or bicycle—and even access to transit—can be challenging, less secure, and less enjoyable. This leads to further reliance on cars and further provision for cars, reducing the likelihood of travel by foot, bicycle or transit.

Another relevant aspect of land-use concerns smaller communities and the extent to which they have access to the facilities and resources needed for everyday living. Without local grocery stores, libraries, schools and parks, journeys must be made to distant communities, usually by car. Elementary and secondary schools are encountering declining enrolments and gradually being centralized in the majority of Canadian provinces. This means that on average, young people make longer journeys to and from school, and are more likely to travel by car or school bus than by foot or bicycle.

> *Between the school years that began in 1997-2002, enrolment in public elementary and secondary schools increased in Ontario and Alberta only. The population between the ages of 5-13 is projected to decrease by half a million between 2001 and 2011. The population aged 14-18 is projected to peak in 2008 at 2.2 million (p.40)* [3].

This trend of centralization is not exclusive to elementary and secondary schools. Small local stores have been replaced by stores in malls, usually at a greater distance from customers, or by larger stores serving a broader catchment area. Young people, who might once have learned much from running errands to a local store, now find themselves accompanying parents on long shopping trips by car.

Land-use density may be the most important factor influencing car use, but there are other factors. For example, the mixing of diverse land uses can be important: if schools, workplaces, and stores are near residences, the result may be more walking and bicycling [4]. If uses are clustered into nodes, transit may be viable along connecting corridors, even though overall urban densities are low.

As well as more general factors influencing overall use of the different modes, there can be local features that help favour one mode over another. An example is provision of sidewalks and bicycle lanes and paths. Another example is the particular positioning of schools and community facilities, which can be on main roads to facilitate access by motorized vehicles, or within neighbourhoods to facilitate access by pedestrians and cyclists (see Section 3.1.1).

Collectively, these factors raised further questions that are detailed in this document.

3. Where do youth typically travel and what modes do they use?

> *To help identify intervention opportunities, it is important to understand where youth go, how they get there, how long they spend, what they do there, and what influences their allocation of time and activities (p.36) [5].*

Research available from the U.S. tends to focus on general travel behaviour, or behaviours specific to a purpose (i.e. travel to school) or program, looks only at the availability of certain destinations (i.e. shopping malls), or investigates after-school activities [5]. As well, travel data in North America, generally overlooks non-motorized trips [6], and this bias often means that non-motorized trips by children and youth to local destinations are rarely counted or considered in transportation and land use decisions. This section presents research on typical destinations and modes of youth travel with links to land-use wherever available, while Section 4 focuses specifically upon the ways that urban form (including land-use) restricts opportunities for active travel among youth.

A German project from 2001 called “U.Move” surveyed 4,417 youth (ages 15-26) to investigate how, where and why young people traveled. This study indicated that the top leisure activity reported by 15-17 year olds was being with friends (86.9%), and showed that travel needs and travel patterns changed with age. Younger adolescents (especially those in non-urban country areas) were unable to go to concerts, movies and theatres as they wished; however, older adolescents were able to “make up for residential deficiencies by means of their own mobility,” (p.33) [7] often through use of a car. U.Move also showed that land use significantly predicted whether youth obtained a driver’s license and this was linked to the distances that youth traveled to get to their place of work or training (i.e. school). Young people living in the country were more likely to have a driver’s license, and 70% traveled more than 30 minutes to get to work or training compared to 75% of young people in the city that required no more than 30 minutes.

In 2005, Cain & Sibley-Perone [8] investigated the use of transit by teens in the U.S. through a review of literature, focus groups with parents and teenagers in Florida, and a survey of transit agencies across the country. A major challenge in conducting the literature review was that youth ridership in the U.S. was often merged with adult data. Nevertheless, findings showed that children and youth under 18 years of age constituted over 25% of the US population, but only 1-3% of this age group were regular transit users. As well, restrictions on teenage mobility included driving age regulations, travel costs, parental safety concerns, and low-density urban development patterns that limited teenagers' ability to walk or cycle. Focus group research revealed that teen modal choice (transit versus car) was influenced by concerns about safety, cost, access and availability, reliability, and image. The private vehicle was viewed by many youth as having clear advantages over transit for social image (i.e. "coolness," which includes freedom and independence), convenience of shorter travel times, and reliability (pending a valid license, availability of a car, and parental permission to drive alone or with friends). In contrast, there were perceived advantages of transit over the use of a private car with respect to the cost of travel. For issues of safety, there were concerns for taking transit as well as using a private vehicle. For example, both parents and teenagers indicated that taking transit after dark was too dangerous. At the same time, parents were concerned about the safety of their teenaged children driving by themselves or with their friends, and also concerned about the burden of having to drive their teenaged children around. In order to highlight the advantages of transit versus travel by private vehicles, three marketing strategies were identified, as indicated in the table below.

Table 1: Potential Marketing Messages to Promote Transit Use among Youth (p.42) [8]

Underlying Issue	Teenager	Parent	Potential Marketing Message	
Independent mobility	Dependent on parents for transportation	Transporting children is time-consuming	Teenagers:	Independence afforded by transit
			Parents:	Don't have to spend time providing child's transportation
Safety	Concerned about the responsibility of driving	Concerned about child driving unsupervised or traveling with other teenage drivers	Parent /Teenager:	Highlight the safety benefits of using transit
Cost	High cost of car travel	High cost of car travel	Teenagers:	Highlight how much money could be saved for other more important things (proms, etc.)
			Parents:	Highlight how much money could be saved by not having to provide a car for their child

In Southern Ontario (Canada), the Transportation Tomorrow Survey (TTS), conducted every 5 years since 1986, provides a wealth of data on the weekday travel of Canadians aged 10 years and older [9, 10]. This has been a well-used and valuable resource for land-use planners, transport planners, and academic researchers in South-Central Ontario. Similar survey data across time are available for the Edmonton region (1994 and 2005)

[11], Ottawa-Gatineau (1986, 1995, and 2005) [12], and Montreal (1970, 1974, 1978, 1982, 1987, 1993, 1998, and 2003) [13].

Analysis of TTS data over time shows remarkable and progressive increases in per-capita automobile trips by 11-15 year-olds across the years 1986 to 2006. The increases were by 111% for Toronto and by 80% for the rest of the Greater Toronto and Hamilton Area (GTHA). In 1986, active transport was the predominant means of travel for 11-15 year-olds in both Toronto and the GTHA. However, by 2006, car travel had become the main mode of travel outside Toronto and would soon become the main mode within Toronto. Transit use by 11-15 year-olds also fell by 16% in Toronto and by 38% in the rest of the GTHA.

Detailed analysis of the trip to school for 11-15 year-olds shows that just over half of the new car trips in 2006, compared with 1986, were to or from school in both Toronto and the rest of the GTHA. Just under half were for other purposes. In Toronto, the new car travel to and from school mostly replaced travel by transit or active transport. Outside Toronto, the new car travel replaced active transport; there was little transit use to replace. Added car trips for purposes other than school-related travel appeared to be mostly *new* trips, i.e., trips made in 2006 that were not made in 1986. Rates of active transport and transit use for non-school-related purposes remained similar across the years. One result of these trends has been that the share of 11-15 year-olds living in the City of Toronto who walked or biked to school fell below half between 1986 and 2006, falling from 53.7% to 45.8%. The share in the rest of the GTHA remained relatively constant at a lower level: 26.7% in 1986 and 26.2% in 2006.

Car travel by 16-20 year-olds changed relatively little across the period 1986-2006, in sharp contrast to that of 11-15 year-olds. Per-capita travel by 16-20 year-olds as a car driver *decreased* by 52% in Toronto and by 30% in the rest of the GTHA. Per-capita travel as a car passenger *increased* by 36% in Toronto and by 40% in the rest of the GTA. Rates of active transport (walking and cycling) changed little in this age group between 1986 and 2006. These trips increased per capita by 9% in Toronto and by 1% in the rest of the GTHA. Similarly, travel by transit was relatively unchanged, rising by 4% and 11% respectively.

The most striking difference between these age groups is the already-noted large increase in car travel by 11-15 year-olds between 1986 and 2006 compared with little or no change by 16-20 year-olds. Nevertheless, the older group still travelled more by car in 2006: 9% more in Toronto and 31% more in the rest of the GTHA. The older age group travelled much more by transit than the 11-15 year-olds: more than twice as much in Toronto and almost four times as much in the rest of the GTHA. Conversely, rates of active transport were higher for 11-15 year-olds than for 16-20 year-olds. They were just over twice as high in Toronto and just under twice as high in the rest of the GTHA.

Overall, it is clear from examples in Canada and the U.S. that motorized transport for youth has increased over the years, with some indication that private cars are used more than public transit, and the use of active transport has decreased. The next section

examines the trip to school, focussing primarily on rates of private car use versus walking or cycling.

