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Equity Considerations in Active School Travel Interventions

Alina Medeiros, *The University of Western Ontario*

Supervisor: Gilliland, Jason A., *The University of Western Ontario*

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Abstract

Active school travel has benefits for children's physical and mental health, academic achievement, and the environment. Underscoring active school travel is children's independent mobility, defined as their ability to travel around their community without adult supervision. Interventions have shown some success in reversing declining trends in active school travel and independent mobility. However, little is known about how interventions have varying impacts on different subgroups of children. This thesis identifies ways to increase equity in active school travel interventions by investigating how equity is currently considered in interventions and gendered disparities in children's ability to engage in independent mobility. This thesis includes a systematic review of active school travel interventions and a quantitative investigation of differences in determinants of independent mobility between boys and girls. Findings have implications for future research and practice among intervention facilitators and evaluators, public health practitioners, policymakers, educators, and school administrators.

Keywords

Active school travel, independent mobility, equity, children, gender

Summary for Lay Audience

Active school travel is defined as any form of human-powered transport to and/or from school, for example walking or biking. Actively traveling to/from school has been found to benefit children's physical and mental health, school success, and the environment. Children who travel around their community without adult supervision, termed independent mobility, are more likely to travel to and from school actively. In the past 20 to 30 years fewer children are independently mobile or travel to and from school actively. Interventions promoting active school travel have shown some success at getting more kids to travel without parents and engage in active school travel. However, little is known about how these interventions affect different groups of children. The purpose of this thesis is to identify ways to increase equity in active school travel interventions by investigating (1) how equity is considered in intervention development, implementation, and evaluation, and (2) whether boys and girls have different barriers and facilitators to engaging in independent mobility on their school trips. This thesis uses a review of active school travel interventions as well as a quantitative investigation of differences in determinants of independent mobility between boys and girls. Findings have implications for future research, policy, and practice.

Co-Authorship Statement

This thesis is presented in an integrated article format with two independent but related studies. Each integrated article has been or will be submitted for publication in a peer-reviewed journal.

Chapter 2: Medeiros, A., Buttazzoni, A., Coen, S., Clark. A., Wilson, K., & Gilliland, J. (2020). A Systematic Review of Equity Considerations in Active School Travel Interventions.

Chapter 2 was written by Alina Medeiros with Adrian Buttazzoni, Dr. Stephanie Coen, Dr. Andrew Clark, Katherine Wilson, and Dr. Jason Gilliland. Alina Medeiros co-conceptualized the paper and co-developed its methodology, performed an updated literature search, data extraction, data analysis, wrote the first draft, and is the primary author. Adrian Buttazzoni completed the primary search; was involved with the methodology, and data extraction; and contributed to editing the paper. Dr. Coen co-conceptualized the paper; was involved with the methodology, validation, and data extraction; and contributed to editing the paper. Dr. Clark and Katherine Wilson were involved in the development of the methodology, validation, and data extraction and contributed to editing the paper. Dr. Gilliland oversaw the project, was involved in conceptualizing the paper, developing the methodology, validation, and contributed to editing the paper.

Chapter 3: Medeiros, A., Clark. A., Martin, G., Seabrook, J., & Gilliland, J. (2020). Exploring the influence of children's gender on parents' perceptions of the environment and their influence on children's independent mobility.

Chapter 3 was written by Alina Medeiros, Dr. Andrew Clark, Dr. Gina Martin, Dr. Jamie Seabrook, and Dr. Jason Gilliland. Alina Medeiros was responsible for conceptualizing this study, helping with data collection, conducting the data analysis, writing the first draft, and is the primary author. Dr. Clark, Dr. Martin, Dr. Seabrook, and Dr. Gilliland provided overall project guidance, assistance with the methodology and analysis, and editing of drafts. Dr. Gilliland is the principal investigator of the ASRTS study.

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List of Abbreviations

AST	Active school travel
IM	Independent mobility
SES	Socioeconomic status
ASRTS	Active and Safe Routes to School

Chapter 1

1 Introduction

1.1 Research Context

Engaging in active school travel (AST), any form of human-powered transport to and/or from school, provides children (5 to 17 years old) with an opportunity to be physically active (ParticipACTION, 2020). In addition, AST is beneficial for children's health as it has been associated with improved cardiovascular fitness (Larouche, Saunders, Faulkner, Colley, & Tremblay, 2014), reduced stress (Lambiase, Barry, & Roemmich, 2010), more positive emotions, and increased wellbeing (Ramanathan, O'Brien, Faulkner, & Stone, 2013). AST has also been linked to reduced air pollution around schools (Gilliland et al., 2019). Despite these positive benefits, rates of AST have been decreasing in recent decades (Buliung, Mitra, & Faulkner, 2009; Gray et al., 2014). Statistics report that only 21% of children 5-10-years-old and 24% of children 11-14-years old typically use AST (ParticipACTION, 2020).

To address low rates of AST among children, interventions promoting AST have been gaining momentum in recent years. Interventions have shown small success at reversing negative trends in AST behaviour (Jones et al., 2019; Villa-González, Barranco-Ruiz, Evenson, & Chillón, 2018). The most notable programs in North America are the School Travel Planning and Safe Routes to School interventions. These two programs employ a similar multi-component framework for implementation and have become common interventions targeting school travel in the region (Buttazzoni, Van Kesteren, Shah, & Gilliland, 2018). Research has found that local interventions have positively influenced parental perceptions of AST; however, the implementation of programs have not significantly increased engagement in AST (Buttazzoni, Clark, Seabrook, & Gilliland, 2019). Furthermore, AST interventions have shown to disproportionally address AST among subgroups of children.

Evaluations of AST interventions have found that different subgroups of children have varying rates of engagement with AST (Ikeda, Hinckson, Witten, & Smith, 2018;

Rothman, Macpherson, Ross, & Buliung, 2018). Specifically, interventions have had greater effects for boys compared to girls (Hollein et al., 2017). Moreover, children from medium-income neighbourhoods have greater participation in AST compared to low or high-income groups, as with those in suburban or urban contexts compared to rural settings (Mammen, Stone, Buliung, & Faulkner, 2014). These disparities in AST participation reinforce a need for equity considerations in AST interventions. Therefore, the purpose of this thesis is to identify how equity is being considered in AST interventions and areas for future practice. Equity in relation to AST is defined as the absence of avoidable or systemic differences in children's engagement in AST (Braveman, 2006).

Recently, organizations supporting AST interventions have adopted equity as a component "so that all members of the school community can participate" (Green Communities Canada, 2018, p.3). However, equity is the least often considered element of AST interventions (Buttazzoni et al., 2018). Addressing differential rates of participation in AST is important to ensure that all children can engage in and benefit from AST programs. To address disparities, interventions need to address barriers to provide greater benefit to disadvantaged groups (Tugwell, de Savigny, Hawker, & Robinson, 2006; White, Adams, & Heywood, 2009). Such suggestions are echoed by physical activity literature in their recommendations surrounding the inclusion of equity in intervention development, implementation, and evaluation (ParticipACTION, 2020).

The complex factors associated with children's travel behaviours have made it difficult for AST interventions to change travel behaviours (Mitra, 2013). School travel mode choice is underlined by two interconnected decisions: (1) whether or not the child is capable of traveling without adult supervision, termed independent mobility (IM); and (2) travel mode choice (Faulkner, Richichi, Buliung, Fusco, & Moola, 2010; Mitra, 2013). Notable factors surrounding children's IM include excessive traffic (Buliung, Larsen, Faulkner, & Ross, 2017; Lopes, Cordovil, & Neto, 2014; Wolfe & McDonald, 2016), perceptions of safety (Lopes et al., 2014; Mammen, Faulkner, Buliung, & Lay, 2012), and child's age (Buliung et al., 2017; Janssen, Ferrao, & King, 2016; Riazi et al., 2019). Mode choice is often influenced by convenience as determined by distance (Larsen et al.,

2009; Wilson, Clark, & Gilliland, 2018) and parental availability (Faulkner et al., 2010; McDonald, 2008).

Canadian AST interventions attempt to address travel behaviours broadly (Green Communities Canada, 2018), ignoring the more specific interrelated decisions influencing AST behaviour. In doing so, the specific barriers and facilitators surrounding IM and travel mode are not considered. Increasing children's ability to travel independently is a key step towards AST participation as it enables them to engage in AST without the constraints associated with parental availability (Faulkner et al., 2010). Therefore, in addition to ensuring that AST interventions are equitable, interventions should also target children's IM as a foundation for their AST participation.

This thesis aims to further examine equity within AST interventions and inform future intervention practices through complementary analyses. First, equity considerations are examined broadly within existing AST interventions. Next, differences between boys' and girls' engagement in IM on the school journey are studied. Gender was chosen as a focus for this paper as literature reports that girls have less IM than boys (Buliung et al., 2017; Mitra, Faulkner, Buliung, & Stone, 2014; Villanueva et al., 2014). In addition, there are reliable, non-invasive, and easy measures of children's gender available to practitioners and researchers. Furthermore, gender tends to be more evenly divided within a school population compared to socioeconomic status (SES), ethnic background, or place (Love, Adams, & van Sluijs, 2017). IM was chosen as the focus as there are different social norms surrounding IM and travel mode choice. As IM is a crucial step towards AST (Faulkner et al., 2010; Mitra, 2013), focusing on IM allows for more tailored intervention strategies. Ultimately, both studies in this thesis provide valuable insights to enhance AST interventions by providing evidence to address key disparities in AST participation among children.

The primary intention of this thesis is to help provide the evidence needed to increase equity in future AST interventions by identifying (1) how equity is currently considered in intervention development, implementation, and evaluation; and, (2) disparities in children's engagement in AST based on their gender. This thesis contributes to public

health practice and research by offering practical intervention strategies and key correlates of disparities in AST participation.

1.2 Theoretical Framework

Theoretical frameworks are an important element of research as they lay the foundation on which knowledge is constructed. Their purpose is to orient the researcher by proving a common lens to support thinking and analysis (Grant & Osanloo, 2014). As such, a researcher's epistemological orientation is reflected in the selection of a theoretical framework (Lysaght, 2011). This thesis uses the socio-ecological model of health behaviour and feminist theory as foundations.

The socio-ecological model used in this thesis was built upon the Ecological Systems Theory of Human Development which posits that to understand human behaviour, the entire ecological context in which development occurs needs to be taken into consideration (Bronfenbrenner, 1979). Accordingly, the socio-ecological model positions health behaviours as influenced by factors within multiple levels – intrapersonal, interpersonal, environment, and policy level (see Figure 1.1; Sallis et al., 2006). Subjective interpretations and objective components of the environment are both important sources of influence within the model (Sallis et al., 2006). Influences can also interact across levels (Sallis, Owen, & Fisher, 2008).

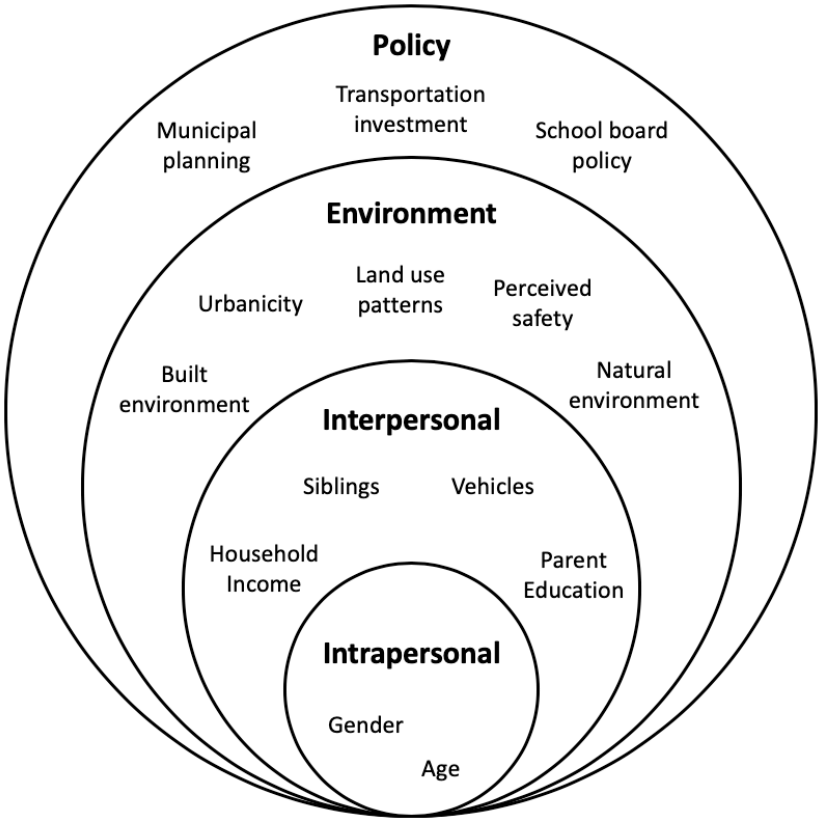

Figure 1.1: Socio-Ecological Model of Health Behavior adapted from Wilson (2018) and Sallis et al., (2006)

The socio-ecological model aligns with human geography to understand how the surrounding environments influence human actions (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009; Sallis et al., 2006, 2008). Utilized within geography, this theory draws attention to intrapersonal and interpersonal factors influencing behaviour. As a result, it enables geographical researchers to overcome the ecological fallacy in which it is implied that the same set of social characteristics are shared by all the people in a given area (Gregory et al., 2009). Within health, this theory enables researchers to understand how modifiable factors within the environment can be changed to support healthier outcomes for people (Sallis et al., 2006). As a result, the socio-ecological model bridges gaps between health and geographical research to enable interdisciplinary analyses of complex human behaviours.

IM and AST are complex behaviours affected by factors at the intrapersonal, interpersonal, environment, and policy levels (Mitra, 2013). The socio-ecological model is useful for this research as it systematically assesses mechanisms of change at multiple levels of behavioural influence (Sallis et al., 2006, 2008). In addition, AST occurs in environmental contexts that are unique to each child. The socio-ecological model enables researchers and practitioners to identify how levels interact to provides a framework for characteristics that facilitate or hinder IM and AST (Sallis et al., 2006, 2008). Finally, this model is often used to inform multicomponent, population-level interventions (Sallis et al., 2006, 2008). As AST interventions often occur at the population level (Buttazzoni et al., 2018), interventions should target all levels of influence as identified by the socio-ecological model (Sallis et al., 2006). This framework is utilized in Chapters 2 and 3 to identify and interpret social issues and phenomena and to discuss potential intervention strategies promoting behaviour change.

The second theory that is applied in this thesis is feminist theory, predicated upon feminism. Core components assert that gender is a socially constructed system in which femininity is devalued and masculinity is favored. Gender inequality is unjust, socioculturally created, and immutable. As such, feminists strive to eliminate gender inequality (Chafetz, 2004). Applying feminist constructs within human geography identifies how genders and geographies are reciprocally produced and transformed (Gregory et al., 2009). Feminist theory in geography is divided into three main lines of research: (1) gender as social relation; (2) gender as a social construction; and (3) gender as difference (Dixon & Jones, 2006). The first approach examines the social relations that connect men and women, while the second addresses how individuals, environments, and other phenomena are gendered. Feminist geographies of difference explore how life experiences differ based on individuals' gender (Dixon & Jones, 2006). This is the main branch of feminist theory that is applied in this thesis.

As environments become coded as masculine or feminine spaces (Gregory et al., 2009), the resulting interactions that children have with their environment vary based on their gender. Traditionally, public spaces were male-dominated, and women’s place was the home (Lloyd, 1975). While today's society has fewer restrictions on the spatial patterns of

men and women, remnants of these norms are still present as boys experience greater territorial range than girls (Brown, Mackett, Gong, Kitazawa, & Paskins, 2008). In combination with the socio-ecological model, these theories allow for greater exploration as to the interaction between children's gender and their perceptions of the spaces and places with which they interact.

In Chapter 2, feminist theory is used broadly to conceptualize gender within AST interventions. A feature of feminist theory is its interdisciplinary nature (Gregory et al., 2009). This systematic review draws on global literature from health, geography, and education. Moving beyond disciplinary divides and making connections across different places allows for further discussion into the processes and norms influencing children's AST behaviours. In Chapter 3, feminist theory is evident throughout the research process. This paper is specifically grounded in feminist theories of difference as it seeks to understand differences in children's AST behaviours based on their gender (Dixon & Jones, 2006; Gregory et al., 2009). Understanding that children's and parents' sense of place differs based on their gender provides a basis for exploration into these differences and how they influence behaviour.

1.3 Research Questions and Objectives

The overall purpose of this research is to identify intervention strategies to address equity in AST interventions. This research aims to better understand equity strategies in existing AST interventions and further target gender equity in IM to inform future AST interventions. This knowledge is necessary to develop equitable intervention strategies, guide future intervention methods, and inform policymakers and practitioners with high-quality evidence to improve children's AST outcomes.

To achieve these objectives, this thesis consists of a literature review of AST interventions and a quantitative assessment of children's IM. The following research questions are used to guide the systematic review:

1. How have studies considered equity factors identified by gender, SES, ethnic background (i.e. minoritized populations based on race/ethnicity, language and

migrant status [Chappell & Cahnmann-Taylor, 2013; DeFinney, Dean, Loiselle, & Saraceno, 2011; Harley, Jolivette, McCormick, & Tice, 2002]), and place (i.e. urban, suburban, and/or rural environmental contexts) in the design and evaluation of AST interventions?

2. To what extent do AST interventions report equity considerations in their analyses, outcomes, programming, and discussions?

Primary data are then used to understand differences in IM between boys and girls. The research seeks to answer the following research questions:

3. How do the intrapersonal, interpersonal, and physical environment factors that influence children's IM differ by children's gender?
4. Controlling for those factors, how do parents' perceptions of barriers and facilitators correlate with children's IM by children's gender?

To answer the first two research questions, this systematic review draws from existing literature on children's AST interventions to determine how these interventions consider equity within all aspects of their intervention development, implementation, and evaluation. This systematic review aims to identify ways in which equity was considered throughout existing AST interventions and how studies report equity considerations.

To answer the third and fourth research questions, a quantitative study was undertaken, drawing on data on children from grades 4 through 8, and their parents, involved in schools associated with the Active and Safe Routes to School (ASRTS) initiative in South Western Ontario. The ASRTS project is outlined in the following section. Methods used in each study are explained in greater detail in their respective chapters, 2 and 3.

This research is timely due to recent recommendations from physical activity literature suggesting equity be considered throughout intervention design, implementation, and evaluation (ParticipACTION, 2020). This research provides a summary of existing strategies in AST interventions to address inequities. Furthermore, differences between boys' and girls' IM are identified, which can be used to address disparities in future interventions. As physical activity behaviours in childhood are important determinants of

physical activity behaviours in adulthood (Telama, 2009), addressing children's inequal AST behaviours can have important long-term health benefits.

1.4 The Active and Safe Routes to School Project

Chapter 3 of this thesis uses baseline data collected as part of the ASRTS program. This program takes place in the cities of London and St. Thomas and the counties of Elgin, Oxford, and Middlesex (see Figure 1.2). The ASRTS program is a regional partnership with representatives from health units, school boards, student transportation services, non-profits, community organizations, and research partners (Active and Safe Routes to School, 2020a). Using School Travel Planning interventions, ASRTS aims to increase uptake of AST in local elementary schools (Active and Safe Routes to School, 2020b). Interventions work by identifying and building upon strengths and removing barriers to AST in the school neighbourhood (Active and Safe Routes to School, 2020c).

