Ontario Active School Travel

Making the Case for Active School Travel:
Fact Sheet & Reference List

Updated January 2023

This document provides information and references to help facilitators of School Travel Planning (STP) communicate with stakeholders about the merits of active school travel (AST; i.e., any form of non-motorized transportation to get to and from school). It also shares guidance and resources to support successful AST interventions.

An Urgent Problem

In recent decades, the proportion of children and youth who are walking to school in Canada has fallen, while the proportion who are driven to school in a private vehicle has surpassed all other modes of travel (Buliung et al., 2009; Rothman et al., 2021).

- From 2014-2016, a mere fifth (21%) of Canadians aged 5 to 19 typically travelled actively for their school commutes;
    - the majority (63%) used passive modes of travel like driving or taking the bus; and
    - the remainder (16%) used a combination of active and inactive modes, such as using public transportation in addition to walking (Canadian Fitness and Lifestyle Research Institute [CFLRI], 2020; ParticipACTION, 2020).
- For a variety of reasons, rates of AST and active travel appear to have improved slightly during the COVID-19 pandemic (ParticipACTION, 2022)[1] but whether these rates will sustain beyond pandemic restrictions is yet to be determined.

Background

Explanations for the rising proportion of students being driven to school are diverse and complex. They can vary between individual students and between and across physical and sociocultural environments (Ikeda et al., 2019; Rothman et al., 2018). For instance:

- Strong cultural norms around private vehicle usage can influence the decision to drive and own a vehicle (Mattioli et al., 2020).[2]
- Some communities are inequitably without traffic safety measures (Rothman et al., 2020; Schwartz et al., 2022) and lack access to supportive physical structures for AST such as bike lanes (Ross et al., 2017).

Consequences

The decline in AST and the increase in private vehicle usage have several consequences, outlined in the remainder of this section.

Physical activity levels. Children and youth who use motorized vehicles to get to school are often less physically active than those who walk or bike (ParticipACTION, 2020). Inadequate daily physical activity is a concern in Canada and around the world:

- Only 28% of Canadians aged 5-17 are achieving the recommended levels of physical activity for their age group, a decrease from previous pre-pandemic years (ParticipACTION, 2022).
- A global comparison of 57 countries indicates that only 27-33% of children and youth are achieving the recommended levels of physical activity for healthy growth and development (Active Healthy Kids, 2022).
- In Canada and around the world, girls are less likely than boys to get enough physical activity (Guthold et al., 2022; ParticipACTION, 2022).[3]
- Negative health consequences of physical inactivity include weight gain, injury and chronic diseases such as obesity, cancer, type II diabetes, and stroke (Tremblay & Willms, 2003; Janssen & Leblanc, 2010; Warburton et al., 2006).

Safety and congestion. Increased traffic makes school zones congested; an estimated 25-40% of vehicle congestion during morning rush hour is related to school drop-off (Coules, 2022; 8 80 Cities, n.d.). Congested school zones are unsafe and present a growing burden on school staff. For instance:

- In one survey, 78% of Ontario parents reported witnessing unsafe driving behaviours in school zones, and only 37% consider the roads around their child's school to be safe (CAA South Central Ontario, 2022).
- A study of 118 elementary schools in Toronto found that dangerous driving behaviours occurred at 88% of schools, where each dangerous driving behaviour during school drop-off time was associated with a 45% higher risk of collision (Rothman et al., 2016).
- Ontario's school principals collectively spend an estimated 720,000 hours a year dealing with traffic problems around their schools (Green Communities Canada & Green Action Centre, 2010).

Air quality. Increased traffic in school zones can significantly increase local concentrations of *fine particulate matter,* or $PM_{2.5}$: an air pollutant with various health impacts (Adams & Requia, 2017). Children are especially vulnerable, experiencing negative impacts at lower levels of exposure than adults (Buonanno et al., 2013; Lee, 2021). Notably:

- Pre-natal and childhood exposure to air pollution has been linked to poorer behavioural functions and cognitive performance (Ni et al., 2022).
- Exposure to air pollution from traffic is also associated with adverse birth outcomes and infant mortality and can negatively affect children's lung function and mental and motor development, along with other negative health outcomes later in life (World Health Organization, 2018).

Greenhouse gas emissions. Increased usage of private vehicles for daily commutes emits unnecessary greenhouse gasses into our cities and the atmosphere. Note that:

- Private vehicles, especially when they transport only one or two people, are the least efficient way to move people around cities (C40 Cities Climate Leadership Group, 2021).
- Across Canada, daily vehicle commutes account for about 11% of the greenhouse gas emissions from household transportation activities (Morissette et al., 2021). If this seems insignificant, consider how many of these commutes could easily be avoided and/or converted into active commutes.

Benefits of Active School Travel

Benefits of increased physical activity

Walking or wheeling to school can be an important source of moderate to vigorous physical activity. Children and youth who walk or bike to and from school are more physically active compared to those who use passive forms of transportation (Barranco-Ruiz et al., 2018; Ikeda et al., 2019; Kek et al., 2019).

Physical activity is associated with numerous, well-established health benefits including:

- Improved cardiovascular and bone health (Proudfoot et al., 2019; Tan et al., 2018).
- Improved cognitive development and brain health (e.g., executive functioning; Benzing et al., 2018; Bidzan-Bluma & Lipowska, 2018).
- Improved memory and attention in the classroom (Castelli et al., 2015) and scholastic performance, especially when physical activity occurs during the school day (Bangsbo et al., 2016).
- Improved health-related quality of life (e.g., physical, social, and emotional functioning; Marques et al., 2019; Moeijes et al., 2019; ParticipACTION, 2020).

Benefits specific to active school journeys

Research on the health benefits specific to AST is limited, but initial research suggests a link to benefits such as:

- Improved cardiovascular health (Lambiase et al., 2010; Larouche et al., 2014).
- Improved cognitive performance (Martinez-Gomez et al., 2011).
- Increased positive emotions and feelings of well-being (Ramanathan et al., 2014).