3.1 The trip to school

Worldwide, trends in travel patterns for the trip to school vary from country to country and within each country. In Britain, the rate of active transport in 2006 was 52% for elementary school children and 42% for secondary school students [14]. In Australia, rates of children walking to school have been reported to be 21.1% for children aged 10-14 in Sydney [15], 35% for 6 and 9 year old children in Melbourne, and 31% for the same age group in Perth [16]. Similarly, another Australian study that surveyed parents of 4-13 year olds from all eight capital cities reported that 41% of all children walked or cycled to school at least once per week [17]. Adding to this concern of low rates of active commuting, many reports indicate a decline in walking rates over the last few decades [15, 18, 19]. Notable exceptions to low and declining rates of active commuting to school are found in China, the Philippines and Switzerland. A study from China [20] found that active commuting to school was common (88%) and bicycle travel was the most common mode for 12-14 year olds. Similar results were found in another study that compared commuting patterns of school children in China and the Philippines [21]. The rate of active school commuting for Chinese youth (ages 14-16) was 77-90% and in the Philippines, 70-71% of students walked or cycled to school. Work in Switzerland [22] used parental questionnaires to determine active commuting rates of 4th and 5th grade students. Reports indicated that 78% actively traveled to school, while 12% were driven at least once a week by car.

In Canada, data from Quebec and Ontario illustrate the diversity in the mode of transportation used for the trip to school. In Quebec [23], a study found that 40.3% of 9 year olds, 15.2% of 13 year olds, and 13% of 16 year olds walked to school. Only 1.2% of 9 year olds, 11.3% of 13 year olds and 13.8% of 16 year olds used public transit; 33.1% of 9 year olds, 51.2% of 13 year olds and 55.6% of 16 year olds travelled by school bus; finally, 14.2% of 9 year olds, 7.3% of 13 year olds and 5% of 16 year olds were transported by car. Girls, children from higher income households, children of immigrants, and children living in rural areas were less likely to walk to school. Cycling, skateboarding and rollerblading to school were not included in the study. An Ontario study [24] involving 21,345 youth in 76 high schools (grades 9-12) found that 42.5% of the students reported actively commuting to school. Similar to the Quebec study, girls and students living in rural areas were less likely to engage in active commuting, as were students in grade 12, students who smoked daily, students who reported low to moderate physical activity and students who attended a rural school.

In the U.S., the National Personal Transportation survey indicates that rates of active commuting to school have declined from 40.7% in 1969 to 12.9% in 2001 [19]. Smaller state and city-based studies conducted from 2001 onwards confirm that there are low levels of active commuting to school, especially among older youth. For example, a travel behaviour study of middle school (grades 6-8) and high school (grades 9-12) students in North Carolina [25] reported that 9.4% of the middle school students usually

walked and 4.1% usually biked to school at least 1 day per week. However, only 4.9% of high school students usually walked and 2.8% bicycled at least 1 day per week. Another U.S. study also shows great variability in modal patterns of youth across the country, with highest rates of walking among Western states (e.g. California and Washington) and lowest rates among the East South Central States (e.g. Alabama and Kentucky) [26].

There is also a growing recognition that intra-household interactions have a bearing on travel mode choices made for and by children and youth. Children's maturity, gender, ethnicity and the employment characteristics of parents have been explored. For a more extensive review of this literature see research by McMillan [27]. Main findings regarding intra-household characteristics are as follows:

- Older youth are less likely to be driven by their parents until they reach driving age;
- Girls are more likely to be driven than boys (see Section 5.1 for a discussion of sex and gender differences);
- Youth living in a household where the mother is working are more likely to be chauffeured;
- Youth of well-educated parents are less likely to actively commute to school (see Section 5.2 on socioeconomic status and Section 6.2 on car ownership);
- Parents' perception of neighbourhood and traffic safety may also influence the travel mode of youth to school (see Section 6).

A U.S. study [26] involving 8,231 children and youth ages 5-18 looked at household interactions, i.e. parental employment status, commuting patterns, and their influence on non-motorized travel by youth to school. Results showed that 11% of children make the trip to school by themselves. For all others, mothers were the most likely travel companions, whether employed or homemakers, and regardless of their children's travel mode to school (by car or on foot). In households where the mother commuted to work in the morning, young children (ages 5-14) were less likely to use non-motorized transportation to travel to school. As well, when using a model to predict modes of commuting, walking rates increased among this younger age group by 2% with yearly increases in age; however, in the older age group (ages 15-18), having a driver's license decreased the probability of walking by 9%. Overall, students in this study made 55% of their trips to school by automobile, 31% by school bus, 12.5% by walking and 0.8% by bicycle.

With respect to transit use for school travel, little information is available. The Florida transit study [8] mentioned in the previous section found that some transit authorities partnered with school boards while other transit authorities were concerned that the use of school buses reduced the sustainability of transit programs. The authors noted that children under age 12 were not likely to use transit unaccompanied, and the most likely age group to consider transit for the trip to school were teens ranging in age from 12-16. Overall, transit authorities in the Florida study indicated that efforts to educate teens and promote benefits of transit required the support of school boards.

3.1.1 Distance to school

Distance to school appears to be one of the most important determinants of active commuting [17, 18, 22, 28-31]. There is some evidence that a distance of 1 mile (1.6 km) for walking or 2 miles (3.22 km) for cycling may be considered reasonable for youth 9-15 years of age to travel to school [32]. The distance between home and school is found to significantly and negatively impact the choice of walking to and from school, with greater consequences on the trip to school. Distance, however, may not affect the choice of cycling to school in the same way as walking, as a California study found that distance is a significant predictor for walking trips but not for cycling trips [28]. This study also showed that there are differences in travel modes between the trip to school and the return trip. Authors suggested that while trip distance is a primary determinant of travel choice, time constraints in the morning combined with trip distance may prompt households to drive children to school.

A Georgia study [30] used distance from school and traffic speeds to estimate numbers of students who could safely walk to school. Using a distance of 0.5 – 1 mile (0.8-1.6 km) and taking posted speed limits for cars into account, it was determined that 6% of elementary school students, 11% of middle school students, and 6% of high school could safely walk to school. These percentages provide insight into the low rates of active commuting cited in urban U.S. studies previously referenced.

3.2 Leisure and non-school trips

The majority of research on travel mode for children and youth has addressed the trip to and from school. There are fewer studies that consider children and youth travel behaviour for leisure or work.

A study from 1995 [33] investigated barriers for travel to leisure destinations encountered by non-driving young adolescents (ages 13-16) in Southern New England (U.S.). Using interviews, this study found that a common concern among youth was the inability to independently access leisure pursuits. Constraints on mobility and frustrations with a lack of places to “hang out” with friends also emerged from the interviews. Many youth felt that they lacked a place for socializing with their friends. For some, even if space for socializing existed (e.g. friends houses, or shopping malls) they were beyond their independent reach and needed to rely upon their parents for rides. Differences were seen by neighbourhood type and youth age and will be explored further in Section 4.

Moreover, urban youth complained that transit routes and schedules did not meet their needs and many destinations were not within walking or cycling distance. Only a small percentage of youth living on the rural-urban fringe were able to actively commute to their leisure destinations because of large distances or busy roads along the route.

The authors also noted gender differences in leisure activities and destinations. Younger girls in their study preferred more one-on-one interactions with friends, and younger boys engaged more often in a group activity in the neighbourhood. The consequence of this

was that girls needed to organize social activities in advance and were more dependent on their parents if a particular friend lived far away, while boys could spontaneously and independently join a game nearby.

A Swedish study [34] considered the impact of mobile phones on youth travel patterns and noted that these devices permit youth to make spontaneous plans to meet with friends. Technology, transport and land use planning that enable this spontaneous travel without the need for a private vehicle are likely to support sustainable transportation for young people and should be explored further.

Recent work in Canada gleaned information from youth focus groups about their leisure destinations [35]. Results showed that youth in the regions of Halton and Peel (Ontario, Canada) voiced similar challenges to Florida youth [8] regarding the routes and schedules of transit. This was a particular concern for trips after-school to work. Youth stated that it could take up to an hour to get to work, after one or more transfers on transit. This made it more likely that they would ask to borrow the family vehicle or request a ride from a parent. Overall, since every transit trip begins with active transportation, we see that the factors that foster walking can influence transit use and service [8].

3.3 Summary

The main destination for typical youth travel considered in Section 3 was the trip to school. Active commuting to school has steadily decreased over the past few decades, with distance to school identified as a key determinant. Studies have suggested that school boards should be involved in travel planning by collaborating with land planners and transit authorities as well as adopting travel planning policies. It is also recommended that researchers conduct longitudinal studies to track changes in youth travel behaviour to school and other destinations as a result of any travel planning policies that are implemented.

Leisure and non-school trips by youth have been identified as a critical research gap. While many researchers have considered walking and driving modes of transport, few have explored factors related to cycling, skateboarding or other forms of active transportation. Future research on youth transport must consider parental concerns, leisure pursuits, part-time jobs, and the availability and accessibility of private cars, public transportation and other modes. Input from youth on transit routes and schedules have also been identified as areas that must be addressed to promote independent travel of youth. Youth living in rural areas, small towns or in the rural-urban fringe have specific sustainable transportation barriers for school and non-school trips, including access to recreation facilities.