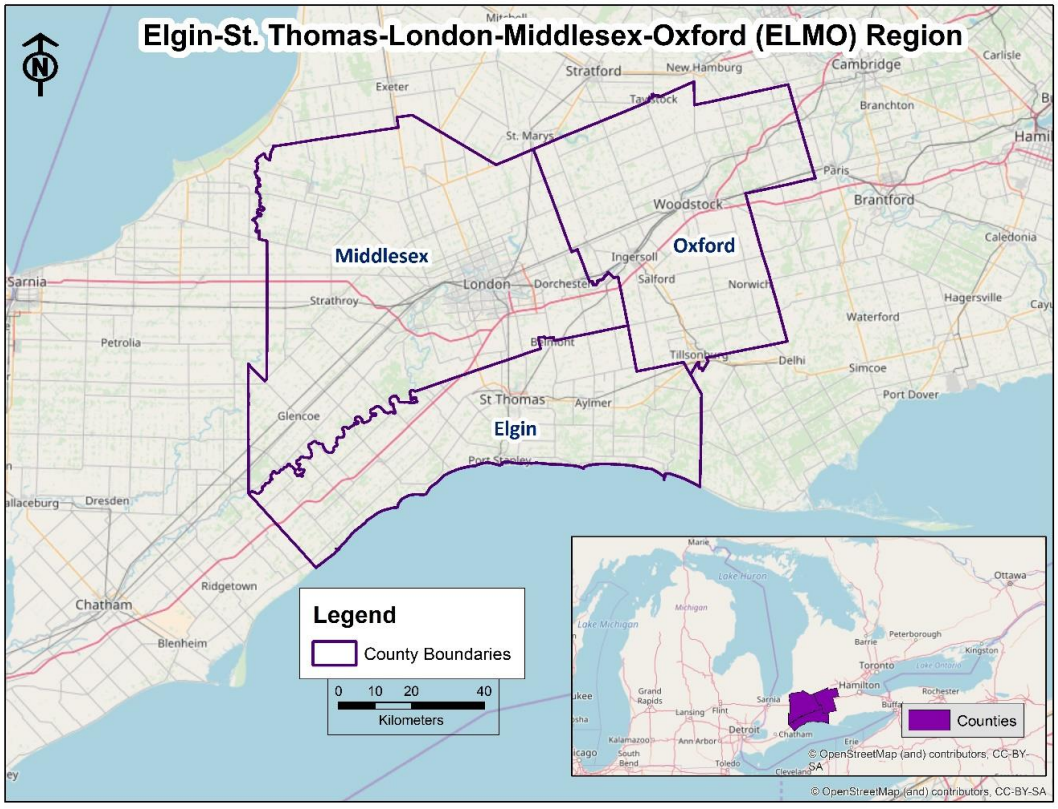

Figure 1.2: Map of ASRTS Study Area (Buttazzoni, 2018)

School self-select their participation into the program following a needs assessment with a school health nurse/school travel planning facilitator and school administrators. Once participating, the nurse/facilitator and school administration work to establish a school travel planning committee at the school. Next, baseline data is collected. This data is used by the committee to inform the subsequent action plan for intervention. The action plan identifies actions that will be taken to address school travel concerns. Following a two to three-year period to implement the action plan, follow up data is collected. This data is used to identify areas of success and next steps (Green Communities Canada, 2018). The primary role of the Human Environment Analysis Laboratory (HEAL) in this partnership is to facilitate and analyze pre- and post-intervention data collection and analysis.

Once a school decided to participate in the project, the nurse/facilitator conducted presentations in grade 4 to 8 classrooms in participating schools. These presentations introduced the project to children and concluded by giving them a package to take home to their parents. This package contained a letter of information providing parents with an overview of the research, a consent form to permit their child to complete the child survey, and a survey for the parent to complete and return to the school (see Appendices B-D). Upon receiving parental consent, the nurse/facilitator gave children an assent form that they needed to fill in before completing a youth survey (see Appendices E-F).

Ethics for the research that contributed to Chapter 3, was approved by the Non-Medical Research Ethics Board of the University of Western Ontario (NMREB #105635) prior to commencement (Appendix G). The project was also approved by the Thames Valley District School Board and London District Catholic School Board via their internal research ethics boards (Appendices H and I).

1.5 Thesis Format

This thesis follows an integrated article format, comprised of two independent but related studies. Both studies have the goal of addressing equity in AST interventions. The first study aims to identify equity considerations in existing AST interventions, whereas the second study focuses on children's IM as a foundation for AST and its differences, based

on children's gender. In doing so, this thesis aims to inform future AST interventions to ensure they are equitable among children. Brief descriptions of each thesis chapter are as follows.

Chapter 2 is a systematic review of existing literature on AST interventions with children. This review identifies methods in which AST interventions consider equity throughout their development, implementation, and evaluation and notes the success of these interventions within groups.

Chapter 3 examines how barriers and facilitators to children's IM for the school journey differ between boys and girls. This study considers known correlates of IM at the intrapersonal, interpersonal, and physical environmental levels of the socio-ecological model, and parents' perceptions of barriers and facilitators to IM along the route and within their neighbourhood.

Chapter 4 concludes this thesis by summarizing and connecting key findings from each integrated article. This chapter discusses research limitations, research contributions, recommendations for future research, and implications for policy and practice.

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Chapter 2

2 A Systematic Review of Equity Considerations in Active School Travel Interventions

2.1 Abstract

Trends over the last few decades have shown that fewer children today are engaging in active modes of travel to and from school than in previous generations. Interventions promoting active school travel can be effective at reversing these trends and increasing rates of active school travel among children. The objective of this paper is to identify how equity has been considered in the design and evaluation of active school travel interventions and how effective these interventions were at addressing/reducing inequities in active school travel participation among children of different gender, neighbourhood socioeconomic status, ethnic background (i.e. minoritized populations on the basis of race/ethnicity, language and migrant status), and place (i.e. urban, suburban, and/or rural environmental contexts). Six databases were used (BIOSIS Previews, GeoBase, PubMed, SCOPUS, SPORTDiscus, and Web of Science) to obtain literature published globally between 2010 and 2019. The inclusion criteria applied in this review included a focus on an active school travel intervention for children (aged 5 to 19 years), quantitative results, and a primary outcome related to active school travel. A total of 69 papers were included in the review. Active school travel interventions rarely consider equity within their intervention design. Gender and socioeconomic status were mentioned most often compared to ethnic background and place. Some papers reported differential effects among groups. Gender, socioeconomic status, ethnic background, and place were most often considered as variables that were controlled for within study samples. Suggestions to address equity within active school travel interventions included using multicomponent interventions with targeted strategies to address equity factors. Using equity frameworks to develop interventions and conducting sub-group analyses during evaluation allows for greater assessment of equity effects. Ensuring the integration of equity into localized interventions is an effective way of encouraging increasing rates of active school travel.

2.2 Introduction

Active school travel (AST) is defined as any form of human-powered travel to and from school, such as walking and cycling. AST has been shown to have positive effects on the health of school-age children (ages 5 to 19 years old), including higher daily physical activity and cardiorespiratory fitness (Larouche, Saunders, Faulkner, Colley, & Tremblay, 2014; Lubans, Boreham, Kelly, & Foster, 2011). AST is also associated with several cognitive benefits such as improved mental health (Ramanathan, O'Brien, Faulkner, & Stone, 2013) and for communities as it can lead to reduced vehicular traffic, increased pedestrian safety around schools, and improved air quality (Adams & Requia, 2017; Gilliland et al., 2019).

Despite the many positive benefits, research suggests that within recent decades fewer children are engaging in active modes of travel and instead are being passively transported to/from school in personal vehicles (Gray et al., 2014; Grize, Bringolf-Isler, Martin, & Braun-Fahrländer, 2010; H. P. Van Der Ploeg, Merom, Corpuz, & Bauman, 2008). There have been many interventions developed and implemented to try to reverse decreases in AST, but recent research shows modest success at increasing rates of AST across populations (Larouche, Mammen, Rowe, & Faulkner, 2018; Villa-González, Barranco-Ruiz, Evenson, & Chillón, 2018). The lack of significant behaviour changes may be due to an absence of consideration for specific mediating factors; variables specific to the child, their family, and/or the community that influence the relationship of the AST intervention and behaviour change (Baranowski, Anderson, & Carmack, 1998). As a result, interventions may not be addressing populations in the community that are least likely to use AST and therefore are not demonstrating large successes. There are gaps in participation along the lines of gender[1], socioeconomic status (SES), ethnic background (i.e. minoritized populations on the basis of race/ethnicity, language and

[1] We acknowledge that sex and gender are used interchangeably within the literature. We have included mentions and consideration of both sex and gender from the literature reviewed. However, in this paper we only use the term gender as it refers to socially constructed characteristics of a person. Since we are discussing health related behaviour within the social context, gender is the most appropriate term.

migrant status (Chappell & Cahnmann-Taylor, 2013; DeFinney, Dean, Loiselle, & Saraceno, 2011; Harley, Jolivette, McCormick, & Tice, 2002)), and place (i.e. urban, suburban, and/or rural environmental contexts) (Davison, Werder, & Lawson, 2008).

Marked disparities in AST participation rates exist by gender with literature reporting that rates of AST are higher among boys than girls (Larouche et al., 2019; McDonald, 2012; McMillan, Day, Boarnet, Alfonzo, & Anderson, 2006). These differences are thought to exist partially due to variations in physical activity participation, as the literature reports boys have higher levels and greater enjoyment of physical activity than girls (Cairney et al., 2012; Hallal et al., 2012). Differences in parental perceptions regarding independent mobility based on a child's gender also contribute to differences in rates of AST (Ghekiere et al., 2017; McDonald, 2012). Stemming from gendered assumptions of feminine vulnerability, girls are often granted less independent mobility compared to boys due to parenting practices that are 'protective' of daughters (Valentine, 1997). For example, parental perceptions of traffic safety were a significant predictor of girls' independent mobility but not boys and girls were less likely than boys to use AST if parents reported that there were busy roads to cross on the route (Ghekiere et al., 2017; Timperio, Crawford, Telford, & Salmon, 2004). Parental perceptions, relative to their child's, have a greater influence on AST behaviours, which suggests parental perceptions may contribute to gender-based differences in AST (Wilson, Clark, & Gilliland, 2018).

Rates of AST vary among different neighbourhood SES levels. Reports from multiple studies consistently illustrate trends suggesting that as SES decreases, children are more likely to engage in AST (Pont, Ziviani, Wadley, Bennett, & Abbott, 2009; Rothman, Macpherson, Ross, & Buliung, 2018). Seemingly higher participation in low SES neighbourhoods may be driven by disadvantages in material circumstances such as less access to a personal vehicle (Rothman et al., 2018). For lower SES neighbourhoods, equity disparities stem not from participation, but from an over-abundance of negative outcomes associated with AST. Research has shown that higher SES neighbourhoods have higher quality pedestrian infrastructure, such as pedestrian and biking facilities (Sallis et al., 2011) and maintenance (Zhu & Lee, 2008). Whereas, children in low SES communities often have greater risk exposure due higher crime rates and traffic dangers

on their route to school (Sallis et al., 2011; Zhu & Lee, 2008). These conditions are of significant concern as pedestrian motor vehicle collisions have higher frequency and mortality in low SES communities (Stoker et al., 2015). Thus, participation rates alone do not tell the whole story about inequities by SES; these rates need to be understood within the social and material context of the local area.

Ethnic background is another central determinant influencing children's AST behaviour. In the United States, Hispanic and African American children are more likely to participate in AST than their white counterparts (Davison et al., 2008; Pont et al., 2009; Rothman et al., 2018). Conversely, Asian children are the least likely to use AST in North America (Rothman et al., 2018). Being of immigrant background is associated with increased AST in New Zealand (Pont et al., 2009). In the United Kingdom, South Asian children are more likely to be driven to school compared to White European and African Caribbean children (Owen et al., 2012). Research suggests that these differences in AST participation among ethnicities partially stem from differences in parenting styles. For example, compared to North American parents, Chinese parents are likely to be more protective of their children and therefore less likely to grant them independent mobility (Karsten, 2015; Lam & Loo, 2014). AST rates among ethnic background also vary among geographical locations as ethnic background intersects with other factors such as SES and place to shape children's and parents' norms and perceptions surrounding AST (Rothman et al., 2018). In combination with differing rates of AST, these complex relationships and differences among norms and perceptions highlight the need for equity considerations within AST interventions. It is necessary to study the influence of ethnic background in the design and evaluation of AST interventions to ensure that they are able to effectively reach minority populations (Conn, Chan, Banks, Ruppar, & Scharff, 2014; Whitt-Glover et al., 2014).

A child's place of residence is a similarly important variable influencing their travel behaviours. Those living within urban areas in North America are most likely to use AST, while children in rural areas are least likely (Kim & Lee, 2016). Characteristics of urban environments, such as intersection density (Ikeda et al., 2018), centrally located schools (Kim & Lee, 2016), more direct routes, and walking and cycling infrastructure

(Davison et al., 2008), promote AST. Barriers to AST such as longer distances between home and school and less pedestrian infrastructure are common in rural areas (Davison et al., 2008), suggesting that children face greater challenges to AST in these communities.

Challenges to equitable AST participation related to gender, SES, ethnic background, and/or place are important to consider. These issues include the sociocultural context of children's independent mobility (Ghekiere et al., 2017; Karsten, 2015; Lam & Loo, 2014; McDonald, 2012), environmental exposures (Zhu & Lee, 2008), and infrastructure accessibility (Davison et al., 2008; Ikeda et al., 2018; Kim & Lee, 2016). To decrease the gaps in AST participation and to ensure that children can safely engage in and benefit from AST, interventions need to address these equity concerns. While inequity is defined a moral injustice, inequality refers to an uneven distribution. Inequalities occur as a result of an intervention when one group benefits more than another (Tugwell, de Savigny, Hawker, & Robinson, 2006; White, Adams, & Heywood, 2009). These differential effects in intervention success increase inequities when the groups that benefit most are those that already more advantaged. Physical activity literature suggests that inequities can be produced throughout the intervention process as a result of differential access to resources (Fernandes & Sturm, 2010), intervention efficacy (Rush et al., 2012), and uptake (J. C. Spence, Holt, Dutove, & Carson, 2010). Interventions can work to reduce inequities by providing greater benefits to disadvantaged groups (Tugwell et al., 2006; White et al., 2009).

To address inequities in AST, interventions should address the different barriers faced by particular sub-groups of children to provide greater opportunities and potential benefits for those of disadvantaged groups (White et al., 2009). In a review of North American AST interventions, equity considerations were the least often reported intervention strategy (Buttazzoni, Coen, & Gilliland, 2018). It is currently unknown how equity considerations are being acknowledged and included in the design and/or evaluation of AST interventions to improve outcomes for disadvantaged groups, as identified by gender, SES, ethnic background, and place. To fully understand how AST interventions are considering equity for school-age children (ages 5 to 19 years), this paper presents a systematic review identifying how equity is considered in AST intervention research

implemented around the world. To address this purpose, two key research questions will be answered:

1. How have studies considered equity factors identified by gender, SES, ethnic background (i.e. minoritized populations on the basis of race/ethnicity, language and migrant status (Chappell & Cahnmann-Taylor, 2013; DeFinney et al., 2011; Harley et al., 2002)), and place (i.e. urban, suburban, and/or rural environmental contexts) in the design and evaluation of AST interventions?
2. To what extent do AST interventions report equity considerations in their analyses, outcomes, programming, and discussions?

2.3 Methods

2.3.1 Search Strategy

The methodology used for this systematic review paper is available on PROSPERO (CRD42018118238). This systematic review builds upon a previous systematic review by Buttazzoni and colleagues (Buttazzoni, Van Kesteren, Shah, & Gilliland, 2018), which focused on AST Interventions in North America. The following search terms used by Buttazzoni and colleagues were re-applied; however, to broaden this paper we removed the focus on North America and included publications up to and including December 2019. We based our search strategy on important relevant concepts and included their synonyms and applied truncation when necessary. The following search strategy was applied: *(active* or *walk* or *bike* or *cycl*)* and *(transport** or *travel* or *commut** or *journey* or *route* or *trip*) and *school** and (*intervention* or *program** or *project* or *initiative* or *promot**). Six electronic databases were used in the search: BIOSIS Previews, GeoBase, SCOPUS, PubMed, SPORTDiscus, and Web of Science.

2.3.2 Eligibility Criteria

Articles were eligible to be included in this study if they met seven eligibility criteria: (1) conducted an evaluation of an AST intervention; (2) contained a description of the intervention design, methodology, implementation, and results of the AST intervention; (3) contained a quantitative outcome; (4) reported a primary outcome related to AST; (5)

were written in English; and (6) were published after January 2010. AST interventions are defined as one of more deliberate actions implemented to address outcomes related to AST. A cut-off date of 2010 was chosen to be consistent with the previous review (Buttazzoni et al., 2018) and with other AST systematic reviews (Larouche et al., 2018; Villa-González et al., 2018).

2.3.3 Study Selection and Review Process

The study selection and review process that was completed for this paper is illustrated in Figure 2.1. The initial database search displayed 15,182 articles, with 265 articles found in BIOSIS Previews, 8,176 in PubMed, 1,437 in SCOPUS, 531 in SPORTDiscus, 1,191 in Web of Science, and 3,582 in GeoBase. After title screening, 1,349 articles were retained from which 448 duplicate articles removed. Abstract screening excluded an additional 667 papers. That left 234 eligible articles for full-text assessment. The full-text assessment removed an additional 170 papers that did not match the eligibility criteria, leaving 63 papers eligible for inclusion. Searching reference lists found an additional six articles, which results in 69 papers included in the final synthesis.

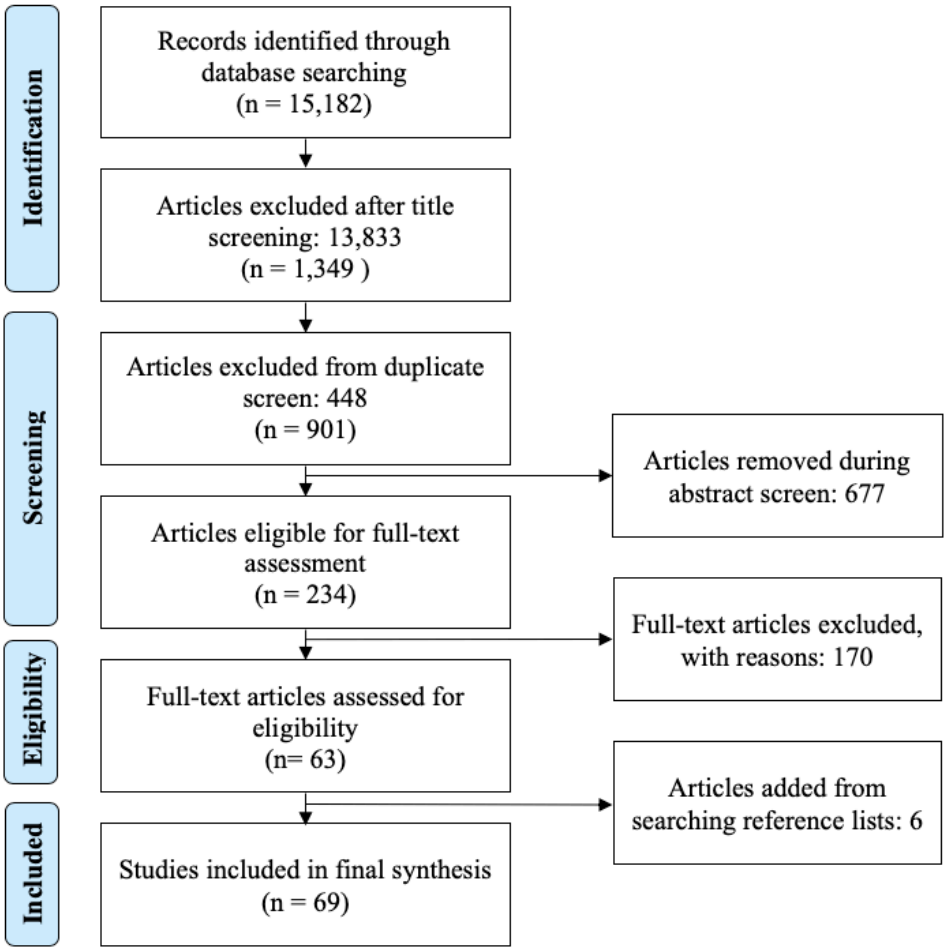

Figure 2.1: Summary of search and study selection

2.3.4 Data Extraction

Data was extracted using a tool from Welch and colleagues to focus on the equity factors assessed in this paper, including gender, SES, ethnic background, and place (Welch et al., 2017). The adapted tool is provided in Appendix A. The final adaptation of the tool was developed through piloting its application across a sample of reviews. Data that was extracted includes background information about the study, such as study design, region, sample, and theoretical background, as well as mentions of each equity factor in the title/abstract, introduction, methods, results, and discussion. Mentions included brief acknowledgements of the equity factor, to more extensive considerations and conscious efforts to address the factor within the intervention. All 69 papers underwent data extraction by the primary reviewer. One-third of the papers were randomly selected and

completed independently by a second reviewer. These were compared to the extractions of the primary reviewer to ensure consensus between reviewers. If there were any differences in information extracted, both sets of information were included. There is no one definition of cut-offs applied for sub-groups of gender, ethnic background (i.e. minoritized populations on the basis of race/ethnicity, language and migrant status [Chappell & Cahnmann-Taylor, 2013; DeFinney et al., 2011; Harley et al., 2002]), language and migrant status), SES, and places.

2.3.5 Quality Assessment

Quality assessments were conducted for study design and implementation using the NIH Quality Assessment Tool for Before-After (Pre-Post) Studies with No Control Group (National Heart Lung and Blood Institute, n.d.). One tool was used to assess quality consistently across all studies. All articles were assessed by two reviewers. The percentage of agreement was approximately 80%. Where there were disagreements between assessments, both reviewers discussed their ratings until a mutually agreed-upon decision was reached. There were no cases where a third reviewer was required to settle disagreements. Studies were rated according to three distinct grades: good, fair, and poor (Table 2.1). Those rated as "good" have a low risk of bias. A "fair" rating indicates that the study may be susceptible to some bias. Studies that were rated "poor" have a significant risk of bias and findings should be interpreted with caution.