Additionally, research indicates that active journeys to school can be sociable, exploratory learning experiences that help children develop autonomy, independence, and sense of place (Morris et al., 2022).

Benefits for communities

The benefits of reduced traffic and improved walkability in school zones can extend beyond students, to their families and communities at large. In addition, when more students choose AST on a daily basis, active travel behaviours can spread throughout their social networks through a process known as social diffusion (McKenzie-Mohr, 2011).

Community benefits of reduced neighbourhood traffic include:

- Diminished air pollution and urban noise (which can affect stress levels and sleep quality of urban residents; Basner & McGuire, 2018).
- Fewer cars on the road and in parking spaces can liberate valuable city space that can be used more productively to support a sense of community (C40 Cities Climate Leadership Group, 2021).

Additionally, people who live in neighbourhoods and cities that are more walkable (and bike-able) and who walk and cycle themselves experience improved physical and mental health and well-being, among other potential social benefits that cannot be achieved through private motorized transport (Sustrans, 2017).

In consideration of the benefits associated with walking and biking to school and reducing the number of vehicles in school zones, implementing solutions to the barriers of AST is an important task!

Yet, just as the barriers to AST are complex and manifold, so are the solutions.

- Wide-reaching solutions include policy change at the provincial and municipal levels (Human Environments Analysis Laboratory [HEAL], 2022; discussed further under "Policy Interventions" near the end of this section).
- Solutions can also be found at the school-level, through AST interventions such as "school travel plans" that encourage students to choose active modes of transportation (ParticipACTION, 2022).

Effective AST interventions address multiple issues with a multipronged approach. This approach includes making physical changes to school zones as well as changing the attitudes and behaviours of students, families, and educators. In other words, they use a combination of non-infrastructure (e.g., education initiatives, enforcement of rules) and infrastructure measures (e.g., sidewalk improvements and bike-rack implementation; Mammen, 2016). These different measures are also known collectively as the five "Es": Education, Encouragement, Engineering, Enforcement (optional) and Evaluation.[4]

This next section provides examples of non-infrastructure and infrastructure measures that have been used in AST interventions, followed by a summary of best practices.

Please note that research on AST interventions is in its early stages and is limited in several respects. For example:

- The research generally lacks standardized ways of measuring outcomes, and fails to assess whether they've sustained in the long-term.
- It tends to focus on young children in elementary school while more research and support is needed to promote active travel among teenagers (ParticipACTION, 2022).

Much of the research has reported low effect sizes (i.e., weak relationships between variables) which limits the practical applicability of the findings (Arnott et al., 2014; Villa-González at al., 2018).[5]

Examples of non-infrastructure measures

• **Physical literacy programs** to improve children's competence, confidence, and motivation to engage in physical activities for life (ParticipACTION, 2020).	• Less than half of children in Canada are meeting the recommended levels of physical literacy (Tremblay et al., 2018). • Physical literacy interventions should address physical and psychosocial factors as well as individual characteristics. • For instance, programs should develop fundamental movement skills alongside targeting physical competence as a whole (e.g., strength, agility, endurance; Collins et al., 2019; ParticipACTION, 2020; Roach & Keats, 2018).[6]
• **Walking school buses,** where children walk in groups supervised by an adult, and other forms of **organized walking and cycling groups** (ParticipACTION, 2020).	• Walking school buses can increase active transportation and physical activity levels (Jones et al., 2019; ParticipACTION, 2020). • In a study of household attitudes in the Greater Toronto and Hamilton Area, parents reported that having their child walk to school in an organized group was their preferred form of school travel for their child, over all other ways of travelling (Metrolinx, 2011). • Children feel safer when walking with a parent (Ahlport et al., 2008; Romero, 2010), friends, siblings (Kullman, 2010, 2014) or when surrounded by familiar, friendly faces (Egli et al., 2019; Morris et al., 2022; Wilson et al., 2019). • The reliance on parent volunteers can compromise the sustainability of these groups (ParticipACTION, 2016), so it can be helpful to share responsibility among parents/guardians to lessen any inconvenience (ParticipACTION, 2020).
• **Air quality monitoring programs.**	• In a study where researchers brought air quality monitoring equipment to schools, parents' behaviours changed immediately, whereby they would park further away from the school and walk their children the remaining distance (Adams & Requia, 2017).
• **Drive to 5 (a.k.a. "Walk a Block") programs,** which designate and encourage the use of walkable locations within a five-minute walk to/from the school.	• When walking all the way to school isn't possible, parents and students can "Drive to 5" and realize some of the benefits of AST (Student Transportation Services of Waterloo Region, n.d.). • Collaboration between schools and municipalities can help ensure effective implementation of Drive to 5 programs (HEAL, 2022).

Examples of infrastructure measures

• **Road crossing enhancements** like pedestrian crossovers and traffic lights.	• The built environment and features related to road crossings in particular are paramount to the safety of pedestrians on their trip to school (Rothman et al., 2014a) and are associated with higher walking rates (Rothman et al., 2014b).
• **Traffic-calming measures** such as speed humps and narrower intersections.	• Traffic-calming measures can reduce vehicle speed and injury risk, alleviating safety concerns associated with AST (Lindenmann, 2005; ParticipACTION, 2016; ParticipACTION, 2022). • For instance, the installation of speed humps has been associated with a reduction in pedestrian-motor vehicle collisions on the roadways where they are installed, especially for children (Rothman et al., 2015).
• **Reducing motor vehicle speed limits** in school zones (e.g., to 30km/hr).	• Lower speed limits can reduce the frequency of pedestrian-motor vehicle collisions (Fridman et al., 2020). • Changes to speed limits are most effective when complimented by additional traffic calming measures (HEAL, 2022) and when combined with education and enforcement (The Centre for Active Transportation, 2016). • Preliminary data on Automated Speed Enforcement systems in Toronto indicates that these systems can improve compliance to speed limits (Toronto, 2021).
• **Cycling infrastructure** such as protected bike lanes, street lighting, and paved surfaces.	• Evidence shows that cycling infrastructure can prevent cyclist accidents and encourage more people to bike (Dill & Carr, 2003; Reynolds et al., 2009). • A study of different types of cycling route infrastructure (e.g., local streets, bike paths, or bike lanes on major streets) showed that protected bike lanes, or "cycle tracks" were the safest route option, with the lowest rates of injury (Teschke et al., 2012).