4. Urban form and youth travel

> *Communities are traditionally built with one transportation mode and user in mind – the adult automobile driver (p.75) [36].*

Community design and youth behaviour warrant greater attention, particularly with respect to public health interventions. Limited research has considered how the "relationships between community design and physical activity may be unique for youth" (p.37) [5]. In 2007, research in Atlanta, U.S. [37] looked at pedestrian travel of 3,161 children and youth aged 5-18 using a survey and a structured two-day diary. The study looked at five urban form variables (intersection density, residential density, mixed land use, commercial land use, and recreation/open space use) and found that the urban form factors that affect adult walking behaviour correspond to the factors that influence youth walking behaviour. The data showed variations in walking patterns according to ethnicity, income, and car ownership: non-Caucasian participants, participants in households with less than $30,000 annual income, and participants in households with less than three cars were more likely to walk compared to others. After controlling for socio-demographic variables, logistic regression analyses indicated that all five urban form variables were significantly related to walking among Caucasian participants. Specifically, those living in areas with greater intersection density, greater residential density, in mixed land use (versus no mix), at least one commercial land use, and at least one open space for recreation were more likely to walk. Among non-Caucasian youth, mixed land use and having at least one recreation space were the only variables significantly related to walking. Furthermore, among low-income and non-Causasian youth, it appeared that lack of access to a car (less than 3 cars per household) was the underlying motivator for their walking behaviour, and not walkable neighbourhood features. Accordingly, authors concluded, "lack of access to a car creates a necessity to walk that overcomes any potential benefits of living in a walkable neighbourhood offering access to commercial and recreation facilities" (p.181) [37].

A Southern New England study previously cited explains that urban form may impact youth leisure time and active transportation by constraining opportunities for youth to spend time with their friends, and limiting the types of activities youth can engage in [33]. In illustration:

> *The existence of high density, mixed land use in the city, and to a lesser extent in the suburban town, meant that friends usually lived within walking distance and "hanging out" or "chilling" was achieved by simply walking to a friend's house. For the younger adolescents in the suburban town, neighborhoods also formed the focus for their social interaction and unstructured activities such as street hockey, soccer, and skate boarding were organized and accessed easily. For the younger suburban girls, spending time at friends' houses formed the dominant component of their unstructured leisure time. A rather different picture emerged for the youth living in the relatively affluent rural-urban fringe community. Because of*

> *the prevalence of large lot zoning (frequently 2 acres), impromptu "get-togethers" were less common (p.367) [33].*

Links between urban form and walking behaviour among combined samples of youth and adults were also explored in a 2004 meta-analysis [6]. The analysis showed that two fundamental concepts of urban form: proximity (mixed land use) and connectivity (directness), influenced choice of travel mode. As well, three environmental characteristics were consistently found to be associated with greater walkability within a neighbourhood: higher population density, greater mixed land use and higher connectivity. Authors indicated that "averaging across all studies and trip purposes, high walkable neighborhood residents reported approximately two times more walking trips per week than low walkable neighborhood residents (3.1 versus 1.4 trips)" (p.255-6) [6]. Residents in high walkable neighbourhoods may make 1-2 more walking trips per week of 1-2 kilometre distances than residents in low walkable neighbourhoods. This could amount to an increase of about 15-30 minutes of walking per week for residents in high walkable neighbourhoods. Walking as a form of sustainable physical activity may be especially important when considering relationships between urban form, youth travel, and youth well-being. These topics are explored further in Section 7.

4.1 School setting

> *Children's travel behaviour is a topic poorly understood by planning academics and practitioners alike, as indicated by the dearth of literature on the topic and the lack of planning for children's travel, particularly for their travel to school (p. 441) [27].*

Urban form and school setting are often discussed using the term "school sprawl" to make the analogy to urban sprawl. Many authors discuss distance and residential density as factors that influence active commuting to school. Evidently, school-setting policies in the past have encouraged schools to be located on tracts of land that allow for large campuses resulting in school locations outside of residential areas. Analysis of active transportation trends of American school children concluded that "nearly half of the decline in walking between 1969 and 2001 can be tied to increased distance between home and school during the study period" (p.509) [19].

There is a growing body of literature looking at urban form and the trip to school and considerable discussion regarding the school setting. A Swiss study [22] looked at the environmental factors associated with active commuting to school for 1st, 4th, and 8th grade students using parental questionnaires. Results showed that the number of major road crossings and distance between home and school were significantly related to the usual mode of transportation. These had an impact on parental safety concerns as well. Research in Portugal that looked exclusively at girls ages 13-16 found that street connectivity (number of four-way intersections) was a positive predictor of active transportation [38]. Work in the U.S. found that neighbourhood density had a positive association with active travel by students ranging from 5-13 years of age [18]. Travel

time and distance were the most critical variables influencing travel mode. Using travel time as a proxy for distance, this study found that "a 1 minute increase in walk travel time leads to a 0.2% decline in an individual's probability of walking; a 10% increase in walk travel time leads to a 7.5% decrease in walk mode share" (p.28) [18]. As this study looked at more than 6,000 American children, the author suggested the following policy implications:

> *If policymakers want to greatly increase the number of students walking to school, long-term strategies must encourage schools to be located near students. Addressing the spatial distribution of students and schools requires coordination of school, land use, and transportation planning (p.30) [18].*

In a Georgia study previously cited, data showed that high population density, small enrolment size and high street connectivity were associated with a greater likelihood of safely walking to school. These results are supported by a study in Minnesota that used geographic information systems (GIS) and available travel data (e.g. bus routes) to examine travel to school patterns [39]. The Minnesota study showed that students enrolled in neighbourhood schools came from smaller geographic areas than students in city-wide schools, and were thus more than six times as likely to walk to school. In conclusion, authors indicated that "the growing size of schools (more so for secondary schools than elementary schools…) also increases average travel distances and reduces the option to walk" (p.516) [39].

Another U.S. study determined that a distance of less than one mile (1.6 km) between home and school makes it three times more likely that a child will actively commute to school (walking or cycling) [36]. The complexity of social and environmental factors was considered in an Australian study [40] dealing with school-aged children up to 12 years of age. Findings are discussed as they are likely applicable to younger youth. The authours found that active commuting to school was negatively correlated with parental perceptions that there were few children in the neighbourhood, no lights at intersections and busy roads on the route to school. As well, children were more likely to actively commute if their route was less than 800 metres. Authours concluded, elementary "school location in relation to residential areas and major traffic routes is an important factor that should be considered in planning for new communities and when school zoning decisions are made" (p.50) [40]. This recommendation is equally applicable to youth who travel to middle and high schools.

4.1.1 School travel planning

Many of the challenges and concerns raised in this review are shared by governments and communities internationally. An effective response has been the development of school travel planning (STP) [41]. This involves collaboration amongst all key stakeholders who have an interest in student travel. Together, they identify and address barriers to active commuting which may include physical or attitudinal barriers. This bridges jurisdictions between municipalities and educators. Examples of actions that have been taken include:

- *Coordination with local municipal engineering, planning, and school district staff to design and implement engineering improvements and other changes at school sites – e.g. pedestrian crossings, adult crossing guards, repairs and upgrades to footpaths, signage;*
- *Introduction of school infrastructure – e.g. bike shelters, bike racks, lockers;*
- *Coordination with transport and safety agencies – e.g. understanding existing guidelines such as Transportation Association of Canada's New Guidelines for School and Playground Areas and Zones and how they intersect with the goals of the STP project;*
- *Education – e.g. safety training for walking and cycling;*
- *Community mobilization – e.g. walking school buses, walking buddies, ride sharing;*
- *Encouragement – e.g. celebrations of physical activity and environment, recognition and rewards for walking/biking (p.3) [41].*

In the end, a comprehensive school travel plan policy in Canada must have a solid vision, and appreciate the necessary processes and funding required for schools to address their specific travel issues through appropriate solutions. After all, "this is the best way forward to improve the health and safety of all of Canada's children and communities"(p.2) [41].

4.2 Summary

Overall, Section 4 shows that youth choices about travel mode and destination are impacted by environmental variables like intersection density, residential density, mixed land use, commercial land use and recreation/open space use. While circumstances may differ for youth based on their demographic characteristics, youth living in neighbourhoods deemed "walkable," and youth living closer to school and desired leisure destinations were more likely to use active forms of transportation.

There is a growing body of research regarding the school setting (i.e. spatial distribution of schools relative to students) and safety concerns (i.e. road crossings and street connectivity); however, longitudinal research is required to track whether youth-friendly school zoning decisions can actually improve rates of active commuting to school among youth. Since individual schools and municipalities may face unique issues with respect to active commuting, it is recommended that each jurisdiction form youth advisory bodies to help identify barriers and brainstorm potential solutions.

5. Demographic characteristics and youth travel

It is becoming increasingly clear that youth live within physical and social environments that favour motorized transportation over non-motorized transportation. For example, large distances between destinations [31], lack of traffic calmed areas or road safety features (e.g. cross-walks, well-lit areas) [42], parental discouragement of active travel modes for safety or other reasons [8], and lack of parents using active transportation [29]

are all likely to result in youth using motorized transportation over non-motorized modes of travel. In addition, demographic characteristics like gender and sex, socioeconomic status, and ethnicity may also impact youth travel opportunities and choices. Each of these demographic factors is discussed in the subsections that follow.

5.1 Gender and Sex

> *Being female decreases the odds of walking/bicycling to school by 40% (p.83) [36].*

The majority of studies that compare males and females with respect to active travel to school find that female youth are less likely to walk than male youth [23, 26, 28, 43] and differences are more prominent at younger ages [25, 44]. At the same time, some research indicates that having a caregiver who is physically active may increase the likelihood that females walk or cycle to school [36]. In these studies, a simple sex analysis was used comparing boys and girls. Studies detailed below go one step further and explored *why* behaviours may have been different among boys and girls, giving some indication as to how gender, i.e. expressions of femininity or masculinity, may affect rates of active transportation. Therefore this section builds upon simple sex-analyses and discusses the ways that gender relates to decisions related to active transportation.