Table 2.1: Study design, objectives, and quality assessment

Citation	Design and Theoretical Framework	Location	Population	Objective	Quality Assessment Rating
Arsenio, Dias, Lopes, & Pereira (2018)	Case study No framework reported	PORTUGAL Águeda	248 15-21y 2 schools	Examined the willingness of children to commute to/from school by e-bike	Fair
Buckley, Lowry, Brown, & Barton (2013)	Case study No framework reported	UNITED STATES Moscow, ID	2 elementary schools	Evaluated designated days for walking and bicycling	Fair
Buliung, Faulkner, Beesley, & Kennedy (2011)	Cross-sectional with no control No framework reported	CANADA Alberta, British Columbia, Nova Scotia, Ontario	1,489 parent self-reports 12 elementary schools	Examined the efficacy of School Travel Planning to promote and facilitate active school transport	Fair
Bungum, Clark, & Aguilar (2014)	Cross-sectional pre-post with control No framework reported	UNITED STATES Henderson, NV	2 elementary schools	Evaluated the effectiveness of a one-day intervention on AST and vehicular traffic at a suburban school	Fair
Buttazzoni, Clark, Seabrook, & Gilliland (2019)	Serial cross-sectional with no control No framework reported	CANADA Southwestern Ontario	4,720 parent self-reports and 2,084 child self-reports 13 elementary schools	Examined the impacts of the School Travel Planning program on children's and parents' perceptions of AST barriers and children's use of AST	Fair

Chen, Jiao, Xu, Gao, & Bischak (2018)	Cluster longitudinal with no control No framework reported	UNITED STATES Seattle, WA	53 elementary and/or middle schools	Identified factors associated with changes in AST behaviours among school-age children	Fair
Christiansen, Toftager, Ersbøll, & Troelsen (2014)	Cluster randomized controlled trial No framework reported	DENMARK South Denmark	1014 11-14y 14 schools	Evaluated the SPACE-for physical activity intervention on AST and perceived school route safety, parent support and attitude towards bicycling	Fair
Collins & Kearns (2010)	Cluster longitudinal with no control No framework reported	NEW ZEALAND Auckland	5 annual walking school bus surveys	Conducted a longitudinal overview of the walking school bus program	Fair
Coombes & Jones (2016)	Longitudinal pre-post with control Gamification	ENGLAND Norwich	80 8-10y 2 schools	Evaluated the impact of the Beat the Street intervention on levels of AST	Fair
Crawford & Garrard (2013)	Phase 1: Cross-sectional pre-post with control Phase 2: Cross-sectional pre-post with no control No framework reported	AUSTRALIA Victoria and Melbourne	Phase 1: 4 elementary schools Phase 2: 13 elementary schools	Conducted an impact-process evaluation of the Ride2School program	Fair
Cuffe, Harbaugh, Lindo, Musto, & Waddell (2012)	Interrupted time series No framework reported	UNITED STATES Boulder, CO	7 elementary schools	Examined the effects of a school-based incentive program for the promotion of children's healthy modes of transportation	Fair
DiMaggio, Brady, & Li (2015)	Retrospective case study Ecological approach	UNITED STATES Texas	Quarterly traffic crash data (Jan. 2008-June 2013)	Examined the effects of the Safe Routes to School program on school-age pedestrian and bicycle injuries	Good

DiMaggio & Li (2013)	Retrospective case study Ecological approach	UNITED STATES New York City, NY	Motor vehicle crash data (2001-2010)	Examined the effects of the Safe Routes to School program on school-age pedestrian injuries	Good
Ducheyne, De Bourdeaudhuij, Lenoir, & Cardon (2014)	Randomized controlled trial No framework reported	BELGIUM Flanders	94 grade 4 children 3 schools	Evaluated the association of a cycle training course on cycling skills at one week and five months after the intervention	Fair
Ducheyne, De Bourdeaudhuij, Lenoir, & Cardon (2013)	Randomized controlled trial No framework reported	BELGIUM Flanders	102 grade 4 children 5 schools	Determined the short-term effects of a cycle training course on cycling skills	Good
Ederer et al. (2016)	Cross-sectional pre-post with control No framework reported	CAMBODIA	13 elementary schools	Examined the effects of a school-based helmet distribution and road safety program on helmet use	Fair
Faulkner, Zeglen, Leatherdale, Manske, & Stone (2014)	Cross-sectional with no control Ecological approach	CANADA Toronto, ON	856 9-12y 18 schools	Examined the influence of school-level variability on children's physical activity	Good
Garrard & Crawford (2010)	Cross-sectional pre-post with no control No framework reported	AUSTRALIA Melbourne, Victoria	Baseline: 479 children, 409 parents Follow-up: 403 children, 358 parents 13 elementary schools	Evaluated the impacts of the Ride2School program on parents' and children's travel attitudes and behaviours	Poor

Ginja, Arnott, Araujo-Soares, Namdeo, & McColl (2017)	Cluster randomized controlled trial Behavioural Ecological model	ENGLAND North East region	29 9-10y 2 schools	Examined the feasibility of an incentive program for the promotion of AST	Good
Goodman, van Sluijs, & Ogilvie (2016)	Natural experimental No framework reported	ENGLAND	3,336 10-11y	Investigated the effectiveness of Bikeabilty cycle training at increasing the frequency of cycling, independent cycling and the likelihood of cycling to school in children	Fair
Gutierrez et al. (2014)	Cross-sectional pre-post with control Social cognitive theory	UNITED STATES Miami, FL	58 intersections near elementary schools	Examined the effects of an increased number of crossing guards on children's AST behaviours	Good
Gyergyay (2013)	Case study Theory of habitual travel patterns	ENGLAND Wimbledon Town Centre, London	452 11-16y 1 school	Evaluated the impact of incentivization on children's habitual travel behaviour	Fair
Harvey, Liguori, Ezell, & Zinke (2015)	Longitudinal pre-post with no control Ecological approach	UNITED STATES Hamilton County, TN	165 grade 4 children 4 schools	Evaluated the Safe Routes to School program on knowledge outcomes and examine the effect of socio-economic status	Fair
Hatfield, Boufous, & Eveston (2019)	Longitudinal pre-post with no control No framework reported	AUSTRALIA Australian Capital Territory	108 year 4-8 children 4 schools	Evaluated the Safe Cycle program on a variety of cycling-related outcomes including knowledge, skills, perceptions, and participation	Fair

Hatfield et al. (2017)	Longitudinal pre-post with control No framework reported	AUSTRALIA Canberra	12 year 6-8 children 4 schools	Evaluated the impact of the Safe Cycle program on children's safety behaviours	Fair
Hinckson & Badland (2016)	Cluster longitudinal pre-post with no control No framework reported	NEW ZEALAND Auckland	33 elementary schools	Determined the effectiveness of the School Travel Planning program at changing children's travel modes	Fair
Hoelscher et al. (2016)	Cluster randomized controlled trial Ecological approach and social cognitive theory	UNITED STATES Texas	78 elementary schools at baseline, 73 at follow-up	Examined the effects of infrastructure vs. noninfrastructure funding allocation methods on child AST, physical activity, and psychosocial experiences, and parent AST-related psychosocial constructs and behaviours	Fair
Holeva-Eklund et al. (2019)	Cross sectional pre-post with no control No framework reported	UNITED STATES Denver, CO	776 pre-intervention survey responses, 587 post-intervention 3 middle schools	Examined the impact of bike fix-it stations on children's active travel behaviours	Fair
Hollein et al. (2017)	Cross-sectional with no control No framework reported	CZECH REPUBLIC	1,522 15y 86 schools	Examined schools' health promotion and physical activity policies on AST and gender	Fair
Hooshmand, Hotz, Neilson, & Chandler (2014)	Longitudinal pre-post with no control No framework reported	UNITED STATES Miami-Dade County, FL	193 11-14y 6 schools	Examined the effectiveness of *The University of Miami BikeSafe*® program at increasing bicycle safety	Fair

				knowledge in middle school-age children	
Huang, Dannenberg, Haaland, & Mendoza (2018)	Randomized controlled trial No framework reported	UNITED STATES Seattle, WA	54 9-12y 4 schools	Examined the effects of a bicycle train intervention on child self-efficacy, parent self-efficacy, and parent outcome expectations	Fair
Isensee, Suchert, Hansen, Weisser, & Hanewinkel (2018)	Cluster randomized controlled trial No framework reported	GERMANY Schleswig-Holstein	1,020 12-16y 29 schools	Examined the impacts of the "läuft" program on moderate-to-vigorous PA, out-of-school sports activities, active transport, cardiorespiratory fitness, and anthropometric data (weight, height, body fat, and waist circumference)	Fair
Ji, Ye, Lu, Li, & Gao (2017)	Cluster randomized controlled trial No framework reported	CHINA Fuyang Town, Chaoshan and Liangying Town, Shantou	2354 children grade 6 pre-intervention, 1901 post-intervention 6 schools	Evaluated the effectiveness of an educational intervention to reduce bicycle injuries	Fair
Lachapelle, Noland, & Von Hagen (2013)	Longitudinal pre-post with no control No framework reported	UNITED STATES Northern New Jersey and Ocean Township, NJ	699 7-15y 3 schools and 9 summer camps	Evaluated the effectiveness of two bicycle education programs; one delivered in a school setting, and the other at a summer camp	Good
Lambe, Murphy, & Bauman (2017)	Cross-sectional pre-post with no control No framework reported	IRELAND South East region	1,457 grade 5-6 children 21 schools	Examined the potential of two community-wide initiatives to increase walking and cycling	Fair

Livingston et al. (2011)	Interrupted time series No framework reported	UNITED STATES Newark, NJ	1,564 grade K-4 children 9 schools	Evaluated short-, intermediate-, and long-term knowledge from a pediatric pedestrian curriculum	Good
Loo, Leung, & Chan (2019)	Longitudinal pre-post with no control No framework reported	CHINA Hong Kong	52 8-17y 3 schools	Explored the effects of a short-term and school-based cycling training program on children's perceptions, cycling skills, habits, and parental perceptions	Fair
P. Love, Villanueva, & Whitzman (2019)	Serial cross-sectional with no control Socio-ecological model	AUSTRALIA Melbourne and Victoria	1600 9-12y and parents 26 schools	Measured the effectiveness of TravelSmart, Ride to School, and Safe Routes to School at increasing AST	Fair
Lucken et al. (2018)	Cross-sectional with control Transtheoretical model of behaviour change	UNITED STATES Almeda County and City of Richmond, CA	245 elementary school parents	Examined the impact of an informational intervention on the benefits of AST on parents' perceptions of AST feasibility	Fair
Malakellis et al. (2017)	Cluster longitudinal pre-post with control Systems theory	AUSTRALIA Australian Capital Territory	656 12-16y 6 schools	Evaluated the effectiveness of the ACT "It's Your Move" systems intervention at increasing physical activity, active travel, and mental well-being	Fair
Mammen, Stone, Buliung, & Faulkner (2014)	Cross-sectional with no control Ecological approach	CANADA national, excluding Quebec	7,827 parent surveys 103 elementary schools	Evaluated a School Travel Planning intervention by examining changes in school	Fair

				travel mode and predictors of mode change	
Mammen, Stone, Faulkner, et al. (2014)	Cluster longitudinal pre-post with no control Ecological approach	CANADA national, excluding Quebec, Yukon, and Nunavut	53 elementary schools	Evaluated a School Travel Planning intervention with rates of AST and to identify predictors of mode change	Fair
Mandic, Flaherty, Ergler, et al. (2018)	Longitudinal pre-post with no control No framework reported	NEW ZEALAND Dunedin	117 12-18y 2 schools	Examined the effects of short-term cycle skills training on knowledge of road rules and cycling-related knowledge, confidence and behaviours	Good
Mandic, Flaherty, Pocock, et al. (2018)	Longitudinal pre-post with no control No framework reported	NEW ZEALAND Dunedin	429 10-12y 3 schools	Examined the effects of short term cycle skills training on knowledge of road rules and cycling-related laws, cycling confidence, and rates of cycling for recreation and transportation	Good
Marconi, Schiavo, Zancanaro, Valetto, & Pistore (2018)	Case study Gamification	ITALY Trento	87 grade 1-5 children and 6 teachers 1 school	Evaluated the effectiveness of the Kids-Go-Green gamified educational experience at changing the behaviour of children and their parents towards sustainable modes of transportation	Fair
McDonald et al. (2014)	Cluster serial cross-sectional with no control Ecological approach	UNITED STATES	801 elementary and middle schools	Examined the effects of the Safe Routes to School program on the proportion of children walking and cycling to school	Fair

		California, Washington DC, Florida, Texas			
McDonald, Yang, Abbott, & Bullock (2013)	Cluster serial cross-sectional with control Ecological approach	UNITED STATES Eugene, OR	14 elementary and middle schools	Examined the effects of the Safe Routes to School program on the proportion of children walking and cycling to school	Poor
McLaughlin & Glang (2010)	Randomized controlled trial No framework reported	UNITED STATES Pacific Northwest	206 grade K-3 children 2 schools	Evaluated the impacts of the Bike Smart program on children's knowledge of bicycle safety behaviours	Fair
McMinn, Rowe, Murtagh, & Nelson (2012)	Longitudinal pre-post with control No framework reported	SCOTLAND	166 8-9y 5 schools	Examined the effects of the Travel Green initiative on children's walking to/from school and physical activity	Fair
Mendoza et al. (2017)	Cluster randomized controlled trial No framework reported	UNITED STATES Seattle, WA	54 grade 4-5 children 4 schools	Assessed the impact of a bicycle train program on student's travel behaviours and physical activity	Good
Mendoza et al. (2012)	Cluster randomized controlled trial No framework reported	UNITED STATES Houston, TX	8 elementary schools	Examined children's pedestrian safety behaviours associated with a walking school bus intervention	Good
Mendoza et al. (2011)	Cluster randomized controlled trial Social cognitive theory	UNITED STATES Houston, TX	149 grade 4 children 8 schools	Evaluated the impact of a walking school bus on children's rates of active commuting to school and physical activity	Good

Molina-García & Queralt (2016)	Mixed methods No framework reported	SPAIN Valencia	262 12-16y 1 school	Evaluated the effects of new helmet use legislation on cycling to school and helmet wearing behaviour	Fair
Moodie, Haby, Swinburn, & Carter (2011)	Case study No framework reported	AUSTRALIA Victoria	6 elementary schools	Evaluated the cost-effectiveness of the TravelSMART Schools Curriculum program as an obesity prevention measure	Fair
Østergaard, Støckel, & Andersen (2015)	Cross-sectional pre-post with control No framework reported	DENMARK Copenhagen, Fredericia, and Dunen	2,415 grade 4-5 children 25 schools	Evaluated the effectiveness of a school cycling program on school cycling and quantified the incidence, predictors, and number of injuries related to cycling to school	Fair
Pérez-Martín, Pedrós, Martínez-Jiménez, & Varo-Martínez (2018)	Longitudinal pre-post with no control No framework reported	SPAIN Cordoba	55 children 1 elementary school	Assessed the effectiveness of a walking school bus at reducing car trips	Fair
Ragland, Pande, Bigham, & Cooper (2014)	Retrospective case study Ecological approach	UNITED STATES California	Safety study: 47 schools Mobility study: 9 schools	Evaluated the long-term impacts of Safe Routes to School-funded infrastructure improvements and engineering modifications on safety and walking and cycling activity, respectively	Fair
Rodriguez et al. (2019)	Cluster longitudinal pre-post with control No framework reported	UNITED STATES Gilroy, CA	2 elementary schools	Examined the impact of the inclusion of Our Voice, a citizen-science engagement model, to the Safe Routes to School program on engagement activities	Fair

Sahlqvist et al. (2019)	Longitudinal with control No framework reported	AUSTRALIA Victoria	715 carers of elementary school children	Examined the impact of the Walk to School campaign on school travel behaviour and student AST behaviour and explored the effect of socio-demographic and area-level characteristics	Fair
Sayers, LeMaster, Thomas, Petroski, & Ge (2012)	Longitudinal pre-post with control No framework reported	UNITED STATES Columbia, MO	77 8-9y 3 schools	Evaluated the effect of a walking school bus program on physical activity rates of children	Fair
Sevil, García-González, Abós, Generelo, & Aibar (2019)	Longitudinal pre-post with control Social-ecological model, self-determination theory, theory of planned behaviour	SPAIN Huesca	210 12-14y 2 schools	Examined the effects of a multicomponent intervention on health behaviours of adolescents and examined gender differences in the effectiveness of the program	Fair
Sirard, McDonald, Mustain, Hogan, & Helm (2015)	Cluster cross-sectional pre-post with no control No framework reported	UNITED STATES Minneapolis, MN	~20,500 children 39 elementary schools	Examined the effects of restricting elementary school choice on travel distance to school and transportation mode	Good
Stark, Berger, Hössinger, & Hoessinger (2018)	Cross sectional pre-post with control Theory of planned behaviour	AUSTRIA Vienna and Tulln GERMANY Itzehoe	169 12-14y 4 schools	Examined the effects of an awareness campaign on children's transport-related attitudes, intentions, and behaviours	Poor

Stewart, Moudon, & Claybrooke (2014)	Cluster longitudinal pre-post with no control Ecological approach	UNITED STATES Florida, Mississippi, Washington, Wisconsin	48 completed Safe Routes to School projects across 53 schools	Evaluated the impact of the Safe Routes to School program on rates of AST	Fair
Teixeira, Silva, & Neves (2019)	Cross sectional pre-post with no control No framework reported	PORTUGAL Porto	285 completed parent baseline surveys, 145 follow-up surveys 1 school	Evaluated the impact of soft mobility intervention measures on student travel modes	Poor
Vanwolleghem, D'Haese, Van Dyck, De Bourdeaudhuij, & Cardon (2014)	Longitudinal pre-post with no control No framework reported	BELGIUM West Flanders	216 parent questionnaire responses 58 6-12y	Examined parent opinions on the feasibility and perceptions of drop-off spots, and their impact on children's AST	Fair
Verhoeven et al. (2016)	Longitudinal pre-post with control Theory of planned behaviour	BELGIUM Flanders	441 17-18y	Examined the effects of an AST promoting intervention on psychosocial factors	Fair
Villa-González, Ruiz, Mendoza, & Chillón (2017)	Longitudinal pre-post with control No framework reported	SPAIN Province of Granada	251 8-11y 5 schools	Investigated the effects of a school-based active-travel intervention on active commuting to school and health-related fitness	Fair
Villa-González, Ruiz, Ward, & Chillón (2015)	Longitudinal pre-post with control No framework reported	SPAIN Province of Granada	206 8-11y 5 schools	Investigated the effectiveness of a school-based active-travel intervention at increasing frequency of active commuting, six months post-intervention	Fair

2.4 Findings

2.4.1 Overall Findings

A total of 69 papers were included in the final analysis (Table 2.2). The majority of these papers (n=44, 64%) focused on elementary school-age children (5-14 years old), occurred in North America (n=31, 45%), and did not report a theoretical framework (n=46, 67%). Cycle training and education programs were frequently reported (13 papers, 19%) and these included interventions that aimed to increase children's cycling-related knowledge, confidence and/or behaviours. A total of 14 (20%) papers focused on Safe Routes to School or School Travel Planning interventions, which are school-specific multicomponent interventions with the goal of increasing rates of AST. Both utilize a framework of "E's" referring to an integrated approach including education, encouragement, enforcement, engineering, and evaluation components within the intervention (Ontario Active School Travel & Green Communities Canada, 2019; Safe Routes to School Partnership, 2019). In 2019, the Safe Routes to School Partnership added equity as the sixth "E" to their framework, however, it was included after the majority of the papers in this review were published (Safe Routes to School Partnership, 2019). Another prominent intervention strategy – the focus of 5 (7%) studies – was the walking school bus which involves an adult chaperone walking along a set route picking up or dropping off children at set stops along the way.

Among all studies, there were no trends in which intervention types considered equity most often or produced the most equitable outcomes. Gender and SES were mentioned either in brief or as an extensive consideration more than the other equity factors (Table 2.3). Ethnic background was mentioned least often. Of these mentions, most occurred in the methods, often as a variable controlled for, or as a description of the study sample.