For a useful guide to infrastructure measures, read The Guide to Safer Streets Near Schools.

Please note that the built environment can include car-centred street design and poor or missing walking and cycling infrastructure. Inadequate infrastructure can create real safety barriers that prevent children from walking or biking to school. Infrastructure concerns should be addressed through traffic and other engineering measures before pursuing education and encouragement initiatives.

Best practices

A. Successful AST interventions are **tailored to the needs of each school** (Mammen, 2016). They are created in collaboration between the different members of a school community including students, parents, staff, and other members of the broader community. Involvement of diverse community members, where individuals from different groups have quality interactions with each other, is crucial (Chillón et al., 2011; Mammen, 2016).

B. **Student involvement** can be a powerful tool to help shift attitudes, norms, and behaviours (Morris et al., 2022; Valente et al., 2003). AST interventions should attend to the experiences of children (Morris et al., 2022) and take into consideration children's unique needs and perspectives (Evans et al., 2013; Holloway & Valentine, 2000).

C. Garnering **school support** can also help facilitate AST interventions. Implementing a program is easier when the school culture is open, accepting, and enthusiastic about AST. Generating a healthy school culture can be achieved via school champions (e.g., school staff, students, parents) who lead the encouragement and promotion of AST (Mammen, 2016).

D. Interventions that include a **parent engagement** component (e.g., parental education and empowerment initiatives) have been shown to increase physical activity in children (Haerens et al., 2007; Ornelas et al., 2007) by modeling and supporting healthy behaviours for their children (Michael et al., 2007).

E. Finally, interventions must keep up efforts over the **long-term**; it is recommended that action plans addressing AST allot two to three years to be implemented and ingrained into the school culture (Mammen, 2016).

For additional reading, we recommend this review of international best practices in active school travel, written by Cate Flanagan and Raktim Mitra from Toronto Metropolitan University in partnership with Green Communities Canada and Metrolinx.

School Travel Planning: A Comprehensive Solution

- School Travel Planning (STP) programs involve a facilitator who works with schools and other stakeholders to create School Travel Plans.
- School Travel Plans are comprehensive intervention tools that document a school's transport issues and provide an action plan to address barriers to active travel in the school and neighborhood.
- Research on the effectiveness of STP programs is limited, but initial research shows "tentative support" for STP (Buliung et al., 2011) and evidence of some localized success at participating schools (Buttazzoni et al., 2019; Mammen et al., 2014). In light of this localized success, however, Mammen et al. (2014)

caution that "[m]ore robust monitoring and evaluation" (p. 55) is needed to determine the effectiveness of STP programs across Canada.[7]

- A 2016 study of STP programs in 13 elementary schools in Ontario demonstrated that the benefits of the programs far outweigh the effort and expenditures of participating in the program, finding an overall cost-to-benefit ratio of 2.4 (Green Communities Canada & University of Toronto, 2016). The researchers in the study predicted that over time, the benefits would only continue to grow.

Policy Interventions

As mentioned earlier, **policy interventions** can play an important role in addressing the barriers of AST. For instance, provincial and municipal policies around land use planning can help improve pedestrian and cycling infrastructure and determine the location of school sites to increase the proportion of students who live within walking distance to school (HEAL, 2022).

Other policies to support AST are outlined in the joint research report Investigation of Supportive Policy for Active School Travel by Green Communities Canada and the Human Environments Analysis Laboratory at Western University (HEAL, 2022).

Addressing Liability Concerns

Some have expressed concern that participating in active travel initiatives could expose them to legal liability. However, an examination of liability issues and AST programs showed that these programs can actually have the opposite effect, by helping school boards and municipalities reduce their liability exposures by decreasing the likelihood of pedestrian accidents (Wyseman, 2010).

Learn More

Making the Case

The 2022 (& 2020) ParticipACTION Report Card on Physical Activity for Children and Youth (ParticipACTION, 2022, 2020)

- These two reports synthesize physical activity data from multiple sources, including peer-reviewed research, to assign evidence-informed physical activity grades across 14 indicators for children and youth in Canada.

Canadian Fitness and Lifestyle Research Institute (CFLRI)

- The CFLRI is a long-standing national research organization on physical activity

and sport participation.

Transport Data Explorer (C40 Cities Climate Leadership Group, 2021)

- The Transport Data Explorer tool provides open data on modes of transportation in cities around the world, including several cities across Canada.
- Graphical visualization made using OpenStreetMap data makes it easy to instantly compare data between cities and regions.
- The Data Explorer is part of a larger project known as the C40 Knowledge Hub: a resource that provides policymakers and city practitioners with the knowledge needed to act on climate change in their cities.

Solutions to Support AST

Investigation of Supportive Policy for Active School Travel (HEAL, 2022)

- This research report provides 57 evidence-based recommendations for policy makers to encourage AST in Ontario.
- The recommendations fall under 5 key themes: Planning, Infrastructure, School Site, Student Transportation, and School Travel Planning.

School Travel Planning in Action in Ontario: Successes and lessons in active and sustainable school transportation (Metrolinx, 2013)

- This report profiles successful STP programs from schools across Ontario. It summarizes success factors for STP that were common across multiple types of communities and provides a case study of each community's STP activities and approaches.

Schooltravel.ca (Ontario Active School Travel and Green Communities Canada)

- This website is dedicated to advancing AST in Canada and is home to the Ideas Lab, an inspirational catalogue of ideas and how-to resources.

Project BEAT (Built Environment and Active Transport) research (Zeglen, 2017)

- Project BEAT was a multidisciplinary research program running from 2009-2012 that explored the interrelationships between AST and the built environment in the Greater Toronto Area.