Differences in active transportation between boys and girls may be due to a variety of factors. An Australian study finds that boys are more active than girls in their free time and more likely to engage in active transportation in their neighbourhood [45]. Other research suggests that even if girls are less likely to walk to school, they are more likely to walk for exercise compared to boys, while boys are more likely to cycle [46]. Similar findings are cited for elementary school children [29]. When considered together, these studies present the case that boys engage in a greater amount (time) and intensity of active commuting, or physical activity, compared to girls. Research from sport sociology explains that the practice of gender in North America and more generally in the western world has created a hierarchy where boys and men are encouraged and expected to be physically active more than girls and women [47]. Therefore, girls may be less likely to engage in active transportation that may result in physical benefits like strength and physiological responses like sweating, "because of the lower value placed on female participation and its lesser relevance to feminine physicality and feminine identity" (p.89) [47].

In addition, studies on active commuting indicate that higher rates among boys may be as a result of having local friends to be active with. A study of youth shows that boys are more likely than girls to report having friends in their neighbourhood [46], and research on children [40] also finds that children are less likely to actively commute if there are few children for them to play with and be with. Research also suggests that differences in walking and cycling behaviour between boys and girls may be linked with gendered perceptions of safety and risk-taking. A US study [48] looked at exposure to traffic and injury rates of urban children ages 4-15 years. Results showed that boys were admitted to

the hospital with pedestrian injuries more than girls, and concluded that boys engage in more risky pedestrian behaviour than girls. This willingness among boys to engage in potentially risky behaviours may explain why boys are also more likely to walk (and cycle) compared to girls. Similarly, an Australian study [16] found that there was little difference in overall walking levels between male and female children (ages 5-10) for the trip to school, however, boys were significantly more likely to cross streets without supervision. Therefore, the number of streets that must be crossed teamed with a perceived lack of safety or high perception of risk may deter girls from active commuting when they are young, and persist through adolescence.

5.2 Socioeconomic status

> *Children of all ages need and want places to play. To support the diversity of their physical activities, they need many types of recreational facilities, both public and private, near their homes and schools. To remedy the relative scarcity of such facilities in low-income neighborhoods, policy makers must ensure that these facilities are more equitably distributed (p.101) [49].*

Socioeconomic status has emerged as an important factor that influences young people's physical activity participation, and subsequently, active transportation; however, findings are inconsistent. In some instances, low-income residents may live closer to high traffic areas and thus have greater exposure to poor air quality or higher risk of injury compared to higher income residents [50]. Therefore, low-income students may be less likely to use active modes of transport on their trip to school and on their trips to leisure destinations. According to National data from the U.S. [51], lower socioeconomic youth have a greater likelihood of living further away from physical activity-related facilities, which are often preferred destinations for youth travel. This implies that youth from lower socioeconomic status families have greater distances to travel to get to these destinations, and these distances may necessitate the use of motorized forms of transportation, e.g. busses or cars. Thus, restricted access to physical activity facilities teamed with high traffic areas may compromise opportunities for youth to be active via structured physical activities and active transportation.

On the other hand, household income may also determine whether there is a vehicle available to transport family members to leisure and school destinations, potentially favouring use of active forms of travel in low-income families without access to a car. Lower socio-economic status (and likely lack of vehicle availability) has been associated with higher levels of walking in Australia [16]. Conversely, vehicle availability is shown to favour motorized transport over active transport in Quebec, Canada [23] Atlanta, U.S. [37], and Portugal [38]. Of exception to this trend of higher socio-economic status (i.e. vehicle availability) and lower rates of walking, structural and environmental measures have been taken in Denmark to foster active commuting to school for all students, regardless of neighbourhood income. For example, half of Danish children live within 1.5 km of their school, and pedestrian safety infrastructure and lower traffic speeds have been enforced within all neighbourhoods to promote safe journeys for students on foot or

bicycle. Therefore, socioeconomic status is less likely to influence travel mode in Denmark [52].

In other research studies, parental education is used as a proxy for socioeconomic status. Studies looking at parental education and active commuting have found that education is negatively associated with the use of active forms of transportation. In North Carolina, higher parental education was found to be associated with reduced likelihood of walking to school amongst high school students [25]. Similar results were found using a large sample of American youth ages 9-15 where students whose parents had an advanced degree were less likely to be active travelers [32]. Further support comes from a study in Portugal [38] that focused solely on girls in grades 7-12 and found that the father's educational level was significantly and negatively associated with active transportation.

5.3 Ethnicity

A number of American studies have found that there are differences in travel patterns between Caucasian and all other students in the U.S., and these differences are likely attributable to markers of socioeconomic status like household income, density, neighbourhood composition and car ownership [18, 26]. Some studies [25, 28] indicate that rates of active transportation may actually be lower among Caucasian students compared to all other students, and may actually reflect "cultural differences across ethnicities on mode-choice decisions" (p.214) [28]. One study modeled travel patterns of Caucasian and Asian children and found that Asian children were more likely to walk independently to school compared to Caucasian children, and Caucasian children were less likely to use transit to travel to school compared to Asian children. Similarly, an extensive study in North Carolina [25] looked at travel by middle school and high school students and found that among both groups, walking was less prevalent among Caucasian students compared to all other students.

5.4 Summary

Overall, exploring youth travel with a specific focus on gender and sex, socioeconomic status and ethnicity has shown that personal characteristics may impact decisions around travel in complex ways. Section 5 shows that mode of active transportation and choice of active transportation versus motorized transportation among boys and girls may be linked with their willingness to be physically active, number of local friends to be active with, perceptions of safety, and willingness to take risks. There's some indication that the willingness of parents or caregivers to support and engage in physically active behaviours may also play a key role in youth active commuting, therefore parental influences are explored further in Section 6.

Research shows that socioeconomic status may indirectly impact youth travel mode via environmental factors often associated with low and high-income areas or low and high-income families. Inconsistent findings relate to the various ways that socio-economic status is defined, and the social systems in place to neutralize effects of neighbourhood income.

With respect to ethnicity, we see that there are variations in patterns of active transportation by ethnic groups in multicultural countries like North America and Canada; however, these may be related to combinations of socioeconomic status and cultural differences in preferred mode-choices. Overall, it is recommended that demographic characteristics are considered when designing future research studies on youth and transport, school travel policies and forming youth advisory bodies.

6. Parental influence on youth transportation choices

> *Children [express] clear and definite views, often diverging from their parents, relating to their transport preferences, the environmental impact of different transport modes, and the benefits of walking and cycling in terms of safe accompanied travel, sociability, and health and fitness (p.864) [53].*

Urban form, land use and distance to school affect the travel options that are available to youth, the choices that youth make, and the choices that are made for them. Research presented in this section largely discusses data on children, not youth, however, issues raised are applicable to younger groups of youth and youth in families with highly protective parents. As well, when comparing studies conducted with groups of younger and older children, developmental trends are seen that likely carry through adolescence. For example, there is some evidence that at younger ages, parents have greater influence over youth travel choices, and the traffic environment also plays a greater role. An Australian study comparing parental perceptions of the neighbourhood as correlates of active commuting among 5-6 year olds and 10-12 year olds [40] found that parents of younger children had significantly greater concerns about strangers, road safety, the presence of lights and crosswalks, and the number of roads that needed to be crossed on the way to school compared to parents of older children. Age and perceptions of child's maturity also emerged as important correlates of travel mode to leisure activities in a Swedish study of 8-11 year old children [54]. Using travel diaries and questionnaires filled out by parents, data showed that parental attitudes towards the independent travel of their child was related to personal characteristics such as child's age, perceptions of the child's maturity, trust of the urban environment, need to protect their child, and presence of older children in the household. On the other hand, parental attitudes towards chauffeuring the child to school were related to environmental characteristics including traffic, quality of paths for walking and cycling and number of cars in the household. Overall, in 73% of the journeys documented in the diaries, parents had chosen the travel mode on behalf of their child.

A number of studies have looked at the perceptions of parents regarding the local neighbourhood. Nearly all of the available research has found associations between parental perceptions of the neighbourhood and active commuting by youth. One exception is a study of 9-15 year olds in Australia [45] that found that parental perceptions of neighbourhood risk were not related to students' choice to actively commute to school. However, in general, negative parental perceptions of the physical

environment are associated with lower rates of active transportation among youth, even if youth have positive perceptions of the neighbourhood. A study in Australia finds that adolescents 12-13 years old are more likely than their parents to see their neighbourhood as safe for walking and cycling [46]. In this study, 347 adolescents and their parents filled out questionnaires regarding youth transport choices. Data showed that parents with boys were more likely to perceive their neighbourhood was safe compared to parents of girls. At the same time, this study showed that the likelihood of girls cycling for recreation was associated with parental perceptions of the neighbourhood as having good places for being physically active. Similar findings are documented in an Australian study of 10-12 year olds that also finds that parental beliefs that there are no traffic lights or safe crossings is negatively associated with walking and cycling in the neighbourhood for boys [31]. Moreover, parental perceptions of road safety were related to the likelihood of youth, particularly girls, walking and cycling in the neighbourhood [46]. On weekdays, boys were more likely to cycle for transport if their parents had positive perceptions of the neighbourhood recreation facilities, and if boys reported having same-age peers to "hang out" with.