Table 2.2: General characteristics of the papers reviewed

Characteristic	Number of papers
Year of Publication	
2010	3
2011	4
2012	4
2013	7
2014	12
2015	5
2016	7
2017	8
2018	10
2019	9
Location	
Asia	3
Europe	23
North America	31
Oceania	12
Target Age	
Elementary school-age children (5-14y)	44
Elementary school-age children (5-14y) and/or caregivers	12
Elementary and secondary school-age children (5-19y)	8
Elementary and secondary school-age children (5-19y) and/or caregivers	2
Secondary school-age children (14-19y)	3
Theoretical Framework	
Ecological approaches	14
Gamification	2
Self-determination theory	1
Social cognitive theory	3
Systems theory	1
Theory of habitual travel patterns	1
Theory of planned behaviour	3
Transtheoretical model of behaviour change	1
None reported	46
Intervention Type	
Bicycle train	2
Cycling skills/education	13
Helmet use	2
Incentive program	3
One-day encouragement event	2
Ride2School	3
Safe Routes to School	9
School Travel Planning	5
School-based health and physical activity	6
School-based AST (distinct)	10

Travel Smart	2
Walking School Bus	5
Other	9
Study Design	
Case study	8
Cross-sectional	21
Interrupted time series	2
Longitudinal	25
Mixed methods	1
Natural experimental	1
Randomized controlled trial	12

Table 2.3: Number of papers that mention the equity factor and the location of the mention within the paper

	Number of Papers that Mention the Equity Factor (N=69) n (%)			
Location of Mention	**Gender**	**SES**	**Ethnic background**	**Place**
Title and/or abstract	14 (20%)	9 (13%)	2 (3%)	8 (12%)
Introduction	16 (23%)	14 (20%)	9 (13%)	11 (16%)
Methods	37 (54%)	38 (55%)	23 (33%)	23 (33%)
Eligibility Criteria	3 (4%)	7 (10%)	3 (4%)	2 (3%)
Population description	45 (65%)	31 (45%)	22 (32%)	12 (17%)
Results – general	32 (46%)	22 (32%)	15 (22%)	10 (14%)
Results – sub-group analysis	10 (14%)	12 (17%)	2 (3%)	3 (4%)
Applicability	11 (16%)	18 (26%)	11 (16%)	10 (14%)
Discussion	14 (20%)	25 (36%)	9 (13%)	13 (19%)

2.4.2 Gender

Gender was mentioned in the majority of papers reviewed (n=54, 78%), ranging from a brief acknowledgement of gender-based differences in AST to gender considerations within intervention design and evaluation. Of these papers, 51 collected gender information. Gender was most often collected using self-report methods (n=24) (Arsenio et al., 2018; Coombes & Jones, 2016; Faulkner et al., 2014; Hatfield et al., 2019; Holeva-Eklund et al., 2019; Hollein et al., 2017; Isensee et al., 2018; Ji et al., 2017; Lachapelle et al., 2013; Lambe et al., 2017; P. Love et al., 2019; Malakellis et al., 2017; Mandic, Flaherty, Ergler, et al., 2018; Mandic, Flaherty, Pocock, et al., 2018; McLaughlin & Glang, 2010; McMinn et al., 2012; Molina-Garcia, Queralt, Bengoechea, Moore, & Mandic, 2018; Østergaard et al., 2015; Rodriguez et al., 2019; Sevil et al., 2019; Stark et al., 2018; Verhoeven et al., 2016; Villa-González et al., 2017, 2015). It is important to note that, when reporting genders, all articles categorized children as either male or female or boy or girl. No papers accounted for gender diversity (e.g., non-binary, Two Spirit, gender fluid identities). As a result, there was no data from this review to report on children who do not identify as a boy or a girl.

Fifteen papers reported intervention effects between genders (Bungum et al., 2014; Buttazzoni et al., 2019; Chen et al., 2018; Christiansen et al., 2014; Collins & Kearns, 2010; Faulkner et al., 2014; Hollein et al., 2017; Huang et al., 2018; Lambe et al., 2017; Mendoza et al., 2017, 2011; Molina-García & Queralt, 2016; Sahlqvist et al., 2019; Sevil et al., 2019; Villa-González et al., 2017), while 11 papers reported no significant differences (Arsenio et al., 2018; Cuffe et al., 2012; Ducheyne et al., 2013, 2014; Goodman et al., 2016; Lachapelle et al., 2013; Loo et al., 2019; P. Love et al., 2019; Mammen, Stone, Buliung, et al., 2014; McLaughlin & Glang, 2010; Sayers et al., 2012). Information regarding gender was collected and/or controlled for in 25 papers; however, these papers did not go on to consider gender as a variable of analysis (Buliung et al., 2011; Coombes & Jones, 2016; Crawford & Garrard, 2013; DiMaggio et al., 2015; DiMaggio & Li, 2013; Ginja et al., 2017; Gyergyay, 2013; Hatfield et al., 2019, 2017; Hoelscher et al., 2016; Holeva-Eklund et al., 2019; Isensee et al., 2018; Ji et al., 2017; Malakellis et al., 2017; Mandic, Flaherty, Ergler, et al., 2018; Mandic, Flaherty, Pocock,

et al., 2018; Marconi et al., 2018; McMinn et al., 2012; Østergaard et al., 2015; Pérez-Martín et al., 2018; Rodriguez et al., 2019; Stark et al., 2018; Vanwolleghem et al., 2014; Verhoeven et al., 2016; Villa-González et al., 2015).

Of the papers that found gender differences, the majority (n=11/15) stated that boys increased their AST more than girls as a result of the intervention (Buttazzoni et al., 2019; Chen et al., 2018; Christiansen et al., 2014; Faulkner et al., 2014; Hollein et al., 2017; Huang et al., 2018; Lambe et al., 2017; Mendoza et al., 2017, 2011; Sevil et al., 2019; Villa-González et al., 2017). An intervention examining rates of helmet use found greater increases in boys' helmet use than girls', noting that rates of helmet use were similar after the intervention (Molina-García & Queralt, 2016). Despite finding no gender differences, a study of 1600 children and parents in Australia suggested that such differences were most likely present in other variables (P. Love et al., 2019). For example, despite literature to support gendered norms in mode of travel to school, these differences may not have been fully captured in their analysis (P. Love et al., 2019).

In an examination of a cycle training intervention among seven to 15 year-olds in the United States, it was found that girls were less skilled at cycling than boys, more likely to ride their bike with their parents, and had a higher likelihood of an accident at baseline (Lachapelle et al., 2013). Knowledge tests used to evaluate the program showed increases in scores (Lachapelle et al., 2013); however, they were not disaggregated by gender, hindering further analysis of trends between genders. Research on a walking school bus intervention in New Zealand reported that boys were perceived by parents and guardians as less likely to follow the rules, and more likely to lack common sense; conversely, girls were seen as more compliant participants (Collins & Kearns, 2010). Differing effects on boys' and girls' AST behaviours were also noted in school policies. Girls were more likely to engage in AST if their school was part of a health-promoting network that focused on broader aspects of health such as individual lifestyle habits and behaviours, society, and the environment (Hollein et al., 2017; Schools for Health in Europe, n.d.). Boys were more likely to use AST if their school informed parents about the importance of physical activity (Hollein et al., 2017). In a study based on 210 children in Spain, intervention components specifically targeting girls, such as encouraging them to voice

their opinions and giving them opportunities to choose activities, were included. Despite these strategies, a larger effect was still reported for boys than girls (Sevil et al., 2019).

2.4.3 Socioeconomic Status

Fifty (72%) of the papers mentioned SES and 42 of these collected SES data. These studies considered SES at the level of the neighbourhood, school, and/or household. The most common method of operationalizing SES was the percentage of the school population eligible for free and/or reduced lunch programs (n=14) (Bungum et al., 2014; Ginja et al., 2017; Gutierrez et al., 2014; Harvey et al., 2015; Hooshmand et al., 2014; Huang et al., 2018; McDonald et al., 2014, 2013; McLaughlin & Glang, 2010; Mendoza et al., 2011, 2012, 2017; Rodriguez et al., 2019; Sirard et al., 2015), followed by parental SES as measured using either the highest level of parent education, income, and/or employment status (n=11) (Crawford & Garrard, 2013; Ducheyne et al., 2013, 2014; Faulkner et al., 2014; Goodman et al., 2016; Ji et al., 2017; Lucken et al., 2018; Sayers et al., 2012; Sevil et al., 2019; Stewart et al., 2014; Vanwolleghem et al., 2014). Twenty-four papers reported SES at some level, but did not consider SES as an independent variable in models (Bungum et al., 2014; Buttazzoni et al., 2019; Christiansen et al., 2014; Crawford & Garrard, 2013; Ginja et al., 2017; Gutierrez et al., 2014; Hoelscher et al., 2016; Hooshmand et al., 2014; Huang et al., 2018; Ji et al., 2017; Lachapelle et al., 2013; Malakellis et al., 2017; McLaughlin & Glang, 2010; McMinn et al., 2012; Mendoza et al., 2017, 2011, 2012; Rodriguez et al., 2019; Sayers et al., 2012; Stewart et al., 2014; Vanwolleghem et al., 2014; Verhoeven et al., 2016; Villa-González et al., 2017, 2015). Only five reported significant differences in AST interventions in relation to SES (Arsenio et al., 2018; Collins & Kearns, 2010; Harvey et al., 2015; Mammen, Stone, Buliung, et al., 2014; McDonald et al., 2014); whereas, 13 papers reported no significant differences according to SES (Chen et al., 2018; Ducheyne et al., 2013, 2014; Faulkner et al., 2014; Goodman et al., 2016; Hinckson & Badland, 2016; P. Love et al., 2019; Lucken et al., 2018; Mammen, Stone, Faulkner, et al., 2014; McDonald et al., 2013; Sahlqvist et al., 2019; Sevil et al., 2019; Sirard et al., 2015).

Multiple studies found that lower SES children had the highest rates of AST participation at baseline (Hinckson & Badland, 2016; Mammen, Stone, Buliung, et al., 2014;

McDonald et al., 2014; Stewart et al., 2014). There were mixed results as to how SES was associated with AST following an intervention. Relative to low SES groups, it was reported by one paper examining School Travel Planning interventions that middle SES populations were most likely to change their behaviour towards AST (Mammen, Stone, Buliung, et al., 2014). Other studies noted that high SES populations were most likely to use e-bikes (Arsenio et al., 2018), and that schools with higher SES populations were more likely to adopt and sustain a walking school bus program (Collins & Kearns, 2010). A study conducted in the United States with 165 fourth grade children found that compared to very low SES, low SES groups had greater knowledge related to AST following an educational intervention (Harvey et al., 2015).

Schools with primarily low SES populations faced the greatest challenges related to AST compared to other strata of SES. Low SES schools tended to lack volunteer participation for AST programs, hindering their implementation (Collins & Kearns, 2010; Ederer et al., 2016). A lack of resources such as bicycles, scooters, and/or safety equipment was also cited as a barrier to AST faced by low SES children. To overcome these concerns, studies by Huang (Huang et al., 2018), Lachapelle (Lachapelle et al., 2013), and Mendoza (Mendoza et al., 2017) and their respective associates provided bicycles and equipment to their sample populations. No outcomes were reported from this strategy as it was simply noted as a method to overcome intervention barriers and potential confounding with income (Huang et al., 2018; Lachapelle et al., 2013; Mendoza et al., 2017).

2.4.4 Ethnic Background

Indicators of ethnic background were mentioned in 32 (46%) of the papers, 26 of which collected such information. Child ethnic background was most often operationalized using family reports (n=10) and/or school composition data (n=9) asking specifically about ethnicity or race (Bungum et al., 2014; Chen et al., 2018; Ducheyne et al., 2014; Goodman et al., 2016; Huang et al., 2018; Lucken et al., 2018; Mandic, Flaherty, Ergler, et al., 2018; Mandic, Flaherty, Pocock, et al., 2018; McDonald et al., 2014, 2013; McLaughlin & Glang, 2010; Mendoza et al., 2017, 2012; Rodriguez et al., 2019; Sayers et al., 2012; Sirard et al., 2015). Three papers used data on first language – family, school, or census reported – to account for ethnic background (Ginja et al., 2017;

Sahlqvist et al., 2019; Stewart et al., 2014), while measures of acculturation and parents' country of birth were used by one paper and two papers respectively (Mendoza et al., 2011; Østergaard et al., 2015; Sahlqvist et al., 2019).

Of the 32 papers, 15 papers collected information related to ethnic background and/or controlled for it in their analysis, however, they did not analyse it as an independent variable (Bungum et al., 2014; Christiansen et al., 2014; Ducheyne et al., 2014; Ginja et al., 2017; Goodman et al., 2016; Gutierrez et al., 2014; Hoelscher et al., 2016; Hooshmand et al., 2014; Ji et al., 2017; Mandic, Flaherty, Ergler, et al., 2018; Mandic, Flaherty, Pocock, et al., 2018; McLaughlin & Glang, 2010; Mendoza et al., 2012; Rodriguez et al., 2019; Stewart et al., 2014). Seven studies found that ethnic background was not significant in predicting AST behaviours (Huang et al., 2018; McDonald et al., 2014, 2013; Østergaard et al., 2015; Sahlqvist et al., 2019; Sayers et al., 2012; Sirard et al., 2015). Four papers found differences in AST participation across groups (Chen et al., 2018; Lucken et al., 2018; Mendoza et al., 2017, 2011).

Although Lucken and colleagues reported no differences in AST perceptions as a result of an informational intervention for parents in the United States, they found that minoritized populations were less likely to use AST (Lucken et al., 2018). These findings were confirmed by other studies which found that white children were most likely to bicycle to/from school (Chen et al., 2018), whereas Asian children were significantly less likely (Mendoza et al., 2017). One paper on a walking school bus intervention noted differences related to child and parent acculturation and AST participation among Latino populations in Texas, USA (Mendoza et al., 2011). Minoritized populations that had adopted attitudes, values, and behaviours of the dominant culture were more likely to participate in the walking school bus program and change their behaviours towards AST (LaFromboise, Coleman, & Gerton, 1993; Mendoza et al., 2011). Loo and colleagues examined a cycle training program in Hong Kong and reported that Chinese parents exhibited protective behaviours more often than Western parents (Karsten, 2015; Loo et al., 2019). They suggested that the cycle training program was important to address cultural differences in parenting styles, as it could help to address some parental concerns

by improving the cycling ability and safety of children (Loo et al., 2019; K. Spence, 2003).

2.4.5 Place

Only 34 (49%) papers mentioned the environmental context of the population studied. Of these, only four of these papers provided specific definitions of place. Three papers cited >10 000 residents as their cut off of urban regions (Goodman et al., 2016; McMinn et al., 2012; Sahlqvist et al., 2019), while one noted > 500 residents/km^2 as defining an urban region and 150 to 500 residents/km^2 defining a suburban area (Vanwolleghem et al., 2014). Nine of the 34 papers focused wholly on schools within urban areas (Faulkner et al., 2014; Hinckson & Badland, 2016; Loo et al., 2019; P. Love et al., 2019; Lucken et al., 2018; McMinn et al., 2012; Mendoza et al., 2017, 2012; Sirard et al., 2015). Four papers studied interventions only in schools located in suburban areas (Bungum et al., 2014; Crawford & Garrard, 2013; Hollein et al., 2017; McLaughlin & Glang, 2010). Only one paper studied an AST intervention exclusively in a rural area (Ji et al., 2017) while 14 papers reported multiple places (Buliung et al., 2011; Buttazzoni et al., 2019; Ederer et al., 2016; Goodman et al., 2016; Hoelscher et al., 2016; Lachapelle et al., 2013; Mammen, Stone, Buliung, et al., 2014; Mammen, Stone, Faulkner, et al., 2014; Rodriguez et al., 2019; Sahlqvist et al., 2019; Vanwolleghem et al., 2014; Verhoeven et al., 2016; Villa-González et al., 2017, 2015). Seven studies controlled for place in their analysis (Bungum et al., 2014; Christiansen et al., 2014; Crawford & Garrard, 2013; Ederer et al., 2016; Hoelscher et al., 2016; Villa-González et al., 2017, 2015).

Three papers of the 34 reported no differences in intervention effectiveness by place (Goodman et al., 2016; Mammen, Stone, Faulkner, et al., 2014; Sahlqvist et al., 2019), and four papers reported differences according to place (Chen et al., 2018; Crawford & Garrard, 2013; P. Love et al., 2019; Mammen, Stone, Buliung, et al., 2014). Rural schools had lower rates of AST in general (Mammen, Stone, Buliung, et al., 2014). Compared to rural locations, one study observed that both urban and suburban schools experienced greater increases in their AST participation rates in Canada (Mammen, Stone, Buliung, et al., 2014). In Australia, inner suburban schools had larger increases in AST relative to outer suburban schools (Crawford & Garrard, 2013). Considering the

interventions that occur within suburban neighbourhoods in Canada, older suburban neighbourhoods were more likely to undergo infrastructure changes whereas newer suburban neighbourhoods more often implemented speed and/or parking enforcement activities (Buliung et al., 2011).

Barriers to AST in rural places stemmed from a longer distance between home and school and a lack of pedestrian infrastructure which led to safety concerns. Further distances between home and schools prevented children from engaging in AST as children were provided a school bus for transportation (Mammen, Stone, Buliung, et al., 2014). Articles also pointed to a lack of pedestrian and cyclist infrastructure associated with rural areas, namely; dirt or cement roads, lack of bicycle lanes and sidewalks, and paved shoulders (Ji et al., 2017; Mammen, Stone, Buliung, et al., 2014). Coupled with the lack of pedestrian infrastructure, higher speed limits on rural roads presented safety concerns for parents and children using AST in rural communities (Mammen, Stone, Buliung, et al., 2014).

2.5 Discussion

The purpose of this paper was to examine how equity factors, identified by gender, neighbourhood SES, ethnic background (i.e., minoritized populations on the basis of race/ethnicity, language and migrant status (Chappell & Cahnmann-Taylor, 2013; DeFinney et al., 2011; Harley et al., 2002)), and place (i.e. urban, suburban, and/or rural environmental contexts), are considered either briefly and/or more extensively in the design and evaluation of AST interventions and to what extent AST interventions report equity considerations in their analyses and outcomes, programming, and discussions. It was found that equity is not considered or mentioned in most of the papers reviewed. Consistent with existing literature (Attwood, van Sluijs, & Sutton, 2016; R. E. Love, Adams, & van Sluijs, 2017), despite collecting demographic information at baseline, papers often controlled for these factors rather than addressing them in their intervention design or evaluation.

Gender and SES were the equity variables most often considered in the papers reviewed, while place and ethnic background were the least often included. Most interventions took place within a school setting and gender was often evenly distributed, whereas other

variables (i.e. place) tended to be skewed within the population (i.e. the school population tends to be from a similar environmental context). Such demographic distributions typically enabled gender to be analyzed, but potentially hindered other equity analyses due to a lack of adequate sample size for sub-group analysis (R. E. Love et al., 2017). Many studies were able to consider dimensions of SES as reliable proxy measures, such as proportion of students eligible for free and reduced lunch and highest level of education parents have completed, are less obtrusive than asking for information on household income (Harwell & LeBeau, 2010). The lack of diversity in ethnic background may be a result of studies having been undertaken in homogenous communities or difficulties in recruiting participants from groups who do not speak the dominant language of the region (Blom-Hoffman et al., 2009). Inclusion criteria for sample populations, such as higher traffic density (Ederer et al., 2016; Mendoza et al., 2011, 2012), existing pedestrian infrastructure, and street connectivity (Mendoza et al., 2011, 2012), contribute to the absence of research in rural areas. As rural communities often lack such features (Davison et al., 2008; Ikeda et al., 2018), they may have been overlooked by practitioners or researchers when recruiting potential intervention schools.

The large differences among intervention types, study methods, and conceptualization of SES (Svedberg, Nygren, Staland-Nyman, & Nyholm, 2016), ethnic background (Drevdahl, Philips, & Taylor, 2006), and place (Brady & Weitzman, 2007; Theobald, 2004) used in the articles complicated evaluation and comparisons. In terms of the design of AST interventions, equity was often overlooked or not reported within the articles. Lack of consideration of equity factors within intervention design may unintentionally increase inequities (Frohlich & Potvin, 2008). Furthermore, many papers did not conduct a sub-group analysis or report intervention effectiveness for population sub-groups. The lack of equity considerations in the evaluation of AST interventions further hindered our ability to examine the effects of AST interventions on equity.

Taking into account intervention design broadly, all of the AST interventions considered in this review were implemented within the community. This design is emphasized by Rose's "population strategy" in which the goal of the intervention is to shift the entire group to a more satisfactory level of activity (Frohlich & Potvin, 2008; Rose, 2001). This

strategy is favourable in physical activity interventions as it enables action towards ensuring that the entire population is meeting recommended levels (Williams, Coen, & Gibson, 2019). Using multiple targeted components within one broad intervention is also suggested to improve their effectiveness (Sallis et al., 2006; Smedly & Syme, 2001). This intervention design considers and acts towards addressing the multi-faceted and complex causes of unfavourable health behaviours (Williams et al., 2019). Interventions implemented at the community level; however, have been criticized due to their lack of consideration for equity factors (Frohlich & Potvin, 2008), as demonstrated by the results of this review.