School Travel Planning in Canada: A Holistic Examination of Program Impact on Active School Travel (Mammen, 2016)

- This doctoral thesis completed at the University of Toronto offers a comprehensive look at the factors influencing AST, the effectiveness of STP as an AST intervention, and suggestions for best practices.

Notes

[1] The rates reported in the 2022 ParticipACTION Report Card on Physical Activity for Children and Youth might suggest an improvement in AST rates since 2014-16. According to the 2022 Report Card, the CFLRI collected data between 2021-22 which says that 46% of Canadians aged 5 to 17 commuted actively to school, either *wholly or partially* in combination with non-active modes. Although 46% may appear higher than the AST rates from 2014-16 (when only 21%, of students commuted actively – or 37% if you include the 16% who commuted actively for only a portion of their journey), claiming that AST rates have improved is perhaps misguided optimism.

Firstly, this is because ParticipACTION (2022) does not provide the breakdown for the percentage of children and youth who commuted actively the entire way to school versus only partially, and the CFLRI 2021-22 data is not yet publicly available nor available to the author of this document. Without knowing this breakdown, it is hard to compare AST rates between the years 2014-16 and 2021-22.

Additionally, the COVID-19 pandemic disrupted people's daily travel patterns and influenced their active travel behaviours in a range of ways. For instance, as pandemic restrictions broke apart organized sport and opportunities for physical activity, families started seeking out other ways of getting exercise, and in regions where schools remained open, some started walking or biking to school. Further, the decrease in use of public transit and bussing services during the pandemic led some children to change the way they commuted, like toward more mixed-mode commuting that incorporates use of private vehicles along with walking to school.

As pandemic concerns and restrictions dissolve, ParticipACTION predicts that AST rates will return to 2014-16 levels. This document will be updated when the 2021-2022 CFLRI dataset is made available.

[2] These cultural norms emerge from the same cultural environment that created our car-centric cities in the first place. Notably, the rise of the automotive industry throughout the twentieth century influenced land use patterns and enabled the creation of car-dependent settlement patterns. These changes have created a greater need of using private vehicles in some places and have made walking and cycling appear less useful (Mattioli et al., 2020).

[3] Explanations for the gender gap are complex but it is clear that as a society, we can provide more opportunities and support for girls' physical activity (Telford et al., 2016).

[4] Enforcement, and the involvement of police, is optional and should not be used without first consulting individual school communities and racialized/marginalized community members. Although traffic enforcement might sometimes be effective at reducing speeding and fatal collisions, it should not be necessary when engineering measures are in place that fit the needs of the community (America Walks, 2020). In communities without equitable engineering measures, police involvement might deepen inequities and negatively impact the well-being of their members. Additionally, having police officers in schools can potentially cause harm to racialized students (Blatchford, 2018; Boyd, 2020; French, 2020). To avoid or limit the need for police involvement in enforcement activities, students and other members of the school community can potentially be involved in enforcement activities instead.

[5] Reasons for low effect size in these studies include issues with selection bias, study design, confounding variables, and data collection (Villa-González at al., 2018).

[6] Note that more physical literacy research is needed to better inform interventions for specific populations (e.g., children with disabilities; Bopp et al., 2019; ParticipACTION, 2020).

[7] This statement arguably reiterates the lack of adequate research on the effectiveness of AST interventions as already described on page 5 of this document.

References

Active Healthy Kids. (2022). The Global Matrix 4.0 on Physical Activity for Children and Adolescents. https://www.activehealthykids.org/4-0/

Adams, M. D., & Requia, W.J. (2017). How Private Vehicle Use Increases Ambient Air Pollution Concentrations at Schools During the Morning Drop-off of Children. *Atmospheric Environment, 165,* 264-273.

Ahlport, K. N., Linnan, L., Vaughn, A., Evenson, K. R., Ward, D.S. (2008). Barriers to and facilitators of walking and bicycling to school: formative results from the non- motorized travel study. *Health Education & Behavior, 35*(2), 221–244.

America Walks (2020, July 29). *PED talks episode 2: A conversation with Dr. Destiny Thomas* [Video]. YouTube. https://www.youtube.com/watch?v=ew4BNihH8QQ

Aranda-Balboa, M. J., Huertas-Delgado, F. J., Herrador-Colmenero, M., Cardon, G., & Chillón, P. (2020). Parental barriers to active transport to school: a systematic review. *International journal of public health*, *65*(1), 87–98. https://doi.org/10.1007/s00038-019-01313-1

Arnott, B., Rehackova, L., Errington, L., Sniehotta, F. F., Roberts, J., & Araujo-Soares, V. (2014). Efficacy of behavioural interventions for transport behaviour change: systematic review, meta-analysis and intervention coding. *The International Journal of Behavioral Nutrition and Physical Activity*, *11*, 133. https://doi.org/10.1186/s12966-014-0133-9

Bangsbo, J., Krustrup, P., Duda, J., Hillman, C., Andersen, L. B., Weiss, M., … Elbe, A.-M. (2016). The Copenhagen Consensus Conference 2016: Children, Youth, and Physical Activity in Schools and During Leisure Time. *British Journal of Sports Medicine, 50,* 1177-1178. 10.1136/bjsports-2016-096325

Barranco-Ruiz, Y., Paz, A., Ramírez-Vélez, R., Chillón, P., & Villa-González, E. (2018). Mode of commuting to school and its association with physical activity and sedentary habits in young Ecuadorian students. *International Journal of Environmental Research and Public Health,15,* 2704.