Similarly, another Australian study finds that peers are important companions for youth active transport; however, in this case, parents (not youth) were surveyed [17]. In this study, 720 parents filled out transportation questionnaires on behalf of their children (ages 4-13). Results showed that even though 50% of the children lived within a 15-minute walk to school, two out of three children were driven to school. When asked about barriers for their children actively commuting to school, parents cited traffic safety, fear of injury, and time, and nearly half of all parents indicated that their child preferred to be driven to school. This contrasts with student views in Ontario (Canada) in which 6,369 elementary school children completed a survey regarding their usual and preferred travel mode to school [55]. Nearly 75% of Ontario elementary children surveyed preferred to walk or cycle to school. A striking result from this survey was the large gap between the number of students who were actually cycling to school (3.5%) and those who preferred this mode of transportation (26.8%). Returning to the results from the Australian study, it appeared that parents of children who actively commuted to school were more aware of potential hazards that their children may face compared to other parents. Thus, parents who were concerned about injuries on the trip to school were nearly twice as likely to have children who walked or cycled to school.

6.1 Knowing neighbours – social capital

> *...parents are more likely to let their children walk when they live in neighborhoods where adults trust their neighbors (p.61) [56].*

Community connectedness [45], trusting the neighbourhood community and the presence of other children in the neighbourhood [40] have all been found to influence whether children use active modes for local travel. An Australian study [46] reported that boys and girls who waved or talked to their neighbours on most days and who considered the local roads to be safe were more likely to walk for exercise and for longer periods of

time. The authours suggested that children's friendships with neighbours may serve as a proxy for social interaction within the neighbourhood. Other research shows that neighbourhood design may actually promote walking behaviour and in turn, social capital. A study in Ireland [57] looked at the relationship between neighbourhood design: traditional, mixed-use, pedestrian-oriented neighbourhoods and car-oriented suburbs, and individual levels of social capital. Data showed that residents of walkable and mixed-use neighbourhoods were more likely to know their neighbours, express trust in others and be socially engaged. The authours suggested that walkable and mixed-use neighbourhoods may in fact encourage the development of social capital. For example, "spontaneous 'bumping into' neighbours, brief (seemingly trivial) conversations, or just waving hello can help to encourage a sense of trust and a sense of connection between people and the places they live" (p.1546) [57]. In sum, research illustrates direct and indirect reciprocal relationships between social capital and active transportation among youth.

6.2 Car ownership

Many studies already noted have found that car ownership affects modal choice for adults, youth and children. The relationship between car ownership and increased chauffeuring of children in cars has been raised as a concern [58]. In contrast, within low-income neighbourhoods, there may be fewer household cars, which results in more active commuting for children and youth, whether this is their preference or not. One study found that youth living in households with no car or one car were four times more likely to walk to their destinations than youth in households with three or more cars [37]. As well, a Swiss study [22] found that the number of cars in a household is significantly and negatively related to the frequency of active trips that children and youth take to school. Similar trends were found in an Australian study [16] in which less car ownership was positively associated with active travel, and research in Sweden [54] has found that car ownership correlates positively with parental attitudes towards chauffeuring as well as the frequency of trips made by car.

6.3 Summary

With respect to parental influence on youth transportation choices, researchers have highlighted issues of neighbourhood safety, time available for parents to chauffeur youth, and parental perceptions of their child's maturity. Because parents are more involved in transport choices of children and younger youth, parents play critical roles in shaping youth transport behaviours that are likely to persist through adolescence and adulthood. Therefore, parents must be involved as key stakeholders in creating and supporting youth-friendly transport planning and active transportation policies.

7. Transportation, urban form and well-being

> *If automobile-linked deaths in the US could be roughly estimated to be 50,000 (5,000 pedestrian deaths from injuries + 45,000 air pollution deaths), that would still be only one-quarter of the 200,000 deaths per year in the US attributable to physical inactivity (USDHHS, 1996). Thus physical inactivity is a far more serious public health problem, and the linkage with transportation means that health and physical activity need to become central concerns for the transportation field (p.251) [6].*

7.1 Physical inactivity and obesity

Neighbourhood design, physical activity, active commuting and obesity are the focus of a growing number of studies. A review of literature on children's physical activity and the built environment states that "physical activity has been engineered out of the daily lives of children through transportation systems, land-use patterns and neighbourhood designs that inhibit play and walking or cycling to school" (p.103) [59]. As these statements are equally applicable to youth, making changes to the built environment may prove effective in promoting youth physical activity and health. A similar view is reinforced by a U.S. study that looked at declining rates of walking among American children and youth for their trip to school, and considered the motorized trip to school as a lost opportunity for physical activity [19]. Furthermore, when considering the built environment, a review of thirty-three studies assessing the relationship between the physical environment and physical activity for children and youth ages 3-18 found that participants were more likely to be active in locations with sidewalks, walkable destinations, public transportation options, fewer uncontrolled intersections and low traffic density [60].

In Canada, data from 2002 indicates that over 50% of Canadian children and youth rely solely on inactive modes of transportation to travel to and from school, with a further 21% using inactive modes for at least part of the journey. Of greater concern, adolescents are more likely than children to commute to school using sedentary forms of transport, overall rates of physical activity have been shown to decline throughout adolescence, and girls are less active than boys with the gap increasing with age [61]. Moreover, research shows that physical activity participation is lower among obese youth compared to non-obese youth [62-64]. As physical activity is necessary for healthy growth and development, these decreasing rates of physical activity raise concerns about the current and future health of Canadian children [65].

Studies from the U.K. [66, 67], Australia [15, 45] and the U.S. [68] show that active forms of transportation are associated with higher levels of physical activity among children and youth. In Bristol, England, research with accelerometers and questionnaires compared physical activity levels of children who actively commuted to school with children who were driven. For boys, walking to school was associated with higher physical activity outside of school [67]. Work in Australia with 9-15 year-olds found that

youth who actively commuted to and from school were approximately 30% more likely to actively commute to other destinations [45]. Authors suggested, "active transport to school predicts a greater likelihood of actively commuting to other destinations in the neighbourhood, irrespective of overall physical activity levels, SES, and parents' perceptions of neighbourhood risk" (p.440) [45]. They also cautioned that encouraging active travel for youth in their local neighbourhood should be accompanied by reducing risk of injury through street design, traffic speeds and education. In the U.S., a study by the Centers for Disease Control (CDC) investigated the impact of infrastructure changes and education regarding the Safe Routes to School Program. Overall, the CDC found that the Safe Routes to School projects in the U.S. have improved the walking and cycling environment for adults as well as youth, and argued that investing in these projects can improve overall physical activity participation among adults and youth [68]. Further support for the link between levels of physical activity and active forms of transport comes from the World Health Organization. In their report, *A Physically Active Life through Everyday Transport*, they conducted an extensive literature review of everyday transport in European countries and concluded, "walking is the most important form of physical activity that should be encouraged to improve public health given that it is the activity most widely available" (p.9) [69].

There are only a few studies that specifically look at cycling and young people, even though cycling is often stated as the preferred mode by this age group [70]. In Odense, Denmark, youth who cycled to school were found to be more fit than those who walked or were chauffeured [71]. A U.S. review indicates that all forms of active commuting have the potential to generate sufficient volume of physical activity for general health benefits; however, with respect to cycling, the intensity of movement is sufficient for specifically enhancing the cardio-respiratory system [70].

While there appears to be a relationship between the built environment and the physical activity of young people, results are mixed regarding active commuting as an obesity prevention strategy, and most studies have focused on children [49, 72]. In one study, data showed that active commuting to school may not be sufficient to affect body mass index (BMI) but may still make valuable contributions to overall levels of physical activity [72]. BMI is an estimate of body composition, and is used to classify individuals as underweight, normal weight, overweight or obese. Looking at fourth grade students in California, another research team found that boys who actively commuted to school had lower BMI than children who did not actively commute to school. However, after examining results over a span of two years, no association was found between active commuting and BMI change or overweight status [73]. Thus, it was unclear whether active commuting had influenced BMI status or if leaner boys tended to commute actively for their trip to school. A Canadian study of high school youth found no relationship between BMI and active commuting [24]. Nevertheless, changes to the built environment and promotion of active transportation may play a prominent role in comprehensive strategies to mitigate increasing rates of childhood (and youth) obesity:

> *Changing the built environment to increase children's physical activity for recreation and transportation, to improve access to healthful foods, and to*

> *reduce access to less healthful foods can help provide long-term solutions to the childhood obesity epidemic. Unlike the often-transitory effects of motivational and education approaches to addressing obesity, changes in behavior prompted by changes in the built environment should be long lasting (p.100) [49].*

These statements are supported by a US study that examined the relationship of urban sprawl and overweight status of American youth [74]. In a cross-sectional analysis, urban sprawl was found to be associated with overweight status among youth and the strength of the relationship was comparable to that found for adults. Specifically, "adolescents living in sprawling counties were more likely to be overweight or at risk of overweight than those living in compact counties" (p.472) [74]. This relationship held even after controlling for socio-demographic and behavioural covariates.