To overcome such criticisms and consistent with existing recommendations for equity in physical activity interventions (Frohlich & Potvin, 2008; R. E. Love et al., 2017; Williams et al., 2019), specific initiatives should be implemented within the broader community intervention targeting disadvantaged groups. Physical activity research suggests that tailoring intervention methods to target specific groups has positive results on reducing inequities in physical activity participation (Clark et al., 2018; K. A. Vander Ploeg, Maximova, McGavock, Davis, & Veugelers, 2014). Among the articles reviewed, a few advocated for or included gender-sensitive interventions specifically targeting girls (Hollein et al., 2017; Sevil et al., 2019). This finding aligns with broader literature as physical activity research suggests that tailoring intervention methods to target specific groups has positive results on reducing inequities in physical activity participation (Clark et al., 2018; K. A. Vander Ploeg et al., 2014). It is recommended that practitioners consider the influence of gender, SES, ethnic background, and place to address the needs of the most disadvantaged sub-groups of children in AST interventions. By doing so, interventions may provide them with greater benefits and address AST participation equitably.

Some specific strategies to address equity in AST interventions were noted in the papers. Addressing gender, Sevil and colleagues attempted to target girls in a multicomponent intervention by considering girls opinions and preferences and enabling them to choose activities (Sevil et al., 2019). Including participants in the intervention design and/or implementation has been shown to increase effect size (O'Mara-Eves et al., 2015).

Despite these actions, results still demonstrated a larger effect size for boys (Sevil et al., 2019). The methods used in the intervention may not have addressed barriers to participation such as stereotypes of physical activity being a masculine endeavour (Chalabaev, Sarrazin, Fontayne, Boiché, & Clément-Guillotin, 2013; Whitehead & Biddle, 2008), demonstrating the importance of addressing the broader social structures influencing physical activity and AST participation in tackling such inequities (Williams et al., 2019). Other results were consistent with this notion as they show some success at addressing gender inequity by promoting AST in alignment with overall health, including but not limited to physical activity (Hollein et al., 2017). Moving beyond physical activity may have overcome such stereotypes held by children, and thus increased the likeliness of girls using AST.

Regarding gendered patterns of helmet-use, it was noted that boys were less likely to use a helmet than girls prior to a helmet use policy being enacted, but boys and girls had similar rates after the policy (Molina-Garcia et al., 2018). Research suggests that parental norms were more protective of girls (Valentine, 1997), girls lacked experience and competence riding a bicycle (Lachapelle et al., 2013), and that parents enforced stronger helmet rules for children that are less experienced cyclists (Ross, Brinson, & Ross, 2014). Consequently, parents' helmet rules may have been stronger for girls than boys. Furthermore, risk taking behaviours associated with boys may have contributed to boy's lack of helmet use (Riesch et al., 2013). This finding is of significance as it demonstrates that policy can be a useful strategy to overcome parental norms and risk taking behaviours associated with gender.

It is suggested that providing bicycles and helmets to children can overcome barriers related to a lack of bicycle ownership or equipment that is not in working order in low SES communities (Lachapelle et al., 2013). To address risk exposure and environmental concerns, reducing traffic dangers and pedestrian injury in low SES communities and ensuring that pedestrian infrastructure is available in rural communities is necessary. In both settings, the primary method to address these issues is to upgrade existing, or build new, infrastructure that is more pedestrian-friendly. Facilities such as traffic calming measures and sidewalks can help to reduce traffic dangers associated with AST (Retting,

Ferguson, & McCartt, 2003; Schwebel, Davis, & O'Neal, 2012). Coinciding with these changes, secondary intervention components should include education for students to ensure that they are able to safely navigate their environments (Schwebel et al., 2012), in addition to encouraging the use of AST to address broader social influences. Addressing concerns related to longer distances in rural communities, drop-off zones, areas for parents or busses to drop-off and/or pick-up students that are in close proximity of the school, can also help to facilitate AST (Mammen, Stone, Faulkner, et al., 2014; Vanwolleghem et al., 2014). No suggestions were made within these papers for addressing barriers to AST related to ethnic background.

Recommendations from this review include addressing equity in the development and design of the intervention. Public health practitioners are encouraged to frame the goals of AST programs towards the needs of the specific school community. For instance, practitioners should incorporate school-specific assessments of existing as well as lacking resources (e.g., cycling infrastructure, education programs) during the pre-implementation phase to more precisely tailor their interventions for all children. Conversely, schools that already have high rates of AST or lack pedestrian infrastructure, such as those in low SES and/or rural communities, may benefit more from practitioners conducting neighbourhood evaluations of environmental risk exposure to ensure the safety of paths commonly used for AST.

For researchers, including theory within the research design and methodology is one important way to understand behaviour and guide equitable research. The theory applied should be selected based on the issues being address and goals of the intervention (Glanz & Bishop, 2010). More literature is needed to determine effective intervention strategies targeting ethnic minority communities. Engaging ethnic minority children through participatory research is important to understand how equity factors intersect to influence perceptions and engagement with AST. Among all factors, evaluation methods should include sub-group analyses to explore differences in intervention effectiveness among groups. Sex- and Gender-Based Analysis can also help to address inequities based on sex and gender within the community and develop research that is representative of the experiences of population sub-groups (Heidari, Babor, De Castro, Tort, & Curno, 2016;

Johnson, Greaves, & Repta, 2009). Broader frameworks, such as PROGRESS (O'Neill et al., 2014), PROGRESS Plus (Mbuagbaw et al., 2017), or tools such as the one used in this review (Welch et al., 2017), can be used to ensure that equity factors are being considered throughout the research process.

2.5.1 Strengths and Limitations

To the authors' knowledge, this is the first systematic review to focus on the inclusion of equity in AST interventions. This review highlights which equity characteristics are lacking in current evaluations and can be better incorporated in the analysis of future research. A strength of this paper is the use of a specifically designed equity tool for health used for data extraction. Focusing on AST to/from school specifically and not setting geographic boundaries allows the analysis to be more complete and provide a greater understanding of the travel modes of the school community population.

Limitations of this paper stem from the exclusion of non-English language papers and qualitative outcomes, which may have provided relevant results and/or greater comprehension into the equity of AST interventions. All the findings reported are unlikely to be causational but rather correlational due to the nature of the studies. The variety of different reported outcomes and measures used in the included studies do not allow for the review to include a meta-analysis of the effectiveness of the equity features of interventions. Finally, the review cannot account for the cross-cultural variance that likely accompanies the priority of the various equity characteristics in different countries

2.6 Conclusions

Most AST interventions do not consider equity within their design or evaluation of AST interventions. It is recommended that broad multi-component interventions are developed to address concerns regarding AST. These interventions should include targeted strategies to address population sub-groups that have lower rates of AST or unsafe environmental conditions. Evaluation of AST interventions should include sub-group analyses and equity frameworks to determine the effectiveness of the intervention at increasing rates of AST equitably within the population.

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Chapter 3

3 Exploring the influence of children's gender on parents' perceptions of the environment and their influence on children's independent mobility

3.1 Abstract

Physical inactivity among children is a public health concern. Children's ability to travel independently is associated with increased physical activity and social connectedness. Consequently, it is concerning that children's independent mobility has decreased in recent years. Studies have highlighted that rates of independent mobility vary among children of different genders; therefore, this study analyzes how correlates of independent mobility (i.e., intrapersonal, interpersonal, physical environment, and parental perceptions) vary between boys and girls from a sample of 476 boys and 618 girls attending 32 elementary schools in Southwestern Ontario. For boys, age was negatively associated with travel with peers. Having one or more siblings of any age was associated with increased travel with peers and having one or more older/same siblings decreased the likelihood of travel alone. Parents' perceptions of the journey being too far/taking too much time was negatively associated with boys' travel alone. In comparison, age was positively associated with travel alone for girls. Having one or more younger or older/same siblings were associated with decreased travel alone, while older/same age siblings were positively associated with travel with peers. Distance was negatively associated with both travel with peers and alone. For girls, parents' perceptions of the journey between home and school being easier to drive and having enough walking trails in the neighbourhood were negatively associated with travel alone and with peers, respectively. The findings of this study can aid in informing future interventions targeting children's school travel and help address inequities in independent mobility between boys and girls.

3.2 Background

Over half of Canadian children (5 to 17 years old) are not achieving their recommended amounts of moderate to vigorous physical activity (Statistics Canada, 2019). Low levels of physical activity are of concern as they have been associated with poor outcomes for body composition, physical fitness, and mental health (Janssen & LeBlanc, 2010; Poitras et al., 2016; Tremblay et al., 2011). Engaging in active school travel (AST), which is any form of human-powered transport to and/or from school, provides an opportunity for children to increase their physical activity (ParticipACTION, 2020). In addition, AST is associated with environmental (Adams & Requia, 2017; Gilliland et al., 2019), and academic benefits (Martínez-Gómez, Ruiz, & Gómez-Martínez, 2011). Despite these positive findings, rates of AST have decreased over the last 50 years (Buliung, Mitra, & Faulkner, 2009; Gray et al., 2014).

Parental permission to travel independently is an important aspect of children's participation in AST (Faulkner, Richichi, Buliung, Fusco, & Moola, 2010; Ghekiere et al., 2016; Page, Cooper, Griew, & Jago, 2010). Children's independent mobility (IM) is defined as children's freedom to travel around their community without adult supervision (Hillman, Adams, & Whitelegg, 1990). IM and AST have an interconnected relationship in which the trip to/from school represents one of the first milestones of independent travel for children and IM is a key component of children's participation in AST (Crawford et al., 2017; Faulkner et al., 2010; Mitra, 2013). Beyond its foundation to AST, IM is associated with increased physical activity (Schoeppe, Duncan, Badland, Oliver, & Curtis, 2013), and social connectedness (Prezza & Pacilli, 2007; Rissotto & Tonucci, 2002). Similar to trends of AST, IM has decreased in recent years (Fyhri, Hjorthol, Mackett, Fotel, & Kyttä, 2011; Loebach & Gilliland, 2019; Schoeppe et al., 2013).

Studies examining correlates of IM often utilize the socio-ecological model to understand travel behaviours (for example, Buliung, Larsen, Faulkner, & Ross, 2017; Carver, Panter, Jones, & van Sluijs, 2014; Crawford et al., 2017; Foster, Villanueva, Wood, Christian, & Giles-Corti, 2014; Ghekiere et al., 2017; Janssen, Ferrao, & King, 2016; Riazi et al., 2019). This model posits that IM is influenced by determinants within the intrapersonal,

interpersonal, physical environment, and policy levels (Sallis et al., 2006). The socio-ecological model is useful for understanding children's health behaviours as it systematically assesses mechanisms of change at multiple levels of behavioral influence (Sallis et al., 2006; Sallis, Owen, & Fisher, 2008). Population-level interventions should target all of these levels of influence to be most effective at changing behaviour (Sallis et al., 2006). As current AST interventions are often conducted at the school-population level, using the socio-ecological model as a framework for this study allows for exploration into behavioural influence and greater application of the results to AST interventions.

Within the intrapersonal level, older children and boys are more likely to be granted IM by their parents (Buliung et al., 2017; Ghekiere et al., 2017; Riazi et al., 2019). Considering the influence of children's family, parental education and encouragement positively influence IM (Carver et al., 2014; Schoeppe, Duncan, Badland, Rebar, & Vandelanotte, 2016). Other interpersonal factors that have been found to predict IM include having siblings and peer support (Carver et al., 2014). The number of motor vehicles owned by the family is negatively associated with IM (Nystrom et al., 2019).

Within the physical environment, characteristics such as land use mix and level of urbanicity are negatively associated with IM (Buliung et al., 2017; Fyhri & Hjorthol, 2009; Lam & Loo, 2014). Walking facilities are positively associated with IM (Veitch et al., 2017). Other barriers to IM stem from parental perceptions of the environment. Perceptions that are negatively associated with IM include excessive traffic, crime, and threats due to unknown adults in the community (Marzi, Demetriou, & Reimers, 2018).

Policy determinants largely consist of school bussing policies that designate criteria for school bus service. In Southwestern Ontario, policies state that, excluding routes with pedestrian hazards or children with disabilities, children living within 1.6 kilometres from the school are not eligible for bus transportation (Southwestern Ontario Student Transportation Services, 2014, 2017, 2020). Instead, school board and bussing officials promote AST, such as walking or bicycling, as modes of transportation for students residing within 1.6 kilometres (Active and Safe Routes to School, 2020). Since distance

is a significant determinant of children's travel behaviour (Larsen et al., 2009; Marzi et al., 2018; Wilson, Clark, & Gilliland, 2018), such policies have large impacts on IM.

The research focused on correlates of IM on the journey to and from school is still emerging and continues to identify key correlates within all levels of the socio-ecological model (for example, Buliung et al., 2017; Janssen et al., 2016; Riazi et al., 2019). Despite gender differences being noted over 20 years ago (Hart, 1979; Valentine, 1997), there is still little evidence on the different potential pathways to IM among children of different genders (Marzi et al., 2018; Marzi & Reimers, 2018). Addressing gender differences in IM is important to address equity within interventions promotion equity. Equity refers to the absence of avoidable or systemic differences in children's engagement in AST (Braveman, 2006). It is important to consider equity in relation to children's IM to ensure that all children are able to benefit from such interventions. Accordingly, this study offers a cross-sectional analysis of IM and seeks to fill a gap in the gendered nature of IM. The aims of this study were to: (1) analyze how the intrapersonal, interpersonal and physical environment factors that influence children's IM differ by children's gender; and (2) controlling for those factors, investigate how parents' perceptions of barriers and facilitators to AST influence IM by gender. This study uses a novel method of IM classification as dependent travel, travel with peers, or travel alone. As travel with peers may be the first step to travel alone (Crawford et al., 2017), understanding differences between the two enable greater insight into the factors that influence IM for each category.

3.3 Methods

This study uses baseline data collected as part of the Active and Safe Routes to School (ASRTS) program of Southwestern Ontario, Canada. The ASRTS program aims to increase AST among students attending elementary schools in the cities of London and St. Thomas, and the Counties of Elgin, Oxford, and Middlesex (Active and Safe Routes to School, 2020). Full details of the program are presented elsewhere (Section 1.4 of Chapter 1, Buttazzoni, Clark, Seabrook, & Gilliland, 2019).

Parent surveys were either completed online or via paper copy at home which were returned to school. Children independently completed surveys during the school day with help from the school health nurse/facilitator and research assistants. Both the family and child survey asked dichotomous, multiple-choice, and Likert-scale questions. The parent survey asked questions regarding family demographics (e.g., family structure, socioeconomic status, postal code), travel behaviours, and perceptions of barriers and facilitators to AST and IM. The child survey asked very similar questions related to child and family demographics, travel behaviours, and perceptions of barriers and facilitators to AST and IM. These surveys use previously validated methods from the Healthy Neighbourhoods Survey and Neighbourhood Environment Walkability Scale (Cerin, Saelens, Sallis, & Frank, 2006; Frank et al., 2010; Saelens, Sallis, Black, & Chen, 2003). The Non-Medical Research Ethics Board at Western University (NMREB #105635) and the two regional English school boards approved this project. (see Appendices G-I)

3.3.1 Sample

The initial sample used in this study consisted of 1764 baseline parent surveys and 1952 child surveys from 32 schools, before four exclusion criteria were applied. First, observations were excluded if a paired child and parent survey were not completed, as responses from both were needed for the analyses. Second, child and parent surveys were excluded if their home postal code was not reported, since the postal code is used to calculate built environment variables for the home neighbourhood. Third, children that were eligible for school bus service were excluded. Finally, observations were excluded if the child did not identify as a boy or girl. It is important to note that only nine students in the sample reported a gender other than a boy or a girl. Due to the very small sample size of this population, these observations were not included in the analysis. After applying these criteria, the final sample consisted of 476 paired parent and child surveys for boys and 618 for girls, or 1094 in total.

3.3.2 Measures

3.3.2.1 Dependent Variable

The dependent variable was level of IM on the journey to/from school. IM is defined as travel without adult supervision and was calculated using child-reported travel behaviours. Children reported how often in a typical week they used each of the following methods: walking, bicycle/scooter, skateboard/rollerblades, car/personal vehicle, school bus, and city bus. Children reported if they used each of the modes of travel never, almost never (1 to 2 days/month), sometimes (1 or 2 days/week), almost always (3 or 4 days/week), or always (5 days/week). Walking, bicycle/scooter, and rollerblades were classified as active travel modes that children could use independently. Car/personal vehicle was considered dependent mobility as elementary school-age children are unable to drive. The school bus and city bus were not used by children in our sample. Next, children reported who they normally travelled with: nobody, sibling(s), friend(s), parent(s), other adult(s), and/or other students(s).

Children were included in one of three categories based on the highest level of independence the child reported: dependent mobility (0), travel with peers (1), or travel alone (2). Dependent mobility encompassed children that were only driven or used active modes of travel with a parent or other adult throughout the week. Travel with peers included those that used active modes of travel (i.e., walk, bicycle, skateboard, scooter, rollerblade) with sibling(s), friends, or other children but never alone. Travel alone comprised of children who used active modes of travel alone to/from school anytime during the week.

3.3.2.2 Independent Variables

Using the socio-ecological model as a framework, independent variables were broken down into three categories: intrapersonal, interpersonal, and physical environment. Policy level factors are controlled for by excluding children that live >1.6 km from the school.

Intrapersonal variables for the child were obtained from the child survey. These factors included age (a continuous measure in years [range = 8–14]), whether or not they owned

a bicycle (yes [0] or no [1]), and if they had a dog (yes [0] or no [1]). All analyses were stratified by the child's gender, as reported by the child as either boy (0) or girl (1).

Interpersonal variables were obtained using child and parent survey methods. Children reported whether they were permitted to walk (yes [0] or no [1]) and bike (yes [0] or no [1]) to or from school, and if their family had moved within the last two years (yes [0] or no [1]). Parents reported the number of motor vehicles in working order (continuous variable [range 0–4]) and their family type (lone parent [0] or two parents [1]). The highest level of education attained by parents within the household (high school or less [0], graduate school [1], or undergraduate college/university [2]) was derived using parent reports of their level of education. Based on parent reports of every child's age and gender in the household, sibling age was calculated for the child that completed the associated child survey. Sibling age was classified as to whether the child had one of more younger siblings (0), older and/or same-age siblings (1), younger and older siblings (2), or was an only child (3). Median family income from the 2016 Canadian census was applied for the census dissemination area in which the child's home is located (Statistics Canada, 2020).

Variables within the physical environment are objectively measured based on the child's home postal code provided by the family survey. These include the distance between home and school, population density (in hundreds/square kilometer), intersection density (# of intersections/square kilometer), land uses, and level of urbanicity. As this study focused on children that live within walking distance (i.e., urban areas and small towns), postal codes are appropriate proxies for home locations (Healy & Gilliland, 2012). Distance between home and school was measured in kilometers using circulation distance, including short cuts and pathways, between a child's home postal code and school. The proportion of land use for commercial, institutional, recreation, and industrial purposes was also measured. Land use was measured within a 500-metre Euclidian buffer of the home as this is considered an appropriate distance within the literature on children's mobility and environmental accessibility (Gilliland et al., 2012; Larsen et al., 2009; Tillmann, Clark, & Gilliland, 2018). ArcGIS Pro 2.4 was used to calculate distances and proportions of each land use (ESRI, 2019). Urbanicity was divided into

four categories: rural small town, urban small town, urban large city, or suburban large city. The urban small town encompasses settlement areas with a population of 10,000 to 100,000 people, while rural small town includes areas with a population between 1,000 and 10,000 people. Both urban large city and suburban large city classifications include areas with settlements greater than 100,000 people. Urban areas are those that have grid-like road networks, high population density, and high land use mix. In comparison, suburban areas have irregular, looping and cul-de-sac road networks, and lower population density and land use mix (Taylor, Clark, & Gilliland, 2018; Tillmann et al., 2018).

Parents' perceptions of barriers and facilitators to AST were captured using a 4-point Likert scale ranging from strongly disagree to strongly agree. The questions were posed to reflect either barriers along the route to/from school or facilitators in their neighbourhood. These observations were analyzed as a binary scale (agree and strongly agree [0] to strongly disagree and disagree [1]). Items were categorized into one of three groups: physical environment, social environment, or individual/family preferences (Table 3.1).