Basner, M., & McGuire, S. (2018). WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep. *International Journal of Environmental Research and Public Health, 15*(3), 519. https://doi.org/10.3390/ijerph15030519

Bidzan-Bluma, I., & Lipowska, M. (2018). Physical Activity and Cognitive Functioning of Children: A Systematic Review. *International Journal of Environmental Research and Public Health*, *15*(4), 800. https://doi.org/10.3390/ijerph15040800

Benzing, V., Chang, Y. K., & Schmidt, M. (2018). Acute Physical Activity Enhances Executive Functions in Children with ADHD. *Scientific reports*, *8*(1), 12382. https://doi.org/10.1038/s41598-018-30067-8

Blatchford, C. (2018). Christie Blatchford: Report shows Toronto school board was wrong to head activists and end police program. *National Post.* https://nationalpost.com/opinion/christie-blatchford-report-shows-toronto-school-board-was-wrong-to-heed-activists-over-police-program

Bopp, T., Stellefson, M., Weatherall, B. &, Spratt, S. (2019). Promoting physical literacy for disadvantaged youth living with chronic disease. *American Journal of Health Education, 50,* 153-158.

Boyd, A. (2020). Should we have cops in schools? Why other districts are now asking Toronto. *Toronto Star*. https://www.thestar.com/news/canada/2020/06/19/amid-our-debate-over-policing-should-we-have-cops-in-schools-why-other-school-districts-are-now-asking-toronto.html

Buliung, R., Faulkner, G., Beesley, T., & Kennedy, J. (2011). School Travel Planning: Mobilizing School and Community Resources to Encourage Active School Transportation. *Journal of School Health, 81*(11), 704-712.

Buliung, R., Mitra, R., & Faulkner, G. (2009). Active School Transportation in the Greater Toronto Area, Canada: An Exploration of Trends in Space and Time (1986-2006). *Preventive Medicine, 48*(6), 507. https://doi.org/10.1016/j.ypmed.2009.03.001

Buonanno, G., Stabile, L., & Morawska, L. (2013). Personal exposure to ultrafine particles: the influence of time-activity patterns. *Science of The Total Environment, 468-469,* 903-907.

Buttazzoni, A. N., Clark, A. F., Seabrook, J. A., & Gilliland, J. A. (2019). Promoting Active School Travel in Elementary Schools: A Regional Case Study of The School Travel Planning Intervention. *Journal of Transport & Health*, *12*, 206–219. https://doi.org/10.1016/j.jth.2019.01.007

CAA South Central Ontario. (2022 September 6). *CAA survey finds majority of parents report dangerous driving behaviours in school zones* [Media release]. https://www.caasco.com/about-us/corporate-news/spotlight?spotlights=8786

Canadian Fitness and Lifestyle Research Institute. (2020). Bulletin 5: Active transportation among children and youth. Ottawa, ON: Canadian Fitness and Lifestyle Research Institute. https://cflri.ca/bulletin-5-active-transportation-among-children-and-youth

Castelli, D. M., Glowacki, E., Barcelona, J. M., Calvert, H. G., & Hwang, J. (2015). Active Education: Growing Evidence on Physical Activity and Academic Performance. [Research brief.] Active Living Research. http://activelivingresearch.org/sites/default/files/ALR_Brief_ActiveEducation_Jan2015.pdf

C40 Cities Climate Leadership Group. (2021). *Why green and healthy transport modes deliver vast rewards for cities* (Policy Brief). C40 Knowledge Hub. https://www.c40knowledgehub.org/s/article/Why-shifting-to-green-and-healthy-transport-modes-delivers-vast-rewards-for-cities?language=en_US

Chillón, P., Evenson, K. R., Vaughn, A., & Ward, D. S. (2011). A systematic review of interventions for promoting active transportation to school. *International Journal of Behavioural Nutrition and Physical Activity, 8*(1), 10.

Collins, H., Booth, J. N., Duncan, A., & Fawkner, S. (2019) The Effect of Resistance Training Interventions on Fundamental Movement Skills in Youth: A Meta-analysis. *Sports Medicine - Open, 5,* 17.

Coules, C. (2022, May 6). School run accounts for nearly 30% of morning traffic in London. *AirQualityNews.com*. https://airqualitynews.com/2022/05/06/school-run-accounts-for-nearly-30-of-morning-traffic-in-london/

Dill, J., & Carr, T. (2003). Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Them, Commuters Will Use Them. *Transportation Research Record, 1828*(1), 116–123. https://doi.org/10.3141/1828-14

Donnelly, J. E., & Lambourne, K. (2011). Classroom-based Physical Activity, Cognition, and Academic Achievement. *Preventive Medicine, 52*(Suppl 1), S36-S42.

Egli, V., Mackay, L., Jellyman, C., Ikeda, E., Hopkins, S., Smith, M. (2019). Social Relationships, Nature, And Traffic: Findings From a Child-centred Approach to Measuring Active School Travel Route Perceptions. *Children's Geographies, 18*(6), 667-683. https://doi.org/10.1080/14733285.2019.1685074

8 80 Cities (n.d.). *School Streets*. 8 80 Cities. https://www.880cities.org/portfolio_page/school-streets/

Evans, A. B., Bright, J. L., & Brown, L. J. (2013). Non-disabled Secondary School Children's Lived Experiences of a Wheelchair Basketball Programme Delivered in the East of England. *Sport, Education and Society, 1*-21.

Flanagan, C., & Mitra, R. (2016). International Best Practices in Regional Planning for School Travel. Toronto: Ryerson University and Metrolinx.

French, C. (2020, June 30). School resource officer program to stay in public schools until at least September. *CBC News*. https://www.cbc.ca/news/canada/edmonton/school-resource-officer-program-to-stay-in-public-schools-until-at-least-september-1.5633829

Fridman, L., Ling, R., Rothman, L., Cloutier, M. S., Macarthur, C., Hagel, B. & Howard, A. (2020). Effect Of Reducing the Posted Speed Limit To 30 Km Per Hour on Pedestrian Motor Vehicle Collisions in Toronto, Canada - A Quasi Experimental, Pre-post Study. *BMC Public Health, 20,* 56. https://doi.org/10.1186/s12889-019-8139-5

Green Communities Canada & Green Action Centre. (2010). Saving Time and Money with Active School Travel. https://greenactioncentre.ca/wp-content/uploads/2010/10/Saving-Money-and-Time-with-Active-School-Travel-MB-web.pdf

Green Communities Canada & University of Toronto. (2016). School Travel Planning Benefit-Cost Report for Toronto and Wellington-Dufferin-Guelph. Toronto. https://ontarioactiveschooltravel.ca/wp-content/uploads/2017/08/Benefit-Cost-Final-Report-2016.pdf

Guthold, R., Willumsen, J., & Bull, F. C. (2022). What is Driving Gender Inequalities in Physical Activity Among Adolescents? *Journal of Sport and Health Science, 11*(4), 424–426. https://doi.org/10.1016/j.jshs.2022.02.003

Haerens, L., De Bourdeaudhuij, I., Maes, L., Cardon, G., & Deforche, B. (2007). School-based Randomized Controlled Trial of a Physical Activity Intervention Among Adolescents. *Journal of Adolescent Health, 40*(3), 258-265.