7.2 Air quality

> *Because short automobile trips tend to have particularly high emission levels, increased active transport for short trips could reduce some of the most polluting automobile trips (p.263) [6] .*

A report commissioned for the World Health Organization (WHO) has found that children may be more vulnerable to airborne pollution because their airways are narrower than those of adults [75-78]. It was also suggested that there appears to be no threshold for ozone levels that are safe [75-78]. Other work for WHO and for the United Nations Economic Commission for Europe (UNECE) reviewed numerous reports of significant associations between respiratory symptoms or hospital attendance and exposure to particulate matter or nitrogen dioxide (two products of vehicle exhaust), or both [79]. Ten studies concerned children with asthma or other chronic respiratory disease. Of these, six reported a significant association between occurrence of respiratory symptoms and exposure to particulate matter, and three reported no significant association (one had no data on this matter). Three of the ten studies reported a significant association with exposure to nitrogen dioxide, and five reported no significant associations (two had no data on this matter). Six studies concerned hospitalization for asthma. Three of these reported a significant association with exposure to particulate matter; three reported no significant associations. Three reported a significant association with exposure to nitrogen dioxide; one reported no significant association (two had no data on this matter).

The same work reviewed studies of non-respiratory effects, including children's mortality and adverse pregnancy outcomes [79]. Significant associations in children have been reported between exposure to particulate matter or nitrogen dioxide, or both, and cancer, immune response effects, eye irritation, growth rate effects, intrauterine mortality, and low birth weight.

Further support for the detrimental health effects of traffic is available in smaller research studies. For example, research in Denver, Colorado, found that children and youth who

live near high-traffic areas (20,000 cars per day) may be six times more likely to develop childhood leukemia and other cancers [80]. Children living in areas of Europe and California with poor air quality have been found to have reduced lung function growth that places them at risk for future respiratory illness [75-78, 81, 82]. Children in low-income areas may experience multiple adverse health impacts from high traffic areas such as higher exposures to air and noise pollution, reduced opportunities for spontaneous play and higher risk of injury. These health inequalities have been framed as issues of environmental injustice (p.55) [50].

Other work has looked at the higher-than-average concentration of vehicle-related pollution at sidewalks and the location of vehicle tailpipes in relation to pedestrian traffic [83, 84]. For example, a study showed that "roadside and in-vehicle and out-of-vehicle concentrations were typically several times higher (in congested roads) than those measured at a background monitoring station" (p.55) [83]. An Australian study reported that pollution concentrations in pedestrian "breathing zones" resulting from passing vehicles (travelling less than 45 kilometres per hour) were on average six times higher when tailpipes were located on the curb side of the vehicle than when they were located on the other side [85]. As walking children and children in strollers are generally closer to tailpipes, the adverse effects of curbside tailpipe location may well be greater for them.

The adverse effect of air pollution on climate change should also be considered when discussing public health and commuting to school [15]. As noted in previous sections, distance to school is a major factor in determining whether young people will actively commute for the school trip. Therefore, attention to school location and infrastructure that supports active transportation may have a positive impact on air quality. Also, attending to other land use arrangements that encourage active transportation is likely to have a positive impact on air quality [86]. This is supported by a US study [39] that looked at the implications of school choice on travel behaviour and emissions. Children living near neighbourhood schools were found to be six times more likely to actively commute to school than students attending "city-wide" schools. Of concern was that longer motorized trips increased greenhouse gas emissions and passenger exposure to air pollutants in cars and buses. The authours also noted that while the societal and environmental health implications were important, these considerations seldom affected where families decided to send their children to school. Therefore, "integrating these factors into the planning by school districts could help to account for overall travel patterns and allow for more economically and environmentally sound implementation of school choice" (p.517) [39].

Research shows that the locations of schools, athletic fields and playgrounds can also impact student exposure to poor air quality if the school is situated near a high traffic area [87]. This introduces some complexities into planning considerations. It appears that situating schools and recreation areas within walking or cycling distances for young people is one consideration. Situating them away from high traffic areas is another.

In-vehicle air may be another source of pollutant that affects young people and individuals with compromised respiratory systems. A Finnish study found that preschool

children who were taken to day-care centres by car or bus had higher peak exposures to carbon monoxide than children who walked or who were taken by bicycle [88]. It was unclear whether higher exposures were related to the duration of car and bus journeys, or to the in-vehicle air quality itself. According to another report, "elevated in-car pollution concentrations particularly endanger children, the elderly, and people with asthma and other respiratory conditions. While it receives little attention, in-car air pollution may pose one of the greatest modern threats to human health" (p.5) [89].

Turning to studies that have looked at air quality on school buses, a New Brunswick report [90] determined that of the 95,000 students enrolled in New Brunswick schools, 77% rely on the school bus for transportation. The study looked at student exposures and found that children who walked to school had the lowest average exposure to all pollutants that were measured. Still, their particulate matter (PM) exposure was 9.7 _g/m^3, which exceeded the ambient PM concentrations. The average length of bus trip for students who were bussed was one hour per day and their exposure was 32.1 _g/m^3. The authours, however, caution a comparison of walkers and bussed students, as measurements for each group were not taken on the same day. Recommendations from the study included retrofitting buses whenever possible, buying low-emission buses when buses are replaced, using alternative interior ventilation systems, enforcing a no idling policy, reducing the number of bus stops or relocating routes to lower traffic density areas.

The Ontario Public Health Association investigated emissions from Ontario school buses and estimated that, "in 2004, Ontario's 15,000 school buses collectively emitted approximately: 114 tonnes of particulate matter, 718 tonnes of hydrocarbons, 2,601 tonnes of nitrogen oxides, and 285 kilotonnes of carbon dioxide" [91]. The study recommended that replacing pre-1994 school buses should be a high priority for school boards and that emissions reduction devices should be installed on all school buses. School boards were also encouraged to develop anti-idling policies.

A study of children's exposure to diesel exhaust on school buses in the United States indicated that concentrations of fine particulates were often 5-10 times higher than average levels measured at fixed-site monitoring stations [92, 93]. Another study conducted in California found that "a child riding inside of a diesel school bus may be exposed to as much as four times the level of toxic diesel exhaust as someone riding in a car ahead of it."(p.1) [94]. Another author reviewed relevant data and found that in comparison to ambient air, levels of benzene were found to be 2-18 times higher, levels of carbon monoxide were 2-14 times higher and levels of nitrogen dioxide were 1-2.5 times higher. Pollutant levels were especially high on fast-paced motorways and during rush hours. The review concluded that "drivers and passengers in cars may inhale up to 18 times as much pollution as people outside their vehicle, the worst occurring in slow-moving driving conditions in urban areas" (p.44) [95].

7.3 Noise

There has been little research looking at how transportation-related noise impacts children and youth. An Austrian study found that the low-level but chronic noise of moderate traffic can stress children and raise their blood pressure, heart rate, and level of stress hormones [96]. A review of related literature [97] found adverse impacts such as delays in reading and evidence of elevated stress through higher cortisol readings. Clear evidence on the effects of road traffic noise on the development and behaviour of young people may result from an ongoing major European Commission project (RANCH) [98]. In the meantime, work showing an adverse effect of aircraft noise on children's cognitive performance can be noted [99].

7.4 Traffic collisions

> *Urban children who are victims of pedestrian crashes have a high level of traffic exposure from a variety of circumstances related to their routine outdoor playing and street crossing activities. ...Future pedestrian injury programs should address the pervasive nature of children's exposure to traffic during their routine outdoor activities (p.231) [48].*

Traffic collisions continue to be the leading cause of injury related death for Canadian children over the age of one year [100-105] and risk of harm to a child from traffic is considerably higher than the risk of harm from a stranger [106]. While the rates of traffic-related injury and fatality are generally lower for children than for adults, this is likely due to the fact that for any vehicle speed, children appear more able than adults to survive crashes without serious injury or death [107]. Nevertheless, empirical evidence indicates that the number of injuries and fatalities resulting from traffic crashes increases dramatically with the speed of the vehicle at the time of impact. For example, one U.S. study reported that compared with crashes involving a vehicle travelling 16-31 kilometres per hour, the risk of serious injury or death to a pedestrian under 20 years old was 2.1, 7.2, and 30.7 times higher at vehicle crash speeds of 32-47, 48-63, and 64 kilometres per hour or more, respectively [107]. Thus, the exposure of young people to traffic is an issue that must be taken into consideration when promoting active commuting among youth.

Research indicates that risk of injury and fatality while active commuting among youth varies by location and destination. An Australian study looked at the traffic exposure of young children to and from school and determined that more pedestrian collisions occur on the trip home from school than the trip school [16]. Authors speculate that this is the case because more children are pedestrians on the return trip than in the morning. A Philadelphia study looked at injuries among children, traffic exposure and collisions for travel to school and neighbourhood play [48]. Results showed that only 15% of the injured children were struck by a car on the trip to school, while the majority were injured either during outdoor play or walking to other places [48]. Therefore traffic with respect to neighbourhood play and walking to destinations other than school deserves

more attention, as it is associated with greater risk of injury among young people compared to the trip to school. The relatively safe nature of the trip to school compared to active trips to other destinations is supported by a New Zealand study [108]. This study also indicates that cycling is the most risky activity in terms of injury followed by walking, and travelling in a private motor vehicle. Travelling by bus or train is associated with the lowest risk of injury.