Table 3.1: Parents' Perceptions of Barriers and Facilitators to AST

Classification as a barrier or facilitator	Survey statement
Physical environment	
Barrier	The journey is too far/takes too much time
Barrier	Nowhere to leave a bike at school
Barrier	The route feels unsafe due to traffic
Barrier	Too many busy streets to cross along the route
Barrier	Drivers speed on streets along the route
Facilitator	There are enough sidewalks on the streets in our neighbourhood
Facilitator	There are walking trails in or near our neighbourhood that are easy to get to
Facilitator	There are bicycle lanes or trails in or near our neighbourhood that are easy to get to
Facilitator	There are lots of trees along the streets in our neighbourhood
Social environment	
Barrier	Feels unsafe because of crime along the route
Barrier	Unsafe for my child to walk alone during the day

Barrier	Unsafe for my child to walk with friends during the day
Barrier	Worried about my child being alone because of strangers
Barrier	Child might get bullied/teased
Barrier	No one for my child to walk with
Facilitator	We know a lot of people in our neighbourhood
Individual/family preference	
Barrier	The route is boring
Barrier	Child gets too hot/sweaty
Barrier	Not fun for my child to walk
Barrier	Child has too much stuff to carry
Barrier	Easier to drive
Barrier	Child is too young to walk/bike
Barrier	Child does not have the skills to bike

Approximately 5% of the data were missing. Missing data were found not to be missing completely at random as Little's MCAR test was significant ($p < .05$) (Li, 2013). To account for missing data, deductive imputation and multiple imputation methods were used to optimize sample size (Jakobsen, Gluud, Wetterslev, & Winkel, 2017; Stuart, Azur, Frangakis, & Leaf, 2009). For age, missing data were imputed based on related data from the associated parent survey. For interpersonal and perception variables, multiple imputation methods were used. No data were missing for physical environment variables.

3.3.3 Statistical analyses

To meet the first aim, this study used bivariate chi-square and bivariate and multinomial logistic regression to understand how intrapersonal, interpersonal, and built environment factors and parents' perceptions of barriers and facilitators to AST influence IM. Bivariate analyses were conducted for categorical independent variables using chi-square tests and for continuous variables using logistic regression analyses. These tests were conducted to determine which variables were significantly associated with IM and should be controlled for in later analyses. A critical value cut off of $p < .10$ was used to identify significant correlates.

Multinomial logistic regression, with odds ratios and 95% confidence intervals, was used to examine how parent perceptions influence IM (Hosmer, Lemeshow, & Sturdivant, 2013). A hierarchical process was used, following the stages of the socio-ecological model: (1) Intrapersonal; (2) Model 1 + Interpersonal; (3) Model 2 + Physical Environment; (4) Model 3 + univariate perceptions; (5) Model 3 + all significant univariate perceptions together. Dependent mobility was used as the reference category. Multicollinearity was assessed and found to not be a concern as variance inflation factors for all independent variables were below 3 (O'brien, 2007). To address the second objective of this study, all models were completed separately for boys and girls. To ensure comparability between children's genders, variables were included in the final models if they were significant for either boys or girls. All analyses were conducted using IBM SPSS Statistics 26 (IBM Canada Ltd., Markham, Ontario, Canada).

3.4 Results

3.4.1 Descriptive Statistics

Descriptive statistics for the study sample can be found in Table 3.2. The sample consisted of 476 boys and 618 girls, ages 8–14 years (grades 4–8). Most children owned a bicycle (84.9% of boys, 84.8% of girls) and did not have a dog (52.3% of boys, 56.6% of girls). For boys and girls, the average median family income (in CAD) was $95,000 (City of London 2017 median family income $83,880 [Statistics Canada, n.d.]), and families owned approximately two motor vehicles. Households with two parents were most common (89.1% of boys and 89.5% of girls). Most parents had completed some form of graduate school (54.8% of boys, 52.6% of girls). Most children did not have a sibling attending their school (40.3% of boys, 36.9% of girls). Having permission to walk (85.5% of boys, 88.5% of girls) and bicycle (60.7% of boys and 58.1% of girls) was most commonly reported by children. The majority of children had not moved within the last two years (72.7% of boys, 74.3% of girls) and approximately 75% of the sample came from suburban large city settlement areas.

Table 3.2: Descriptive statistics about the sample (boys: n = 476, girls: n= 618)

Variable	Boys	Girls

	n	%	n	%
Independent Mobility				
Dependent mobility	259	54.4	357	57.8
Travel with peers	117	24.6	176	28.5
Travel alone	100	21.0	85	13.8
Intrapersonal	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
Age	10.8	1.4	10.8	1.4
	n	**%**	**n**	**%**
Child owns a bike				
Yes	404	84.9	524	84.8
No	54	11.3	73	11.8
Has a dog				
Yes	203	42.6	245	39.6
No	249	52.3	350	56.6
Interpersonal	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
Median family income (CAD, tens of thousands)	9.5	2.7	9.5	2.8
Number of motor vehicles	1.7	0.7	1.7	0.7
	n	**%**	**n**	**%**
Lone parent vs. two parents				
1 parent	35	7.4	42	6.8
2 parents	424	89.1	553	89.5
Max. parent education level				
High school or less	49	10.3	70	11.3
Graduate school	261	54.8	325	52.6
Undergraduate college / university	146	30.7	195	31.6
Relationship with siblings				
Younger sibling(s)	135	28.4	186	30.1
Older/same age sibling(s)	73	15.3	100	16.2
Younger & older sibling(s)	29	6.1	39	6.3
Single child	192	40.3	228	36.9
Allowed to walk				
Yes	407	85.5	547	88.5
No	59	12.4	63	10.2
Allowed to bike				
Yes	289	60.7	359	58.1
No	164	34.5	231	37.4
Family moved within the last two years				
Yes	95	20.0	113	18.3
No	346	72.7	459	74.3
Physical Environment	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
Distance to school (km)	1.0	0.5	0.9	0.5
Commercial land use	2.4	6.5	2.8	7.6
Institutional land use	2.9	4.4	3.1	4.7

Recreation land use	18.9	22.4	17.7	20.7
Residential land use	72.7	20.8	73.5	19.2
Industrial land use	3.2	7.2	2.9	6.6
Population density	19.8	10.4	20.8	10.2
Intersection density	31.1	10.6	31.4	11.5
	n	**%**	**n**	**%**
Urbanicity				
Rural small town	30	6.3	37	6.0
Urban small town	68	14.3	89	14.4
Urban large city	25	5.3	31	5.0
Suburban large city	353	74.2	461	74.6

3.4.2 Bivariate Analyses

To determine bivariate relationships between each independent variable and IM, chi-square analyses were conducted with categorical independent variables and univariate logistic regression was used with continuous independent variables (Table 3.3). Differences were found in the distribution of significant factors between boys and girls within the interpersonal and physical environment levels.

Within the intrapersonal level, age was significant for children of both genders (boys: $X^2 = 16.35$, $p < .001$; girls: $X^2 = 32.37$, $p < .001$). Sibling age (boys: $X^2 = 61.10$, $p < .001$; girls: $X^2 = 46.04$, $p < .001$), maximum parent education (boys: $X^2 = 9.72$, $p = .05$; girls: $X^2 = 10.31$, $p = .04$), and permission to walk (boys: $X^2 = 17.83$, $p < .001$; girls: $X^2 = 17.77$, $p < .001$) were significant for both boys and girls at the interpersonal level. The number of motor vehicles ($X^2 = 6.53$, $p = .04$) was significant only for boys, whereas permission to bike ($X^2 = 8.3$, $p = .02$) was significant only for girls. Within the objective physical environment, distance was significant for both genders (boys: $X^2 = 14.53$, $p < .001$; girls: $X^2 = 30.41$, $p < .001$). Population density ($X^2 = 10.91$, $p < .01$) was significant for boys. No other variables were significant for girls.

Table 3.3: Chi-square test results; intrapersonal, interpersonal, and physical environment variables

	Boys		**Girls**	
Variable	**Chi-Square Value**	**P-value**	**Chi-Square Value**	**P-value**
Intrapersonal				
Age	16.35	**<0.001**	32.37	**<0.001**

Child owns a bike	0.15	0.93	0.83	0.66
Has a dog	0.50	0.78	3.78	0.15
Interpersonal				
Median family income	2.85	0.24	1.94	0.38
Number of motor vehicles	6.53	**0.04**	0.08	0.96
Lone parent vs. two parents	0.50	0.78	1.16	0.56
Max. parent education level	9.72	**0.05**	10.31	**0.04**
Sibling age	61.10	**<0.001**	46.04	**<0.001**
Permission to walk	17.83	**<0.001**	17.77	**<0.001**
Permission to bike	5.82	0.06	8.30	**0.02**
Family moved within the last two years	1.28	0.53	1.40	0.50
Physical environment				
Distance to school (km)	14.53	**<0.001**	30.41	**<0.001**
Commercial land use	1.32	0.52	2.97	0.23
Institutional land use	3.61	0.17	0.51	0.78
Recreation land use	2.00	0.37	0.45	0.80
Residential land use	0.77	0.68	0.58	0.75
Industrial land use	0.02	0.99	5.07	0.08
Population density	10.91	**<0.01**	0.14	0.93
Intersection density	1.86	0.39	0.77	0.68
Urbanicity	9.61	0.14	8.74	0.19

Notes: The reference category is “Dependent mobility”; Significant (p<.05) correlates are bolded

3.4.3 Model Specification

The results of the multivariate logistic regression models follow. Tables 3.4 and 3.5 show the hierarchical modeling approach used to analyze intrapersonal, interpersonal, and physical environment variables with IM. Results of the univariate models can be found in Tables 3.6 and 3.7. These tables display the effect of each parent perception on IM, controlling for significant ($p < .10$) intrapersonal, interpersonal, and physical environment variables from bivariate analyses. The final models, in Table 3.8 and 3.9, illustrate how parent perceptions combine to influence IM, controlling for the other variables. Each of these models was stratified by gender to allow for gender-based analysis.

3.4.3.1 Hierarchical Modelling

Hierarchical modeling is used to identify how intrapersonal, interpersonal, and physical environment variables influence IM (Table 3.4 and 3.5). This approach was used to build a representative model of control variables for use in the final model. Model C of Table

3.4 shows the effect that these three levels of variables have for boys' IM. Having one or more younger siblings (peers: OR = 2.58, p < .01 ; alone: OR = 0.50, p = .03) and older/same age siblings (peers: OR = 2.38, p = .02; alone: OR = 0.25, p =.01) and distance between home and school (peers: OR = 0.60, p = .04; alone: OR = 0.56, p = .03) significantly impacted IM, both with peers and alone. The child's age (OR = 0.80, p = .02), having younger and older siblings (OR = 4.56, p < .01), and permission to walk (OR = 5.28, p < .001) significantly influenced boys' travel with peers. Population density (OR = 1.03, p = .03) significantly influenced boys' travel alone.

For girls, model C of Table 3.5 shows that having one or more younger siblings (peers: OR = 1.71, p = .03; alone: OR = 0.38, p < .01) and distance between home and school (peers: OR = 0.46, p < .001; alone: OR = 0.29, p < .001) significantly impacted IM with peers and alone. Having one or more older/same age siblings (OR = 2.40, p < .01) and permission to walk (OR = 2.24, p = .04) significantly influenced girls' travel with peers. Travel alone was significantly influenced by age (OR = 1.38, p < .01) and parent education of high school or less (OR = 0.33, p = .04).

3.4.3.2 Univariate Model Results

While controlling for significant intrapersonal, interpersonal, and physical environment variables from bivariate analyses, each of the parent perceptions was compared with IM using logistic regression models to determine individual associations (Tables 3.6 and 3.7). No parent perceptions were significant (p < .05) predictors of IM with peers for boys. Perceptions of the journey being too far/taking too much time (OR = 0.30, p = .03) and the child is too young to walk/bike (OR = 0.45, p = .04) were significant for boys' travel alone.

For girls, travel with peers was significantly influenced by perceptions of the neighbourhood having enough walking trails (OR = 0.37, p < .001). Perceptions of the journey being unsafe due to traffic (OR = 0.54, p = .04), easier to drive (OR = 0.41, p = .03), and knowing a lot of people in the neighbourhood (OR = 0.53, p = .03) were significant predictors of girls' travel alone. For both boys and girls, all of the odds ratios

are less than one, indicating that as perceptions of these factors increase, odds of IM decrease.

3.4.3.3 Multivariate Model Results

All perceptions that were found to be significant for either boys or girls (at significance level $p < .10$) in the univariate models were included in the final, multivariate models, displayed in Tables 3.8 and 3.9. As with the preceding analyses, models were run separately for boys and girls.

3.4.3.3.1 Boys

Within the intrapersonal level, age was statistically significant, indicating that as boys got older, they were less likely to travel with peers (OR = 0.78, p = .02). Sibling age, and permission to walk were statistically significant interpersonal variables. Results showed that boys with one or more siblings of any age (i.e. younger sibling(s) [OR = 2.83, p < .01], older/same age sibling(s) [OR = 2.43, p = .02], or younger and older siblings [OR = 5.20, p < .01]) attending the school were more likely to travel with peers compared to boys that did not have a sibling attending the school. Only those with one or more older/same age siblings were also less likely to walk alone (OR = 0.22, p = .01). Permission to walk was positively associated with travel with peers (OR = 4.96, p < .01). Within the physical environment, population density was positively associated with travel alone (OR = 1.03, p = .04).

Parents' perceptions of barriers and facilitators of AST were only significantly related to travel alone. Perceptions that the journey is too far/takes too much time (OR = 0.27, p = .02) was negatively associated with boys' travel alone. Parents' perceptions that the route is boring is positively associated with boys' travel alone (OR = 3.26, p = .03).

3.4.3.3.2 Girls

At the intrapersonal level, age was positively associated with travel alone for girls (OR = 1.33, p = .01). Significant interpersonal variables for girls were maximum parent education, sibling age, and permission to walk. Girls whose parents had a high school diploma or less were less likely to travel with peers compared to those that had an

undergraduate university/college certification (OR = 0.40, p = .04). Girls that had one or more younger (OR = 0.39, p < .01) or older/same age (OR = 0.28, p = .04) siblings attending the school were significantly less likely to travel alone compared to girls did not have a sibling attending the school. Only girls that had one or more older/same age siblings were significantly more likely to travel with peers (OR = 2.30, p < .01). Permission to walk was positively associated with travel with peers (OR = 3.13, p = .01). Within the objectively measured physical environment, distance and industrial land use were statistically significant correlates of girls' IM. Distance is negatively associated with both travel with peers (OR = 0.48, p < .01) and alone (OR = 0.31, p < .001). Industrial land use was negatively associated with girls' travel with peers (OR = 0.96, p = .05).

Parents' perceptions of barriers and facilitators of AST were significantly related to both travel with peers and alone. Perceptions that drivers speed on streets was significantly related to girls' travel alone (OR = 1.92, p = .05). Nearby walking trails were negatively associated with girls' IM with peers (OR = 0.37, p < .001). Girls whose parents perceived that it was unsafe for them to walk with friends during the day were more likely to travel with peers (OR = 2.12, p = .02). Knowing lots of people in the neighbourhood was negatively associated with girls' travel alone (0.52, p = .04). Perceptions that the route is boring was negatively associated with travel with peers (0.31, p = .03). Perceiving that the journey was easier to drive was negatively associated with girls' travel alone (OR = 0.40, p = .03).

Table 3.4: Hierarchical logistic regression to develop predictive models of IM based on socio-ecological framework variables for boys

	Travel with Peers				Travel Alone			
Variable	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**
A: Intrapersonal								
Age	0.81	0.08	**0.01**	0.69, 0.95	1.21	0.08	**0.03**	1.02, 1.42
B: Intrapersonal and interpersonal								
Age	0.79	0.09	**0.01**	0.66, 0.95	1.07	0.10	0.50	0.88, 1.29
Number of motor vehicles	0.68	0.19	**0.05**	0.47, 0.99	0.77	0.19	0.17	0.54, 1.11
Max. parent education level (ref: Undergraduate college/university)								
High school or less	0.82	0.44	0.66	0.35, 1.95	0.85	0.49	0.74	0.33, 2.21
Graduate school	1.50	0.27	0.12	0.89, 2.53	1.75	0.31	0.07	0.95, 3.20
Sibling age (ref: single child)								
Younger sibling(s)	2.54	0.32	**<0.01**	1.35, 4.79	0.48	0.31	**0.02**	0.26, 0.88
Older/same age sibling(s)	2.39	0.36	**0.02**	1.18, 4.81	0.26	0.53	**0.01**	0.09, 0.76
Younger & older siblings	4.44	0.49	**<0.01**	1.70, 11.62	0.49	0.69	0.31	0.13, 1.92
Permission to walk (ref: no)	6.13	0.50	**<0.001**	2.30, 16.36	3.10	0.50	**0.03**	1.16, 8.32
Permission to bike (ref: no)	0.80	0.28	0.41	0.46, 1.38	1.08	0.31	0.80	0.59, 1.99
C: Intrapersonal, interpersonal, and physical environment								
Age	0.80	0.09	**0.02**	0.67, 0.97	1.07	0.10	0.47	0.89, 1.30
Number of motor vehicles	0.71	0.19	0.08	0.48, 1.04	0.81	0.19	0.26	0.56, 1.17
Max. parent education level (ref: Undergraduate college/university)								
High school or less	0.82	0.44	0.65	0.34, 1.95	0.81	0.50	0.66	0.30, 2.13
Graduate school	1.53	0.27	0.12	0.90, 2.58	1.82	0.31	0.06	0.98, 3.38

Sibling age (ref: single child)								
Younger sibling(s)	2.58	0.33	**<0.01**	1.36, 4.92	0.50	0.31	**0.03**	0.27, 0.92
Older/same age sibling(s)	2.38	0.36	**0.02**	1.18, 4.82	0.25	0.54	**0.01**	0.09, 0.74
Younger & older siblings	4.56	0.49	**<0.01**	1.72, 12.09	0.52	0.70	0.35	0.13, 2.05
Permission to walk (ref: no)	5.28	0.51	**<0.001**	1.95, 14.29	2.67	0.52	0.06	0.97, 7.34
Permission to bike (ref: no)	0.78	0.28	0.36	0.45, 1.34	1.03	0.32	0.93	0.55, 1.92
Distance to school (km)	0.60	0.25	**0.04**	0.37, 0.97	0.56	0.27	**0.03**	0.33, 0.95
Population density	1.01	0.01	0.22	0.99, 1.04	1.03	0.01	**0.03**	1.00, 1.05
Industrial land use	1.00	0.02	0.91	0.97, 1.04	1.02	0.02	0.39	0.98, 1.05

Notes: The reference category is "Dependent mobility"; Significant ($p < .05$) correlates are bolded

Table 3.5: Hierarchical logistic regression to develop predictive models of IM based on socio-ecological framework variables for girls

	Travel with Peers				Travel Alone			
Variable	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**
A: Intrapersonal								
Age	0.89	0.07	0.08	0.78, 1.01	1.53	0.09	**<0.001**	1.28, 1.84
B: Intrapersonal and interpersonal								
Age	0.88	0.08	0.09	0.76, 1.02	1.36	0.11	**<0.01**	1.11, 1.67
Number of motor vehicles	0.89	0.16	0.46	0.64, 1.23	0.96	0.19	0.84	0.67, 1.39
Max. parent education level (ref: Undergraduate college/university)								
High school or less	0.46	0.39	**0.05**	0.21, 1.00	0.36	0.54	0.06	0.13, 1.04
Graduate school	0.86	0.21	0.48	0.58, 1.30	0.89	0.28	0.68	0.51, 1.55
Sibling age (ref: single child)								
Younger sibling(s)	1.75	0.25	**0.03**	1.07, 2.86	0.43	0.30	**0.01**	0.24, 0.77
Older/same age sibling(s)	2.30	0.28	**<0.01**	1.34, 3.95	0.31	0.58	**0.05**	0.10, 1.00
Younger & older siblings	1.44	0.38	0.33	0.69, 3.01	0.17	1.14	0.13	0.02, 1.76

Permission to walk (ref: no)	2.75	0.37	**0.01**	1.32, 5.72	8.67	1.04	**0.04**	1.13, 66.66
Permission to bike (ref: no)	0.85	0.21	0.44	0.56, 1.28	1.21	0.31	0.54	0.66, 2.24
C: Intrapersonal, interpersonal, and physical environment								
Age	0.87	0.08	0.08	0.75, 1.01	1.38	0.11	**<0.01**	1.11, 1.70
Number of motor vehicles	0.85	0.17	0.34	0.60, 1.20	0.95	0.20	0.78	0.65, 1.39
Max. parent education level (ref: Undergraduate college/university)								
High school or less	0.46	0.40	0.06	0.21, 1.02	0.33	0.55	**0.04**	0.11, 0.97
Graduate school	0.85	0.21	0.43	0.56, 1.28	0.89	0.29	0.67	0.50, 1.55
Sibling age (ref: single child)								
Younger sibling(s)	1.71	0.25	**0.03**	1.04, 2.81	0.38	0.31	**<0.01**	0.21, 0.70
Older/same age sibling(s)	2.40	0.28	**<0.01**	1.38, 4.16	0.31	0.61	0.06	0.09, 1.04
Younger & older siblings	1.38	0.39	0.41	0.65, 2.93	0.14	1.17	0.10	0.01, 1.54
Permission to walk (ref: no)	2.24	0.39	**0.04**	1.05, 4.76	6.80	1.06	0.07	0.86, 53.83
Permission to bike (ref: no)	0.86	0.22	0.47	0.56, 1.31	1.26	0.32	0.47	0.67, 2.37
Distance to school (km)	0.46	0.22	**<0.001**	0.30, 0.71	0.29	0.32	**<0.001**	0.16, 0.55
Population density	1.00	0.01	1.00	0.98, 1.02	1.01	0.01	0.37	0.99, 1.04
Industrial land use	0.97	0.02	0.10	0.94, 1.01	1.02	0.02	0.41	0.98, 1.05