Human Environments Analysis Laboratory. (2022). Investigation of Supportive Policy for Active School Travel. *Western University*. https://ontarioactiveschooltravel.ca/wp-content/uploads/2022/08/Supportive-Policy-Report-AST-2022.pdf

Holloway, S. L., & Valentine, G. (2000). Children's Geographies: Playing, Living, Learning. *Psychology Press, 8*, 1-26.

Ikeda, E., Hinckson, E., Witten, K., & Smith, M. (2019). Assessment of Direct and Indirect Associations Between Children Active School Travel and Environmental, Household and Child Factors Using Structural Equation Modelling. *International Journal of Behavioral Nutrition and Physical Activity, 16*(32), 1-17. https://doi.org/10.1186/s12966-019-0794-5

Janssen, I., & Leblanc, A. G. (2010). Systematic Review of the Health Benefits of Physical Activity and Fitness in School-aged Children and Youth. *International Journal of Behavioral Nutrition and Physical Activity, 7*(40), 1-16.

Jones, R. A., Blackburn, N. E., Woods, C., Byrne, M., van Nassau, F., & Tully, M. A. (2019). Interventions promoting active transport to school in children: A systematic review and meta-analysis. *Preventive medicine*, *123*, 232–241.10.1016/j.ypmed.2019.03.030

Kek, C. C., García Bengoechea, E., Spence, J. C., & Mandic, S. (2019). The Relationship Between Transport-to-school Habits and Physical Activity in a Sample of New Zealand Adolescents. *Journal of Sport and Health Science, 8,* 463–70.

Kullman, K. (2010). Transitional Geographies: Making Mobile Children. *Social & Cultural Geography, 11*(8), 829–846. https://doi.org/10.1080/14649365.2010.523839

Kullman, K. (2014). Children, Urban Care, and Everyday Pavements. *Environment and Planning, 46*(12), 2864–2880. https://doi.org/10.1068/a46260.

Lambiase, M. J., Barry, H. M., & Roemmich, J. N. (2010). Effect of a Simulated Active Commute to School on Cardiovascular Stress Reactivity. *Medicine and Science in Sports and Exercise, 42*(8), 1609.

Larouche, R., Saunders, T. J., Faulkner, G. E., Colley, R. C., & Tremblay, M. S. (2014). Associations Between Active School Transport and Physical Activity, Body Composition and Cardiovascular Fitness: A Systematic Review of 68 Studies. J*ournal of Physical Activity and Health, 11*(1), 206-227.

Lee, J. T. (2021). Review of Epidemiological Studies on Air Pollution and Health Effects in Children. *Clinical and Experimental Pediatrics, 64*(1), 3–11. e-cep.org/journal/view.php?doi=10.3345/cep.2019.00843

Lindenmann, H. P. (2005). The Effects on Road Safety of 30 Kilometer-per-hour Zone Sign Posting in Residential Districts. *Institute of Transportation Engineers ITE Journal, 75*(6), 50-54.

Mammen, G. (2016). School Travel Planning in Canada: A Holistic Examination of Program Impact on Active School Travel [Doctoral dissertation, University of Toronto]. TSpace. https://tspace.library.utoronto.ca/handle/1807/73050

Mammen, G., Stone, M. R., Faulkner, G., Ramanathan, S., Buliung, R., O'Brien, C., & Kennedy, J. (2014). Active School Travel: An Evaluation of the Canadian School Travel Planning Intervention. *Preventive medicine*, *60*, 55–59. https://doi.org/10.1016/j.ypmed.2013.12.008

Marques, A., Peralta, M., Santos, T., Martins, J., & Gaspar de Matos, M. (2019). Self-rated health and health-related quality of life are related with adolescents' healthy lifestyle. *Public health*, *170*, 89–94. https://doi.org/10.1016/j.puhe.2019.02.022

Martinez-Gomez, D. R.-M., Chillón, P., Rey-López, J. P., Díaz, L. E., & Marcos, A. (2011). Active Commuting to School and Cognitive Performance in Adolescents: The AVENA study. *Archives of Pediatrics and Adolescent Medicine, 165*(4), 300-305.

Mattioli, G., Roberts, C., Steinberger, J. K., & Brown, A. (2020). The Political Economy of Car Dependence: A Systems of Provision Approach. *Energy Research & Social Science*, *66*. https://doi.org/10.1016/j.erss.2020.101486

Mendoza, J. A., & Liu, Y. (2014). Active commuting to elementary school and adiposity: an observational study. *Childhood Obesity, 10*(1), 34-41.

Metrolinx. (2011). Metrolinx Greater Toronto and Hamilton Area School Travel Household Attitudinal Study Report: Fall 2011. https://www.metrolinx.com/en/projectsandprograms/steppingitup/ENG-2011GTHASchoolTravelStudy.pdf

Metrolinx. (2013). School Travel Planning in Action in Ontario: Successes and Lessons in Active and Sustainable School Transportation. Toronto.

McKenzie-Mohr, D. (2011). Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing (3rd Edition). New Society Publishers. Gabriola Island, Canada.

Michael, S., Dittus, P., & Epstein, J. (2007). Family and community involvement in schools: results from the School Health Policies and Programs Study 2006. *Journal of School Health, 77*(8), 567-587.