While active commuters may be relatively safe on the trip to school compared to other leisure destinations, a Florida (U.S.) study [109] finds that there is a higher incidence of pedestrian collisions within half a mile of schools. In this study, researchers identified the location of both pedestrian and bicyclist crashes involving school-aged children over a period of 5 years in Orange County, Florida. Analyses revealed that older children were more likely to be involved in accidents compared to younger children, and this was related to the fact that middle and high schools were more often located near multi-lane, high speed roads compared to elementary schools. Therefore schools with greater accessibility by car had higher crash risks. The authours recommended strict enforcement of measures to reduce traffic speed in conjunction with offering pedestrian safety programs at schools – particularly middle and high schools.

Similarly, higher risk of injury was found in California, U.S., within areas of greater traffic flow and vehicular speeds [110]. Number of injuries was also positively related to youth population densities and family unemployment, and negatively related to the presence of high-income households. The authours recommended that improving public transit systems, reducing vehicular speeds, and decreasing traffic flow, especially during high-risk hours on residential streets, would help to reduce risk of injury to youth. This is supported by a Danish study that found that the culture of active commuting in Denmark has been enhanced by reducing the risk of harm from traffic and creating safe environments for young people to actively commute [52].

Finally, it is important to note that physical injury may not be the only outcome of a traffic collision for a child. A study in the UK found that one third of children who survive traffic collisions may suffer from post-traumatic stress disorder. Symptoms include depression, recurring nightmares, difficulty attending to schoolwork, and fear of cars [111].

7.5 Emotional well-being

Few studies have examined relationships between transportation and emotional well-being among youth; however, studies that have looked at adults and active commuting have found that commuters who walk or cycle to work tend to be happier than those who do not [112]. There is some evidence from Austrian work that young people who walk to school may be emotionally healthier than those who travel by motorized means [79]. This study of 244 young people aged 9-16 years, found that those who always walked to school showed lower scores concerning depression, aggression/hostility, anxiety, and psychosomatic symptoms compared with children who never or seldom walked. However, due to the cross-sectional nature of the survey, it cannot be determined whether

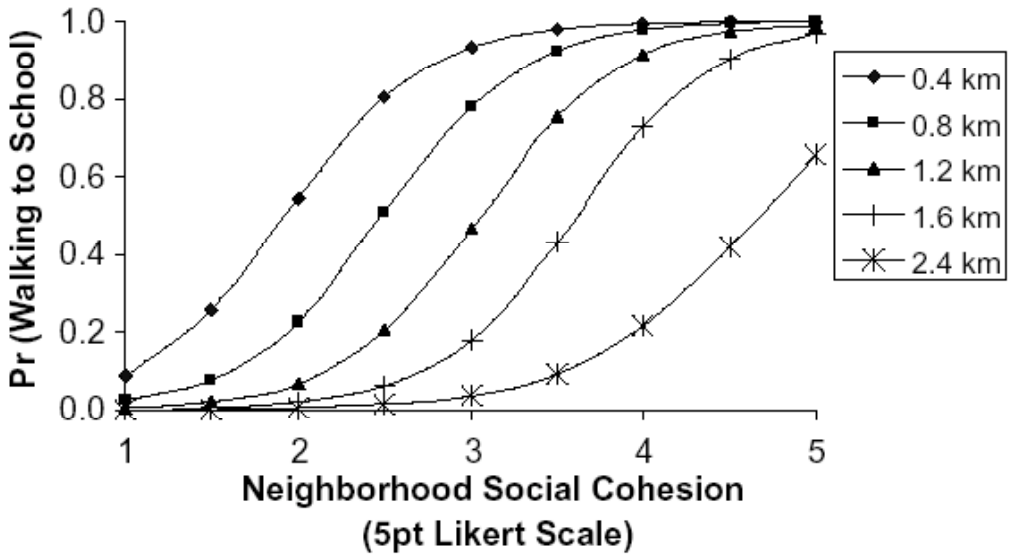
youth were emotionally healthy because they walked, or youth who were emotionally healthy preferred to walk. Similarly, a study looking at adults found that commuters who walked or cycled to work tended report greater happiness than those travelling by motorized modes [112]. Once again, causal relationships cannot be determined.

As youth who actively commute may also engage in high levels of physical activity (see Section 7.1), research examining physical activity and well-being is relevant. Research shows that active commuters may be more likely to perceive higher quality of life compared to their less active peers [61]. This 2002 study from the Canadian Fitness and Lifestyle Research Institute (CFLRI) asked youth to rate their quality of life on a scale from 1 to 10. Results showed that youth who reported higher levels of overall physical activity more often rated their quality of life as 9 or 10 compared to those with low levels of physical activity. Another Canadian study found that active commuting was positively related to self-perceptions of athletic ability such that those who self-rated as having fair or poor athletic ability were also less likely to actively commute to school [24].

Similar to sport and physical activity, active commuting may be associated with greater well-being by giving youth opportunities for independence and psychological development; conversely, lack of independent mobility, especially within neighbourhoods, may impede such development [16]. Evidence shows that heavy traffic reduces the independent mobility of children and youth [113], and such transportation restrictions "lend support to broader concerns that the psychological development of children may be impaired by curtailment of their sense of independence and personal mobility" (p.291) [16]. Active commuting is also used by children to meet with friends for spontaneous and non-structured play, and these meetings are important for well-being via social development. An investigation in the UK shows that opportunities and locations for spontaneous, non-structured play can be severely restricted by traffic [114-116]. Data from a Swiss study provides further support [117]. Results indicate that "traffic is a nuisance and menace to children at play", as 50% of five-year-old children who lived on a street with traffic never played outside and only 10 per cent played outside for more than two hours a day, but mostly in playgrounds.

Active commuting may also be associated with well-being by providing greater opportunities for social bonding between youth and their neighbours. Social trust and cohesion have been found to favour active transportation for children and youth (see Figure 3) [56]. Research in the U.S. also indicates that social bonds between adult neighbours may be weaker according to the extent of automobile dependence of a neighbourhood's residents, regardless of the extent of urban sprawl, i.e. population density [118].

Fig. 1 Effect of neighbourhood social cohesion on walking for children 5-15 (p.60) [56].



Source: McDonald, N. C. (2007b). Travel and the social environment: Evidence from Alameda County, California. *Transportation Research Part D-Transport and Environment, 12*, p.60

Finally, there is a growing body of research that supports the value of active commuting for children and youth to increase their exposure to the natural environment, the local neighbourhood and school [119]. Familiarity with the local environment that comes with active modes of transportation can contribute to youth wellness by building confidence in a young person's navigational abilities, and ability to independently access local destinations.

7.6 Summary

Motorized transportation may adversely affect the physical health of youth by decreasing opportunities for physical activity, increasing exposure to poor air quality (both outdoors and in-vehicle), creating stress via noise disturbances, and posing safety hazards in high traffic and high speed areas. Moreover, research indicates that using active forms of transportation may have a positive impact on several aspects of emotional well-being among youth, including self-esteem, independence, psychological development, social development (such as opportunities for meeting with friends for leisure), and exposing youth to the natural environment. Overall, Section 7 builds the case that transportation is an important public health issue because of its complex consequences for youth well-being.

8. Considerations for youth participation in policy development and planning

> *A United Nations Commission on Population and Quality of Life concluded that a decent standard of living for all will require simultaneous attention to the carrying capacity of the planet and the caring capacity of society. Children stand at the heart of both agendas for change (p.21) [120].*

Youth needs, aspirations, and well-being are undeniably affected by land use and transport planning. Worldwide trends reflect the rationale for and benefits of involving youth in policy development and planning within their communities. In some countries, this is standard practice but may not be the case in many North American cities and towns. The Child Friendly Cities [121] movement originating in Europe argues convincingly that youth must be involved in city planning decisions for the following reasons:

- They are experts on their local environment;
- They can identify their needs, which may differ from adults;
- They will develop skills to contribute to society;
- Their participation may prompt them to develop values and skills for lifelong environmental stewardship [120].

The Convention on the Rights of a Child (signed by Canada) supports the case for youth participation in matters that influence their quality of life. This sentiment is echoed in the *Child and Youth Friendly Land Use and Transport Planning Guidelines* developed by Gilbert and O'Brien, which recommends that municipal bodies establish opportunities for child and youth participation in land-use and transport decisions [1].

There are several considerations for involving youth in decision-making processes. Research discussing initiatives in Italy [121] emphasizes the importance of engaging youth in realistic and respectful ways by providing clear expectations for their participation, and communicating the reality that some of their ideas may not be implemented. In a similar vein, a 2006 literature review on youth participation in planning indicates that planners should strategically choose projects that can be relevant and mutually beneficial for all major stakeholders:

> *To increase the chances that youth participation will be a positive experience and achieve significant community change, planners looking to create processes should select 'win-win-win' projects that clearly serve the interests of planners, youth, and the community. Such projects would be of direct concern to youth, likely achieve improved design and implementation with youth involvement (and thus be attractive to planners) and be less controversial within the community (p.369) [122].*

Other considerations for involving youth in community planning are the potential barriers to their participation [122]. Structural barriers include the language used in planning documents, economic interests that may override sound planning decisions, as well as distorted views of youth capacity in decision-making. For example, some adults believe that youth are not developmentally capable of making informed decisions about their community; some are overprotective of youth and see them as more vulnerable than they actually are; some view youth as "partial citizens" who need to be educated and are not ready to participate in meaningful planning decisions; and finally, some adults romanticize youth views and assume that all youth ideas will be more creative and dynamic than those of adults. All of these distortions can be a barrier to effective adult-youth communication and collaboration and may be partially overcome by establishing more partnerships between schools, community organizations, universities and youth advocates.