Notes: The reference category is "Dependent mobility"; Significant ($p < .05$) correlates are bolded

Table 3.6: Univariate logistic regression analysis to understand the impact perceived barriers and facilitators to AST have on boys' IM while controlling for socio-ecological framework variables

	Travel with Peers				Travel Alone			
Parent Perception (ref: disagree)	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**
Physical environment								
Too far/takes too much time	0.73	0.43	0.47	0.31, 1.73	0.30	0.57	**0.03**	0.10, 0.91
Nowhere to leave a bike at school	0.77	0.32	0.40	0.41, 1.44	0.74	0.32	0.35	0.39, 1.39
Route feels unsafe due to traffic	1.16	0.26	0.58	0.69, 1.94	0.94	0.27	0.82	0.56, 1.58

Too many busy streets to cross	0.97	0.27	0.91	0.58, 1.64	0.58	0.29	0.06	0.33, 1.03
Drivers speed on streets	1.06	0.26	0.84	0.63, 1.77	1.14	0.27	0.64	0.67, 1.94
Enough sidewalks on the streets in the neighbourhood	0.87	0.28	0.61	0.50, 1.51	0.63	0.29	0.12	0.36, 1.12
Walking trails in or near the neighbourhood	0.78	0.27	0.35	0.46, 1.32	1.07	0.32	0.83	0.57, 2.04
Bicycle lanes or trails in or near the neighbourhood	1.46	0.25	0.13	0.90, 2.38	0.86	0.28	0.59	0.50, 1.49
Lots of trees	0.76	0.31	0.38	0.41, 1.40	0.88	0.33	0.71	0.46, 1.70
Social environment								
Feels unsafe because of crime	0.94	0.31	0.84	0.51, 1.72	1.13	0.35	0.73	0.57, 2.26
Unsafe for child to walk alone	0.97	0.28	0.91	0.56, 1.68	0.55	0.37	0.11	0.27, 1.14
Unsafe for child to walk with friends	1.09	0.36	0.81	0.54, 2.22	0.62	0.47	0.31	0.25, 1.56
Worried about child being alone because of strangers	1.26	0.26	0.38	0.76, 2.10	0.94	0.30	0.83	0.53, 1.68
Might get bullied/teased	1.26	0.34	0.50	0.65, 2.47	1.32	0.33	0.40	0.70, 2.51
No one to walk with	0.85	0.36	0.65	0.42, 1.74	1.18	0.37	0.65	0.58, 2.42
Know a lot of people	0.61	0.27	0.07	0.36, 1.03	0.96	0.30	0.89	0.54, 1.71
Individual/family preference								
Route is boring	1.33	0.46	0.54	0.54, 3.30	1.91	0.46	0.16	0.77, 4.69
Get too hot/sweaty	1.32	0.46	0.55	0.53, 3.23	1.26	0.47	0.63	0.49, 3.22
Not fun to walk	1.02	0.51	0.97	0.37, 2.83	1.77	0.46	0.22	0.71, 4.43
Too much stuff to carry	1.17	0.33	0.64	0.61, 2.23	1.62	0.30	0.11	0.90, 2.91
Easier to drive	0.86	0.29	0.61	0.49, 1.52	0.66	0.33	0.21	0.35, 1.27
Too young to walk/bike	0.93	0.31	0.82	0.51, 1.69	0.45	0.40	**0.04**	0.20, 0.98
No skills to bike	0.93	0.31	0.81	0.51, 1.70	0.69	0.34	0.28	0.36, 1.36

Notes: The reference category is “Dependent mobility”; Significant ($p < .05$) correlates are bolded; Control variables are age, number of motor vehicles, maximum parent education, sibling age, permission to walk, permission to bike, distance to school (km), population density, and industrial land use

Table 3.7: Univariate logistic regression analysis to understand the impact perceived barriers and facilitators to AST have on girls' IM while controlling for socio-ecological framework variables

	Travel with Peers				Travel Alone			
Parent Perception (ref: disagree)	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**
Physical environment								
Too far/takes too much time	1.11	0.29	0.71	0.63, 1.98	1.03	0.46	0.95	0.41, 2.61
Nowhere to leave a bike at school	1.13	0.24	0.62	0.71, 1.80	1.15	0.35	0.69	0.58, 2.27
Route feels unsafe due to traffic	0.89	0.22	0.58	0.58, 1.36	0.54	0.30	**0.04**	0.30, 0.97
Too many busy streets to cross	0.84	0.24	0.47	0.53, 1.34	0.52	0.37	0.08	0.25, 1.09
Drivers speed on streets	0.96	0.22	0.84	0.62, 1.47	1.65	0.30	0.10	0.91, 2.99
Enough sidewalks on the streets in the neighbourhood	0.69	0.24	0.14	0.43, 1.12	0.60	0.32	0.11	0.32, 1.11
Walking trails in or near the neighbourhood	0.37	0.22	**<0.001**	0.24, 0.58	0.67	0.30	0.19	0.37, 1.22
Bicycle lanes or trails in or near the neighbourhood	0.78	0.21	0.24	0.52, 1.17	1.39	0.27	0.22	0.82, 2.36
Lots of trees	0.83	0.24	0.42	0.52, 1.31	0.75	0.32	0.36	0.40, 1.40
Social environment								
Feels unsafe because of crime	0.88	0.26	0.63	0.54, 1.46	0.89	0.36	0.75	0.44, 1.82
Unsafe for child to walk alone	0.91	0.23	0.68	0.58, 1.42	0.57	0.34	0.11	0.29, 1.12
Unsafe for child to walk with friends	1.72	0.28	0.06	0.98, 3.01	0.84	0.46	0.71	0.34, 2.08
Worried about child being alone because of strangers	1.01	0.21	0.95	0.67, 1.54	0.80	0.27	0.41	0.47, 1.36
Might get bullied/teased	0.66	0.28	0.13	0.38, 1.14	0.65	0.39	0.27	0.30, 1.39
No one to walk with	0.74	0.27	0.27	0.44, 1.26	1.34	0.34	0.40	0.68, 2.62
Know a lot of people	0.80	0.24	0.36	0.50, 1.29	0.53	0.30	**0.03**	0.29, 0.95
Individual/family preference								
Route is boring	0.38	0.52	0.06	0.14, 1.06	0.97	0.50	0.95	0.36, 2.57

Get too hot/sweaty	0.96	0.33	0.91	0.51, 1.82	0.86	0.48	0.76	0.33, 2.23
Not fun to walk	1.08	0.37	0.84	0.52, 2.24	1.89	0.48	0.18	0.74, 4.83
Too much stuff to carry	0.94	0.22	0.78	0.61, 1.46	0.77	0.33	0.43	0.40, 1.47
Easier to drive	0.89	0.22	0.58	0.58, 1.36	0.41	0.41	**0.03**	0.18, 0.92
Too young to walk/bike	1.08	0.27	0.76	0.64, 1.83	1.10	0.40	0.81	0.50, 2.39
No skills to bike	1.10	0.23	0.68	0.70, 1.73	0.66	0.36	0.25	0.33, 1.34

Notes: The reference category is "Dependent mobility"; Significant ($p < .05$) correlates are bolded; Control variables are age, number of motor vehicles, maximum parent education, sibling age, permission to walk, permission to bike, distance to school (km), population density, and industrial land use

Table 3.8: Multivariate logistic regression analysis to understand the impact perceived barriers and facilitators to AST have on boys' IM while controlling for socio-ecological framework variables

	Travel with peers				Travel alone			
Variable	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**
Intrapersonal								
Age	0.78	0.10	**0.02**	0.64, 0.96	0.99	0.11	0.93	0.81, 1.22
Interpersonal								
Number of motor vehicles	0.73	0.20	0.12	0.49, 1.08	0.82	0.21	0.36	0.54, 1.25
Max. parent education level (ref: Undergraduate college/university)								
High school or less	0.74	0.47	0.52	0.29, 1.85	0.77	0.52	0.62	0.28, 2.15
Graduate school	1.48	0.28	0.16	0.86, 2.54	1.57	0.32	0.16	0.84, 2.96
Sibling age (ref: single child)								
Younger sibling(s)	2.83	0.35	**<0.01**	1.43, 5.60	0.57	0.32	0.08	0.31, 1.08
Older/same age sibling(s)	2.43	0.37	**0.02**	1.18, 5.03	0.22	0.54	**0.01**	0.08, 0.65
Younger & older siblings	5.20	0.52	**<0.01**	1.85, 14.63	0.56	0.72	0.43	0.14, 2.33
Permission to walk (ref: no)	4.96	0.53	**<0.01**	1.75, 14.05	1.65	0.54	0.36	0.57, 4.76
Permission to bike (ref: no)	0.83	0.29	0.53	0.47, 1.47	1.13	0.33	0.71	0.59, 2.18
Physical environment								

Distance to school (km)	0.62	0.26	0.07	0.37, 1.04	0.68	0.29	0.18	0.39, 1.20
Population density	1.01	0.01	0.25	0.99, 1.04	1.03	0.01	**0.04**	1.00, 1.06
Industrial land use	1.00	0.02	0.87	0.96, 1.03	1.01	0.02	0.53	0.98, 1.05
Parental perceptions (ref: disagree)								
Too far/takes too much time	0.66	0.46	0.37	0.27, 1.64	0.27	0.57	**0.02**	0.09, 0.83
Route feels unsafe due to traffic	1.32	0.38	0.46	0.63, 2.78	1.60	0.36	0.20	0.78, 3.26
Too many busy streets to cross	0.85	0.36	0.65	0.42, 1.73	0.52	0.39	0.10	0.25, 1.12
Drivers speed on streets	0.99	0.29	0.98	0.56, 1.75	1.16	0.30	0.62	0.64, 2.09
Walking trails in or near the neighbourhood	0.86	0.28	0.60	0.50, 1.50	1.10	0.35	0.79	0.55, 2.18
Unsafe for child to walk with friends	1.01	0.38	0.99	0.47, 2.13	0.70	0.51	0.49	0.25, 1.93
Know a lot of people	0.61	0.29	0.09	0.35, 1.08	0.90	0.33	0.76	0.47, 1.74
Route is boring	1.54	0.51	0.40	0.57, 4.22	3.26	0.54	**0.03**	1.11, 9.55
Easier to drive	0.80	0.31	0.47	0.43, 1.47	0.80	0.38	0.57	0.38, 1.72
Too young to walk/bike	0.91	0.33	0.78	0.48, 1.75	0.48	0.44	0.10	0.20, 1.15

Notes: The reference category is “Dependent mobility”; Significant ($p < .05$) correlates are bolded

Table 3.9: Multivariate logistic regression analysis to understand the impact perceived barriers and facilitators to AST have on girls’ IM while controlling for socio-ecological framework variables

	Travel with peers				Travel alone			
Variable	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**	**Odds Ratio**	**Std. Error**	**P-Value**	**Confidence Interval**
Intrapersonal								
Age	0.86	0.09	0.08	0.73, 1.02	1.33	0.11	**0.01**	1.07, 1.66
Interpersonal								
Number of motor vehicles	0.84	0.18	0.33	0.59, 1.20	0.97	0.20	0.87	0.65, 1.44
Max. parent education level (ref: Undergraduate college/university)								

High school or less	0.40	0.43	**0.04**	0.17, 0.94	0.38	0.56	0.08	0.13, 1.14
Graduate school	0.77	0.23	0.25	0.49, 1.20	0.95	0.30	0.87	0.52, 1.73
Sibling age (ref: single child)								
Younger sibling(s)	1.62	0.26	0.07	0.96, 2.72	0.39	0.33	**<0.01**	0.21, 0.74
Older/same age sibling(s)	2.30	0.29	**<0.01**	1.30, 4.06	0.28	0.61	**0.04**	0.08, 0.95
Younger & older siblings	1.25	0.41	0.59	0.56, 2.80	0.13	1.17	0.09	0.01, 1.42
Permission to walk (ref: no)	3.13	0.44	**0.01**	1.31, 7.47	8.11	1.10	0.06	0.95, 69.67
Permission to bike (ref: no)	0.83	0.23	0.40	0.53, 1.29	1.22	0.33	0.55	0.64, 2.33
Physical environment								
Distance to school (km)	0.48	0.24	**<0.01**	0.30, 0.77	0.31	0.35	**<0.001**	0.16, 0.62
Population density	1.00	0.01	0.73	0.98, 1.03	1.01	0.02	0.72	0.98, 1.04
Industrial land use	0.96	0.02	**0.05**	0.93, 1.00	1.02	0.02	0.31	0.98, 1.06
Parental perceptions (ref: disagree)								
Too far/takes too much time	1.36	0.34	0.37	0.70, 2.64	1.73	0.52	0.29	0.62, 4.85
Route feels unsafe due to traffic	0.80	0.29	0.44	0.45, 1.42	0.52	0.38	0.09	0.24, 1.11
Too many busy streets to cross	0.75	0.31	0.35	0.41, 1.37	0.63	0.46	0.31	0.25, 1.56
Drivers speed on streets	0.91	0.25	0.69	0.56, 1.47	1.92	0.33	**0.05**	1.01, 3.66
Walking trails in or near the neighbourhood	0.37	0.25	**<0.001**	0.23, 0.61	0.72	0.31	0.29	0.39, 1.33
Unsafe for child to walk with friends	2.12	0.33	**0.02**	1.11, 4.04	0.91	0.51	0.85	0.33, 2.47
Know a lot of people	0.93	0.25	0.78	0.57, 1.53	0.52	0.32	**0.04**	0.27, 0.98
Route is boring	0.31	0.54	**0.03**	0.11, 0.91	0.88	0.54	0.81	0.30, 2.54
Easier to drive	0.86	0.25	0.54	0.53, 1.39	0.40	0.42	**0.03**	0.18, 0.90
Too young to walk/bike	0.98	0.32	0.96	0.52, 1.84	1.38	0.45	0.48	0.57, 3.36

Notes: The reference category is “Dependent mobility”; Significant ($p < .05$) correlates are bolded

3.5 Discussion

The aims of this study were to: (1) analyze how the intrapersonal, interpersonal and physical environment factors that influence children's IM differ by children's gender; and (2) controlling for those factors, investigate how parents' perceptions of barriers and facilitators to AST influence IM by gender. Among all variables, only permission to walk showed similar influences on increasing travel with peers for both boys and girls. All other variables had differing effects on IM between children's gender. Across almost all levels, more variables were statistically significant for girls' IM than boys.

A novel contribution of this paper is its consideration of IM both with peers, and alone. Parents' perceptions of barriers and facilitators to AST were found to vary in their influence on travel with peers versus travel alone between boys and girls. Each perception either significantly influenced travel with peers or alone, but no perceptions influenced both modes. As AST interventions seek to influence parental perceptions to foster positive behaviour change, insights into these differences provide a foundation for influencing children's IM. Travelling with peers can facilitate a transfer of pedestrian and spatial skills among children and be a solution to parents' fears about their child travelling alone (Crawford et al., 2017). Understanding correlates of travel with peers, and how they differ from those of travel alone, can provide an opportunity to reduce barriers to travel with peers as a starting point for IM. It is important to understand these factors as they differ between children's genders as there are differences in social activities and spaces between boys and girls. Although boys are granted IM earlier, girls are thought to attain similar levels of IM by travelling with peers (Brown, Mackett, Gong, Kitazawa, & Paskins, 2008). As such, the results of this study identify barriers to girls' travel with peers, providing starting point for interventions addressing inequitable AST and IM among children.

Age was a positively associated with girls' traveling alone; by contrast, it was negatively associated with boys traveling with peers. It is not surprising that age is associated with

IM, as children's maturity is related to parental expectations (Zebrowitz, Kendall-Tackett, & Fafel, 1991). Pertaining to IM, children with greater cognitive capacity are seen by parents as being better able to navigate their environment or advocate for their safety in the presence of strangers (Mammen, Faulkner, Buliung, & Lay, 2012; Mitra, 2013). In terms of gender, parents grant boys IM at an earlier age than girls, but differential rates of IM decrease as children get older (McDonald, 2012; Wolfe & McDonald, 2016). Since the sample consists of children under the age of 14, these findings coincide with the period of time in which differences in IM are prominent (Wolfe & McDonald, 2016). Since travelling with peers is the first step towards travelling alone (Brown et al., 2008), it is interesting that age is negatively associated with travel with peers for boys. These findings may suggest that, within the age group studied, a significant number of boys had already attained full IM privileges and therefore did not need to travel with peers to be independent. In comparison, older girls were gaining IM within this age group. Through the use of mapping exercises, research has noted that, compared to boys, girls' friends tend to be more scattered and spread out farther in their neighbourhood. As a result, girls' must travel farther distances to see their friends (Brown et al., 2008). Applied to the journey to/from school, girls' may be less likely to travel with friends, supporting the positive relationship between travel alone and age. Future research should consider using a wider age range consisting of younger children to further capture age-related and gendered trends in IM.

Sibling age was significant for both boys' and girls' IM but had different patterns among travel with peers and alone. For boys, having one or more siblings of any age were associated with a significant increase in travel with peers, and older/same age sibling(s) had a significant negative relationship with travel alone. Having one or more younger or older/same age siblings for girls was significant to decreased travel alone; however, only older/same age sibling(s) significantly increased travel with peers. Interestingly, younger sibling(s) and younger and older siblings did not predict an increase in IM for girls as they did for boys. Literature has mixed findings on the effect of siblings on IM, with some reporting significant relationships (Carver et al., 2014; Christian et al., 2016; Jones, Davis, & Eyers, 2000; Lin et al., 2017), and others not (Janssen et al., 2016; Riazi et al., 2019; Wolfe & McDonald, 2016). To explain the influence of siblings, it is posited that

older siblings increase parents' perceptions of safety by taking on a supervisory role for younger siblings (Jones et al., 2000; Lin et al., 2017). There are many differing methods used to account for siblings, such as measuring the number of siblings (Carver et al., 2014; Janssen et al., 2016), the presence of any siblings as a binary variable (Riazi et al., 2019), or the company of older siblings as a binary variable (Christian et al., 2016; Lin et al., 2017; Wolfe & McDonald, 2016). As there is large heterogeneity in the way studies measure siblings, it is difficult to fully understand these patterns and the gendered nature of sibling dynamics and IM. More research is needed to further understand the role of siblings in granting children IM.

Gender differences in IM among children are often reported as being a result of parental norms which depict girls as being more vulnerable and therefore in greater need of protection (Hart, 1979; Valentine, 1997). Examining parental perceptions associated with IM, provides support for the impact of gendered parental norms on children's IM. Norms are illustrated in perceptions of having walking trails in the neighbourhood, the journey being easier to drive, and distance between home and school and their resulting implications for IM between boys and girls.

Considering parental norms associated with children's gender and their resulting IM, it is interesting to note that perceptions of the neighbourhood having enough walking trails nearby were significant for girls, but not for boys. Contrary to existing IM literature (Evenson et al., 2006; Guliani, Mitra, Buliung, Larsen, & Faulkner, 2015), this study found that perceptions of the presence of walking trails were negatively associated with girls' travel with peers. Many of the trails in the region of study are more secluded when compared to sidewalks. Having passive surveillance in communities, or eyes on the street, contributes to parents' sense of safety and children's comfort when commuting independently (Holt, Lee, Millar, & Spence, 2015; Jacobs, 1961; Jamme, Bahl, & Banerjee, 2018). When such trails are secluded, a reduced sense of safety exists (Holt et al., 2015). Combined with more protective parental norms for girls (Hart, 1979; Valentine, 1997), walking trails hinder IM for girls. More research is needed examining children's IM development to understand why this perception is only related to girls' travel with peers.