Moeijes, J., van Busschbach, J. T., Wieringa, T. H., Kone, J., Bosscher, R. J., & Twisk, J. W. R. (2019). Sports participation and health-related quality of life in children: results of a cross-sectional study. *Health and Quality of Life Outcomes, 17*(64). https://doi.org/10.1186/s12955-019-1124-y

Morissette R., Deng, Z., & Messacar, D. (2021). Working from home: Potential implications for public transit and greenhouse gas emissions. *Economic and Social Reports, 1*(4). https://doi.org/10.25318/36280001202100400005-eng

Morris, S., Lawlor, E. R., Foley, L., Summerbell, C., Panter, J., Adams, J., Jago, R., & Pollard, T. M. (2022). Children's experiences of the journey between home and school: A qualitative synthesis using meta-ethnography. *Health and Place, 76,* 1-12. https://doi.org/10.1016/j.healthplace.2022.102819

Ni, Y., Loftus, C. T., Szpiro, A. A., Young, M. T., Hazlehurst, M. F., Murphy, L. E., Tylavsky, F. A., ... & Karr, C. J. (2022). Exposures with Child Behavioral Problems and Cognitive Performance: A U.S. Multi-Cohort Study. E*nvironmental Health Perspectives, 130*(6), 1-15. https://doi.org/10.1289/EHP10248

Ornelas, I. J., Perreira, K. M., & Ayala, G. X. (2007). Parental influences on adolescent physical activity: a longitudinal study. *International Journal of Behavioral Nutrition and Physical Activity, 4*(1), 3.

ParticipACTION. (2016). Are Canadian Kids Too Tired to Move? *2016 ParticipACTION Report Card on Physical Activity for Children and Youth.* https://www.activehealthykids.org/wp-content/uploads/2016/11/canada-report-card-long-form-2016.pdf

ParticipACTION. (2018). Canadian kids need to move more to boost their brain health. *2018 ParticipACTION Report Card on Physical Activity for Children and Youth.* *https://www.participaction.com/wp-content/uploads/2022/09/2018_participaction_report_card_-_highlight_report_0.pdf*

ParticipACTION. (2020). #Family Influence: The Role of the Family in the Physical Activity, Sedentary and Sleep Behaviours of Children and Youth. *2020 ParticipACTION Report Card on Physical Activity for Children and Youth.* https://participaction.cdn.prismic.io/participaction/f6854240-ef7c-448c-ae5c-5634c41a0170_2020_Report_Card_Children_and_Youth_Full_Report.pdf

ParticipACTION. (2022). Lost & Found: Pandemic-Related Challenges and Opportunities for Physical Activity. *2022 ParticipACTION Report Card on Physical Activity for Children and Youth*. https://www.participaction.com/wp-content/uploads/2022/10/2022-Children-and-Youth-Report-Card.pdf

Proudfoot, N. A., King-Dowling, S., Cairney, J., Bray, S. R., MacDonald, M. J., & Timmons, B. W. (2019). Physical Activity and Trajectories of Cardiovascular Health Indicators During Early Childhood. *Pediatrics*, *144*(1), e20182242. https://doi.org/10.1542/peds.2018-2242

Quante, M., Cespedes Feliciano, E. M., Rifas-Shiman, S. L., Mariani, S., Kaplan, E. R., Rueschman, … Redline, S. (2019). Association of Daily Rest-Activity Patterns with Adiposity and Cardiometabolic Risk Measures in Teens. *Journal of Adolescent Health, 65*(2), 224–231. https://doi.org/10.1016/j.jadohealth.2019.02.008

Ramanathan, S., O'Brien, C., Faulkner, G., & Stone, M. (2014). Happiness in Motion: Emotions, Well-Being, and Active School Travel. *Journal of School Health, 84*, 516-523.

Reynolds, C.C., Harris, M. A., Teschke, K., Cripton, P. A. , & Winters, M. (2009). The Impact of Transportation Infrastructure on Bicycling Injuries and Crashes: A Review of the Literature. *Environmental Health, 8,* 47.

Roach, L., & Keats, M. (2018). Skill-based and planned active play versus free-play effects on fundamental movement skills in preschoolers. *Perceptual and Motor Skills, 125,* 651-668.

Romero, V. (2010). Children's views of independent mobility during their school travels. *Children, Youth and Environments, 20* (2), 46–66. https://www.jstor.org/stable/10.7721/chilyoutenvi.20.2.0046

Ross, A., Rodríguez, A., & Searle, M. (2017). Associations between the Physical, Sociocultural, and Safety Environments and Active Transportation to School. *American Journal of Health Education*, *48*(3), 198–209. https://doi.org/10.1016/j.trd.2022.103448

Rothman, L., Cloutier, M. S., Manaugh, K., Howard, A. W., Macpherson, A. K., & Macarthur, C., (2020). Spatial distribution of roadway environment features related to child pedestrian safety by census tract income in Toronto, Canada. *Injury Prevention, 26*(3), 229–233. https://doi.org/10.1136/injuryprev-2018-043125

Rothman, L., Hagel, B., Howard, A., Cloutier, M. S., Macpherson, A., Aguirre, A. N., … Winters, M. (2021). Active school transportation and the built environment across Canadian cities: Findings from the child active transportation safety and the environment (CHASE) study. *Preventive Medicine, 146*. https://doi.org/10.1016/j.ypmed.2021.106470

Rothman, L., Howard, A., Buliung, R., Macathur, C., & Macpherson, A. (2016). Dangerous student car drop-off behaviors and child pedestrian-motor vehicle collisions: An observational study. *Traffic Injury Prevention, 17*(5), 454-459.

Rothman, L., Macarthur, C., To, T., Buliung, R., & Howard, A. (2014a). Motor Vehicle-Pedestrian Collisions and Walking to School: The Role of the Built Environment. *Pediatrics, 133*(5), 776-784.