The 2006 literature review indicates five keys to involve youth in planning [122]:

- Give youth responsibility and a voice;
- Build youth capacity for participation;
- Encourage youthful styles of working;
- Involve adults throughout the process;
- Adapt the sociopolitical context to remove barriers for youth participation.

Several other recommendations have been made to promote successful partnerships between adults and youth in planning decisions [8, 123]. YouthPower [123], a community-service learning program in Holyoke, Massachusetts (U.S.) identifies four constructive roles for adults working with youth: supporter, resource provider, power broker, and coordinator. For instance, adults can support youth engagement by helping youth to network with one another. Adults may also work with youth to review policies and institutional barriers to youth participation, and devise strategies to remove barriers, i.e. adjust the timing of city council meetings to accommodate youth participation. Additionally, youth commissions may be established and linked with youth programs in the community. Any successes may be disseminated through relevant youth-generated newsletters and web pages, youth summits as well as publications, websites, and professional journals. Youth may also provide input regarding transit [8] and influence decisions regarding routing and level of service. School teachers may play important roles in gathering this input by incorporating an evaluation of transit systems into a Geography or Civics class.

9. Recommendations for further research and action

Research related to youth, active transportation and physical activity has expanded considerably in the past five years. Concerns regarding physical inactivity and obesity have heightened interest in opportunities for intervention and education. There has also been growth in literature regarding the built environment and physical activity. This section outlines the gaps in research and some recommendations for action that can be drawn from examples reviewed in this document.

9.1 Research

We recommend that future research target the following areas:

- longitudinal studies regarding active commuting, physical activity and BMI;
- studies that involve youth participation;
- fostering active transportation for girls;
- impact on student travel behaviour when school districts adopt school travel planning;
- youth and cycling;
- other forms of active transportation – particularly skateboard;
- youth in rural areas and small towns.

9.1.1 Longitudinal studies

A number of cross-sectional studies noted the need for longitudinal evidence, particularly regarding BMI and active commuting. This methodology would also be valuable for documenting behaviour change that may occur following infrastructure improvements and education programs. For example, evidence from the Centers for Disease Control study regarding Safe Routes to School programs in the U.S. demonstrated that the program had increased walking behaviour for both children and adults [68].

9.1.2 Studies that involve youth participation

The majority of studies in this review did not involve youth, other than as research participants. Youth could be engaged as research assistants or advisors for research projects. For example, they could document (e.g. through photography) the barriers to active transportation that they encounter in their neighbourhood. They could co-facilitate focus groups that involve youth and offer advice on strategies for engaging youth in research. Two authors of this review, Gilbert and O'Brien, engaged youth in an evaluation process of the *Child and Youth Friendly Land Use and Transport Planning Guidelines*. Youth in Calgary, Alberta (Canada) interviewed a wide range of young people, including homeless youth, to provide input on the guidelines. Adolescents in Winnipeg, Manitoba (Canada) prepared a powerpoint that demonstrated their needs and aspirations regarding sustainable transportation (see www.kidsonthemove.ca for further information).

9.1.3 Fostering active transportation for girls

There is considerable evidence that girls tend to be less physically active than boys and that their active transportation patterns also differ from boys. Intervention strategies could be developed that focus on barriers for girls as well as factors that might influence or motivate them to walk or cycle to their destinations more often. Research that documents successful interventions is needed. Involving adolescent girls in this research may also provide further insights.

9.1.4 Impact on travel behaviour when school districts adopt school travel planning

Studies that document the impact on student travel behaviour when school districts adopt school travel planning could contribute to school policy development that favours active transportation. For example, it would be valuable to monitor student travel behaviour when various infrastructure changes are made, bicycle racks are installed, vehicle parking is restricted or policies are developed that favour active transportation. To our knowledge, there are no school districts in Canada that have an active transportation policy at this time.

9.1.5 Youth and cycling

There are few studies that focus on youth and cycling; thus, there is a lack of information on the barriers and motivators for using this mode of transportation. A Canadian study that involved six youth in Vancouver determined that youth who chose to cycle to the majority of their destinations did so because it was fun, a relatively fast mode of transport and they enjoyed cycling as a form of fitness [124]. Extending this research to a larger sample size with varied locations is recommended.

9.1.6 Exploring other forms of active transportation – particularly skateboard

Research has not kept pace with one mode of active transportation that youth enjoy: skateboards. We found no studies on this topic. Discussions that we have had with youth across Canada suggest that many youth do not feel that their community is supportive of skateboard use for travel. There is often a bylaw that prohibits skateboards on roads and sidewalks; thus, youth are unable to travel to skateboard parks and other local destinations using their skateboards. Overall, it is necessary to create opportunities for youth to participate in studies that investigate their needs and aspirations. As well, it is important to document case studies of communities that have successfully supported this mode of transportation.

9.1.7 Youth in rural areas and small towns

There is a lack of research regarding active travel for youth in rural areas. However, we do know that distance, lack of infrastructure and high traffic speeds for motorized vehicles present barriers for active transportation among rural populations. Nevertheless, some rural communities are creating successful active transportation routes [125] and this should be documented and shared with other rural communities.

This review did not include searches for documents regarding non-motorized trails, however, this is emerging as an important area of interest for rural communities and small towns. A preliminary search for such documents suggests that there is very little research being done on this topic. Decisions about the value of non-motorized trails are currently not made with research evidence and may be influenced by interest groups that lobby for motorized trails. Therefore research that compares trail-use when trails are

shared with motorized and non-motorized travellers has practical applications for trail planning. Moreover, collision rates for pedestrians and cyclists on shared-use trails are not readily available. In order to promote active transportation in rural communities and small towns, these research gaps must be addressed.

9.2 Action

In addition to the research gaps indicated above, we recommend the following actions:

- Endorse and implement *Child and Youth Friendly Land Use and Transport Planning Guidelines;*
- Develop active transportation policies for school districts;
- Increase access to school facilities after school hours;
- Establish youth advisory bodies for municipalities.

9.2.1 Endorse and implement Child and Youth Friendly Land Use and Transport Planning Guidelines

Gilbert and O'Brien [1] have conducted consultations across Canada towards the development of *Child and Youth Friendly Land Use and Transport Planning Guidelines*. Municipal staff, health professionals, educators, academics, youth, and provincial government representatives have participated in these consultations. The *Guidelines* have been favourably received, and the Ontario Professional Planners Institute has officially endorsed the Ontario version [126]. Nevertheless, very few communities are currently considering the needs and aspirations of young people in the area of land use and transport planning, and youth are rarely involved in contributing to community plans. We recommend that the *Guidelines* be endorsed and implemented through appropriate provincial and municipal bodies in order to raise the profile of children and youth. Further information may be found at www.kidsonthemove.ca. Communities outside of Canada could also adapt the *Guidelines* to their own context.

9.2.2 Develop active transportation policies for school districts

The development of active transportation policies for school districts would enhance the opportunities for the educational sector to contribute to physical activity and healthy living. School active transportation policies may be developed after reviewing the following issues:

- school setting;
- school bus policy;
- school bus idling;
- air-quality within buses and resulting from bus exhaust;
- parking for motorized vehicles;
- traffic speeds in the school vicinity;
- drop-off locations;
- timing of traffic lights;
- policies regarding skateboard use;
- availability of bicycle racks and storage;

- cycling paths nearby the school.

The education sector could also encourage active transportation by integrating this topic into relevant academic subjects such as health, science, physical education, geography and environmental studies.

A further step would involve school travel planning. Sustained government funding would likely be required to support school travel planning at a national level. The documents discussed in 4.1.1 provide detailed information regarding national and international experiences with school travel planning. Collaboration with transit authorities may also lead to shorter trip lengths for students.

9.2.3 Increase access to school facilities after school hours

Increasing access to school facilities after school can provide additional recreation and community venues that are within active commuting distance for young people and their families. This would be particularly valuable in rural areas and other locations where there is a deficiency of recreation facilities. Provincial governments could support this recommendation by providing liability coverage.

9.2.4 Establish youth advisory bodies for municipalities

Youth needs and aspirations for sustainable transportation will not be fully recognized nor understood without their input. Creating a youth advisory body would provide a formal venue for ongoing participation for this sector of the population.

9.3 Concluding Thoughts

There is a growing awareness in research arenas that the travel behaviour and aspirations of children and youth merit investigation and may contribute to travel policy and planning. This research can also be applied to improve the health and well-being of young people and contribute to healthy communities. In this review, we have identified research gaps and made recommendations for future actions. Some of these actions will require interdepartmental and multi-stakeholder collaboration, such as school districts working with municipalities; transportation, public health, environment, municipal affairs, and education departments recognizing the common ground they share; and federal funding to support both research and action.

If these steps are taken, it is our hope is that a review of literature in the coming years portrays the benefits of policy and infrastructure changes toward sustainable transportation – and that youth are engaged in this process.

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