Rothman, L., Macpherson, A., Buliung, R., To, T., Macarthur, C., Larsen, K., & Howard, A. (2015). Installation of Speed Humps and Pedestrian-Motor Vehicle Collisions in Toronto, Canada: A Quasi-Experimental Study. *BMC Public Health, 15,* 774.

Rothman, L., Macpherson, A., Ross, T., & Buliung, R. (2018). The decline in active school transportation (AST): A systematic review of the factors related to AST and changes in school

transport over time in North America. *Preventive medicine*, *111*, 314–322. https://doi.org/10.1016/j.ypmed.2017.11.018

Rothman, L., To, T., Buliung, R., Macarthur, C., & Howard, A. (2014b). Influence of social and built environment features on children's walking to school: An observational study. *Preventive Medicine, 60,* 10-15.

Schwartz, N., Howard, A., Cloutier, M.-S., Mitra, R., Saunders, N., Macpherson, A., … Rothman, L. (2022). Social inequalities in child pedestrian collisions: The role of the built environment. *Transportation Research Part D: Transport and Environment, 11*. https://doi.org/10.1016/j.trd.2022.103448

Sims, R., Schaeffer, R., Creutzig, F., Cruz-Núñez, X., D'Agosto, M., Dimitriu, D., … Tiwari, G. (2014). Transport. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, … & J. C. Minx (Eds.), *Climate Change 2014. Mitigation of Climate Change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC: Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar5/wg3/

Statistics Canada. (2021). A look at the potential impact of telework on public transit and greenhouse gas emissions using 2015 data. https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2021040-eng.htm

Student Transportation Services of Waterloo Region. (n.d.). Drive-to-5: Planning Guide. https://www.stswr.ca/wp-content/uploads/Drive-to-5-Planning-Guide.pdf

Sustrans. (2017). Active Travel Toolkit - The role of active travel in improving health. https://www.sustrans.org.uk/our-blog/research/all-themes/all/active-travel-toolkit-the-role-of-active-travel-in-improving-health

Tan, V. P., Macdonald, H. M., Gabel, L., & McKay, H. A. (2018). Physical Activity, but not Sedentary Time, Influences Bone Strength in Late Adolescence. *Archives of Osteoporosis, 13*(1), 31. https://doi.org/10.1007/s11657-018-0441-9

Telford, R. M., Telford, R. D., Olive, L. S., Cochrane, T., & Davey, R. (2016). Why Are Girls Less Physically Active than Boys? Findings from the LOOK Longitudinal Study. *PloS one*, *11*(3), e0150041. https://doi.org/10.1371/journal.pone.0150041

Teschke, K., Harris, M. A., Reynolds, C. C., Winters, M., Babul, S., Chipman, M., … Cripton, P. A. (2012). Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study. *American Journal of Public Health, 102,* 2336-2343.

The Centre for Active Transportation. (2016). Guide to Safer Streets Near Schools: Do you want safer streets in your neighbourhood? https://www.tcat.ca/resources/guide-to-safer-streets-near-schools/

Toronto. (2021, August 24). *Preliminary Automated Speed Enforcement evaluation data points to increased compliance and reduced speeding in first year of implementation.* [News release]. https://www.toronto.ca/news/preliminary-automated-speed-enforcement-evaluation-data-points-to-increased-compliance-and-reduced-speeding-in-first-year-of-implementation/

Tremblay, M. S., Longmuir, P. E., Barnes, J. D., Belanger, K., Anderson, K. D., Bruner, B., … Woodruff, S. J. (2018). Physical Literacy Levels of Canadian Children Aged 8-12 Years:

Descriptive and Normative Results from the RBC Learn to Play-CAPL project. *BMC Public Health,18*(Suppl 2), 1036. https://doi.org/10.1186/s12889-018-5891-x

Tremblay, M. S., & Willms, J. D. (2003). Is the Canadian Childhood Obesity Epidemic Related to Physical Inactivity? *International Journal of Obesity, 27*(9), 1100-1105.

Valente, T., Hoffman, B., Ritt-Olson, A., Lichtman, K., & Johnson, C. (2003). Effects of a Social Network Method for Group Assignment Strategies on Peer-led Tobacco Prevention Programs in Schools. *American Journal of Public Health, 93*(11), 1837-1843.

Vanos, J. K. (2014). Children's Health and Vulnerability in Outdoor Microclimates: A Comprehensive Review. *Environment International, 76,* 1-15.

Villa-González, E., Barranco-Ruiz, Y., Evenson, K. R., & Chillón, P. (2018). Systematic Review of Interventions For Promoting Active School Transport. *Preventive Medicine*, *111*, 115–134. https://doi.org/10.1016/j.ypmed.2018.02.010

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health Benefits of Physical Activity: The Evidence. *Canadian Medical Association Journal, 174*(6), 801-809.

Wilson, K., Coen, S. E., Piaskoski, A., & Gilliland, J. A. (2019). Children's Perspectives on Neighbourhood Barriers and Enablers to Active School Travel: A Participatory Mapping Study. *The Canadian Geographer/ Le Géographe canadien, 63*(1), 112–128. https://doi.org/10.1111/cag.12488

World Health Organization. (2018, July 12). *Air pollution and child health: prescribing clean air*. Geneva, Switzerland. who.int/publications/i/item/WHO-CED-PHE-18-01

Wyseman, D. (2010). Risk Management and Active School Travel Fact Sheet. Green Communities Canada. https://ontarioactiveschooltravel.ca/wp-content/uploads/2018/05/Risk-Management-AST-2018-En..pdf

Zeglen, L. (2017). Time, Space & Gender: Key Lessons from Project BEAT. *Project BEAT*. https://ontarioactiveschooltravel.ca/wp-content/uploads/2017/09/Project-BEAT-Summary-Report.pdf

Zhang, J., Yang, S. X., Wang, L., Han, L. H., & Wu, X. Y. (2022). The influence of sedentary behaviour on mental health among children and adolescents: A systematic review and meta-analysis of longitudinal studies. *Journal of Affective Disorders*, *306*, 90. https://doi.org/10.1016/j.jad.2022.03.018