It is not surprising that perceiving that driving is an easier mode of travel to/from school is negatively associated with IM, as this mode of travel is often tied to convivence and parental availability (Faulkner et al., 2010). It is novel to note the gendered nature of this trend, as parental perceptions of the journey being easier to drive were only negatively associated with girls' travel alone. Two sets of norms are thought to contribute to these findings. First, are those surrounding safety. As parental norms dictate that girls are more vulnerable in public spaces (Hart, 1979; Valentine, 1997), driving presents an option for parents to protect their daughters. Second, social norms around physical activity are thought to impact parents' perceptions of travel modes. Research has found that physical activity is often deemed to be a masculine endeavour (Whitehead & Biddle, 2008), with girls receiving less social support for physical activity behaviours than boys (Reimers, Schmidt, Demetriou, Marzi, & Woll, 2019). Since IM requires that girls partake in active modes of travel, it is novel to note the broader social norms influencing girls' IM.

Distance is consistently found to be an important predictor of IM (Larsen, Gilliland, & Hess, 2012; Marzi et al., 2018; Sharmin & Kamruzzaman, 2017; Wilson et al., 2018). The results of this study found that objectively measured distance had a significant negative relationship with girls travelling alone and with peers, but not boys. This finding is in agreement with the literature as it has found that girls have a smaller range for IM around the home than boys (Brown et al., 2008; Loebach & Gilliland, 2016a). However, parental perceptions of the journey between home and school being too far or taking too much time was significantly negatively associated with boys' travel alone. These findings are likely a reflection of more ambiguous IM boundaries in place for boys compared to girls (Valentine, 1997). Other measurement methods are needed to fully capture the gendered IM norms at play that incorporate the decision-making process of territorial ranges both as an objective distance and subjective boundary (Loebach & Gilliland, 2016b).

Unexpectedly, this study found that parental perceptions that the route is boring and that drivers speed on streets were positively associated with travel alone for boys and girls, respectively. As research has shown that IM is positively associated with children's spatial awareness (Rissotto & Tonucci, 2002), these findings are thought to be a result of

a heightened environmental attentiveness from engaging in IM. Spatial awareness associated with school travel has not shown to be significantly different between girls and boys (Ahmadi & Taniguchi, 2007). Therefore, it is interesting that the elements associated with awareness differ between boys and girls. As concerns regarding vulnerability and safety have been common themes underscoring girls' IM (Hart, 1979; Valentine, 1997), it is thought that these concepts may be present in how girls and their parents perceive their environments. More research is needed to confirm this interpretation and understand how gendered norms may be present within children and parents' spatial awareness.

There are complexities to parental perceptions of their child's gender and associated IM. Namely, girls are generally more mature than boys the same age (among 8 to 11 year old's), boys are perceived to be more impulsive, and parents may ignore gender stereotypes and consider their child's individual personality when making IM decisions (Valentine, 1997). Despite these views, this study provides evidence for more IM barriers for girls than boys. With the positive benefits of IM including greater physical activity and social connectedness (Prezza & Pacilli, 2007; Rissotto & Tonucci, 2002; Schoeppe et al., 2013), it is important to ensure that interventions targeting IM and are equitable to children of all genders.

3.5.1 Policy and Practice

Findings from this study highlight gender differences in correlates of IM for the school journey. Gender differences were noted in all categories: intrapersonal, interpersonal, physical environment levels, and parents' perceptions of barriers and facilitators to AST. This study supports previous research that identifies differences in IM by gender (Brown et al., 2008; Buliung et al., 2017; Ghekiere et al., 2017; Guliani et al., 2015; Riazi et al., 2019). More parents' perception measures were significantly associated with girls' IM than boys', reiterating the importance of understanding how parental, social, and gender norms influence IM decisions for children.

IM and AST have an important reciprocal relationship in which IM is a key component of participation in AST and AST is a foundational steppingstone for IM (Crawford et al.,

2017; Faulkner et al., 2010; Mitra, 2013). Interventions promoting AST have been shown to be effective at increasing overall rates of active modes of travel (Larouche, Mammen, Rowe, & Faulkner, 2018); however, they have also been shown to have stronger effects for boys than girls (Hollein et al., 2017; Lambe, Murphy, & Bauman, 2017). It is important to address gender disparities in children's ability to travel independently to ensure that children are able to participate in AST and address disparities in such interventions. Identifying modifiable correlates of IM by gender, such as parents' perceptions, enables practitioners to better target their interventions to address such factors and target IM. Positioning these correlates within the socio-ecological model provides insight into gender differences at all levels and can inform multicomponent intervention strategies (Sallis et al., 2006), with the aim of making access to such interventions equitable for children of all genders.

3.6 Strengths, Limitations, and Future Directions

This study provides insight into differences between boys' and girls' IM and contributes to the growing body of literature on IM. The strengths of this study include its large sample size and its novel classification of IM, differentiating between independent travel with peers and alone. This study provides a new approach to capturing the multifaceted nature of IM, understanding that different barriers and facilitators exist to travel with peers compared to travel alone. Another strength of our study is the classification of siblings by age relationships. Such methods enable greater exploration into children's relationships with peers as supervisory or supervised and provide further insight into gender dynamics and IM.

A limitation of this study is the lack of consideration of ethnicity. The language that is spoken at home, a proxy measure for ethnicity, is correlated to IM (Riazi et al., 2019). Future studies should include measures of ethnicity to provide further understanding as to how cultural norms influence IM by gender. Another limitation of this study is the use of self-reported measures of IM and inability to verify. Using supplementary objective measures such as GPS logging would be beneficial to avoid bias. Finally, although many relevant confounding variables were included in analysis, due to the correlational nature of this study, conclusions cannot be drawn about causation.

Future research should include qualitative methods to further understand the trends identified from this study, as well as the norms and expectations associated with them. Using methods and populations that capture experiences of non-binary children are also pertinent to increasing equity in IM. Children's perspectives are known to vary from those of their parents and have a role in parents' decision-making (Crawford et al., 2017; Wilson et al., 2018). Future research should seek to capture children's perceptions to understand their experiences and perceptions of IM and related self-efficacy.

3.7 Conclusions

This study makes multiple contributions to IM literature. First, novel approaches are used to classify siblings and IM. These methods enable greater exploration into the role that siblings and friends make in IM. Second, this study finds significant differences in IM between boys and girls. These differences occur among all levels of behavioural influence, both objective and perceived. Our findings suggest that interventions addressing IM should focus on parental norms of safety, especially for girls.

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Chapter 4

4 Synthesis and Conclusions

4.1 Summary of Studies

This thesis explores equity considerations related to active school travel (AST) interventions and independent mobility (IM). Chapter 2 presents a systematic review exploring how equity has been considered in previous AST intervention research. Chapter 3 offers a quantitative analysis examining differences in correlates of IM by children's gender. Findings from the systematic review identify that little is currently being done to address equity issues in AST, highlighting the need for further research to understand the gendered nature of children's AST. Building upon current AST knowledge gleaned from the review, this thesis sought to provide insights for improving AST interventions, by making them more accessible and effective at increasing rates of AST for all children.

The first study (Chapter 2) systematically reviews peer-reviewed publications studying AST interventions and examines how equity is considered in these studies. The study focused on multiple equity considerations, namely children's gender, socioeconomic status (SES), ethnic background (i.e. minoritized populations based on race/ethnicity, language and migrant status [Chappell & Cahnmann-Taylor, 2013; DeFinney, Dean, Loiselle, & Saraceno, 2011; Harley, Jolivette, McCormick, & Tice, 2002]), and place (i.e. urban, suburban, and/or rural environmental contexts). This chapter identifies how equity was considered and reported in AST intervention research across the globe. Six electronic databases were systematically searched for articles published between 2010 and 2019. From an initial 15,182 records identified, 69 papers were included in the final analysis.

Results from the review showed that gender and SES were the equity factors most often reported in intervention papers. In terms of gender, most articles found that boys increased their AST more than girls after an intervention. Multiple papers mentioning SES agreed that lower SES schools had the highest rates of AST engagement at baseline, compared to middle and high SES groups (Hinckson & Badland, 2016; Mammen, Stone,

Buliung, & Faulkner, 2014; McDonald et al., 2014; Stewart, Moudon, & Claybrooke, 2014). Low SES communities also faced greater challenges in implementing AST interventions and accessing resources (e.g. bicycles) (Collins & Kearns, 2010; Ederer et al., 2016). Little is known about AST intervention efficacy for minoritized populations as ethnic background was least often considered. In terms of place, populations in rural environments had the lowest rates of AST, noting lack of pedestrian infrastructure as a hinderance (Ji, Ye, Lu, Li, & Gao, 2017; Mammen et al., 2014). Overall, Chapter 2 highlights a lack of equity considerations in peer-reviewed articles examining AST interventions. To address disparities in AST interventions, it is recommended that practitioners include intervention components that specifically target barriers to AST faced by population subgroups.

Chapter 3 presents a quantitative analysis of children's gender and IM on the journey to/from school. In considering children's AST, travel decisions are often influenced by two interrelated decisions: (1) whether children can travel independently and (2) travel mode. IM provides a key foundation for AST as enabling children to travel to school independently can overcome barriers related to parental availability, influencing mode choice (Faulkner, Richichi, Buliung, Fusco, & Moola, 2010). As different social norms are surrounding each decision, focussing on IM allows for more tailored intervention strategies. Gender was specifically chosen as a focus for this study for several empirical and practical reasons. First, Chapter 2 identified that children's gender was strongly associated with their AST outcomes; however, interventions addressing gender disparities were unsuccessful at increasing AST among girls. Second, there are reliable, non-invasive, and agreed-upon measures of children's gender available to practitioners and researchers. Finally, gender tends to be more evenly divided within a school population compared to SES, ethnic background, or place (Love, Adams, & van Sluijs, 2017).

Using a sample of 1094 parent and child surveys for boys (n=476) and girls (n=618), Chapter 3 explored how barriers and facilitators of children's AST influence their IM comparing gender. More specifically, intrapersonal, interpersonal, and physical environment correlates of IM and parents' perceptions of barriers and facilitators to AST

were examined by children's gender to identify differences in IM. IM was classified into one of three categories based on level of independence: (1) dependent mobility (travel with a parent or other adult), (2) travel with peers, or (3) travel alone.

For boys, age was negatively associated with travel with peers. Having siblings of any age (i.e. younger, older/same age, or younger and older) was positively related to travel with peers, while boys with older/same age siblings were less likely to travel alone. Permission to walk was positively associated with travel with peers and population density was positively associated with travel alone. Parental perceptions that the journey is too far/takes too much time had a negative association with travel alone, while perceptions that the route is boring was positively associated with boys' travel alone.

For girls, age was positively associated with travel alone. Parents' maximum education level of high school or less was negatively associated with travel with peers. Compared to girls that did not have siblings attending the school, girls that had a younger or older/same age sibling attending the school were significantly less likely to travel alone whereas those with an older/same age sibling were significantly more likely to travel with peers. Permission to walk was positively associated with travel with peers. Within the built environment, distance was negatively associated with both girls' travel with peers and alone, whereas industrial land use was negatively associated with travel with peers. Parents' perceptions that were enough walking trails nearby and that the route is boring were negatively associated with travel with peers. Perceiving that it is unsafe to walk with friends was positively associated with travel with peers. Knowing people in the neighbourhood and believing that the journey is easier to drive were negatively associated with girls' travel alone. Meanwhile, perceptions that drivers speed on streets was positively associated with travel alone.

The results of Chapter 3 illustrate the ways in which barriers and facilitators to IM differ between boys and girls. Across almost all levels of influence, girls had more factors reducing travel with peers or alone, compared to boys. These results are supported by gendered parental norms which depict girls as vulnerable and in need of protection (Hart, 1979; Valentine, 1997). AST intervention components should be included specifically

targeting barriers to girls' IM to provide them with greater benefits and make AST interventions more equitable. Identifying differences in IM decision making enables intervention practitioners to address barriers to IM and further engage girls in AST interventions.

4.2 Research Contributions

Research has noted a lack of equity considerations in AST interventions (Buttazzoni, Van Kesteren, Shah, & Gilliland, 2018). In their most recent report card on children's physical activity levels, ParticipACTION (2020) has recommended that interventions targeting children's physical activity, such as those focusing on AST, should work to address inequities. Both Chapters 2 and 3 of this thesis contribute to the growing body of literature on equity in children's health behaviours and respond to these identified needs. Contributions to the literature on children's environments are made by providing an understanding of the environmental influences of AST. Identifying how children experience their environments differently based on specific factors (e.g. gender, SES, etc.) provides further understanding of the connection between the environment and children's behaviour.

Chapter 2 identified how equity was considered in AST interventions. While it attempted to catalogue a range of intervention strategies addressing equity, instead it found that many interventions were not considering equity. A clear need for equity considerations is illustrated by the lack of strategies identified. Chapter 2 noted different barriers facing communities of differing SES. These findings draw attention to the varying goals of AST interventions: ensuring safe facilities of AST versus increasing AST participation. Both of these goals are crucial to children's wellbeing, but they vary based on the community in which the AST intervention takes place. Further underscoring the context-specific nature of AST interventions is the finding that ethnicity and place are considered least often. A need for consideration of the environment and social contexts of AST is noted for future interventions and related research.

Chapter 3 further examines the correlates of children's IM based on their gender. Following unsuccessful intervention attempts to address gender disparities, as noted in

Chapter 2, this paper contributes to research on equity and AST by providing insights on which future AST interventions can be developed. Using a feminist perspective provided a novel way with which to examine these findings. Feminist theories of gender as difference highlighted variances in the ways that environments are experienced based on individuals' gender. Using this approach enabled the examination of differences in IM between boys and girls. These findings reinforce social norms that depict girls as more vulnerable in public spaces and thus hinder girls' participation in AST (Hart, 1979; Valentine, 1997). Addressing barriers to girls' IM specifically enables interventions to provide girls with greater benefits and reduce inequities (Tugwell, de Savigny, Hawker, & Robinson, 2006; White, Adams, & Heywood, 2009). Overall, this chapter provides valuable insights into gender disparities and identifies areas for future AST intervention strategies and research.

Both studies in this thesis utilize the socio-ecological model. Chapter 2 recommends this framework as a foundation for AST interventions, while Chapter 3 utilizes it as a framework for analysis. This framework provides an important foundation for AST interventions and research as it helps understand how factors at intrapersonal, interpersonal, environmental, and policy realms influence AST behaviour (Sallis et al., 2006; Sallis, Owen, & Fisher, 2008). Sallis et al. (2006) describe a process for using the socio-ecological model in research in which the first step is to identify correlates of behaviour at all levels of the model. The second and more challenging step in their process is for research to consider the interactions of factors across levels and their resulting influence on behaviour. As used in this thesis, the socio-ecological model allowed for exploration into interaction across levels by disaggregating analysis by children's gender. Such examination enabled further understanding of children's AST behaviours.

4.3 Methodological Contributions

The distinction in IM between travel with peers and travel alone used in Chapter 3 is novel to IM research, and to this author's knowledge, this is the first study on IM to use this classification. It is important to understand differences in IM attainment between travel with peers and alone as travelling with peers is the first step toward children's

ability to travel alone (Crawford et al., 2017). Often, parents perceive greater safety for their child when with peers compared to alone (Witten, Kearns, Carroll, Asiasiga, & Tava'e, 2013). Travel with peers has also been noted as an opportunity for children to develop skills related to IM as children with greater independence or knowledge of the neighbourhood can transfer such proficiencies to their peers (Crawford et al., 2017). Pertaining to children's gender, girls are more likely to attain IM by travelling with peers (Brown, Mackett, Gong, Kitazawa, & Paskins, 2008). These factors identify some of the ways in which travel with peers is the first step towards travelling alone. It is important to capture the differing correlates of travel with peers compared to alone to further understand barriers and facilitators for IM and the development of IM in children.

4.4 Limitations

There are several limitations in the research presented in this thesis that should be considered. The review presented in Chapter 2 focuses specifically on peer-reviewed publications. In limiting the types of articles reviewed, equity considerations captured elsewhere in the intervention process may have been missed. Furthermore, it is likely that a large portion of AST interventions are never formally evaluated and not all evaluation results made publicly accessible in articles and reports. Therefore, a potentially fruitful area of future research would be to review the AST intervention action plans of different organizations who undertake the interventions (i.e., schools, school boards, community organizations) to determine how equity considerations are built into the action plans.

A limitation of Chapter 3 is its lack of consideration of child perspectives. Children experience their environments differently than adults and have different barriers and facilitators to AST and IM (Wilson, Clark, & Gilliland, 2018). Children also have some ability for negotiation in deciding their IM boundaries (Crawford et al., 2017). To further understand how AST and IM decisions are made, future research should seek to better understand the influence of children's perceptions and behaviours on those of their parents. Nevertheless, as parent perceptions have been reported to be more significant to AST behaviours than those of children (Wilson et al., 2018), using only parental data is considered appropriate for answering the research questions posed in this study.

A noted limitation of most AST studies, including those reported in the articles reviewed in Chapter 2, and the methods used in Chapter 3, is the correlational nature of the relationships identified. To address this limitation, many relevant non-confounders were included in Chapter 3. An avenue for future AST research would be to use qualitative research methods to enable further understanding of the structures and norms influencing behaviour (Morse & Field, 1996). Applied to Chapter 2, it could help provide a deeper understanding of the equity considerations made in AST interventions and the role that the environmental and social contexts play in shaping children's AST outcomes. It could also provide an understanding of the variations in equity characteristics across counties. To answer the research questions posed in Chapter 3, qualitative research methods could also be used to help provide a further understanding of the IM decision-making process within families and parental and social norms underscoring those decisions. Qualitative research could also help provide further insights into differences between boys and girls and the norms and perceptions affecting those behaviours.

4.5 Implications for Policy and Practice

AST provides an opportunity for children to increase their physical activity, addressing a key public health concern (ParticipACTION, 2020). Furthermore, engagement in AST provides benefits for children's mental health (Ramanathan, O'Brien, Faulkner, & Stone, 2013), academic achievement (Martínez-Gómez, Ruiz, & Gómez-Martínez, 2011), and the environment (Adams & Requia, 2017; Gilliland et al., 2019). Fostering positive AST habits in childhood helps to support long-term engagement in physical activity (Telama, 2009). With the numerous benefits associated with AST, practitioners and policymakers should continue to work to address low rates of AST in children. This thesis has numerous findings pertaining to AST intervention practice and policies to make them more equitable among children.

Children's AST decisions and resulting behaviours are complex and influenced by a myriad of factors. Current AST interventions attempting to address such influences are often founded in the socio-ecological model (Buttazzoni et al., 2018). These interventions address factors correlated with AST at each level of the model; however, they have had little impact on changing AST behaviour (Buttazzoni, Clark, Seabrook, & Gilliland,

2019; Larouche, Mammen, Rowe, & Faulkner, 2018). Moving beyond examining factors at each level of influence identified by the socio-ecological model, this thesis explores how these levels interact by analysing differing factors at each level by children's gender. Specifically, findings from Chapter 3 highlight different factors based on children's gender. These findings can be used to develop and target interventions towards addressing barriers to IM faced by girls and reduce inequities in children's IM and AST. Addressing interactions among factors requires combining concepts and methods from multiple disciplines (Sallis et al., 2006). Practitioners should consider taking a multidisciplinary approach to implement these findings and address children's travel behaviours. For example, interventions could include combined efforts from policy, engineering, public health, and education officials.

In Canada, the leading AST intervention is School Travel Planning. This project aims to increase overall engagement in AST (Green Communities Canada, 2018). School Travel Planning utilizes a general multicomponent intervention framework to address barriers to AST and create a supportive travel culture (Green Communities Canada, 2018). A local evaluation found that children's use of AST was not significantly higher after a School Travel Planning intervention was implemented (Buttazzoni et al., 2019). AST intervention practitioners should further consider the role of IM in children's AST. Future interventions should address barriers to IM identified in Chapter 3 to ensure that children have the foundation necessary to engage in AST.

Moving beyond equity within AST interventions, equity among AST interventions should also be considered. As was identified in Chapter 2, interventions should not attempt to increase rates of AST without ensuring that the community has the proper infrastructure needed to engage in AST safely. For example, children of low SES households are most likely to use AST (Rothman, Macpherson, Ross, & Buliung, 2018); however, in low SES communities, unsafe traffic environments contribute to disproportionately higher rates of child pedestrian motor vehicle collisions (Rothman, Cloutier, et al., 2019; Rothman, Macarthur, Wilton, Howard, & Macpherson, 2019). In these contexts, goals of increasing rates of AST are unwarranted and dangerous. These findings suggest that both children's AST participation and the environment must be

taken into consideration when initiating and developing an AST intervention. Interventions should develop broader goals to ensure that children have safe environments conducive to AST participation.

Practitioners and policymakers responsible for the allocation of funding and resources for AST interventions need to ensure that they consider more than AST engagement when making such decisions. As previously mentioned, AST goals should expand their focus to include addressing the broader environment in which AST takes place. Decisions regarding funding and resources for interventions should be made with an understanding that both factors influencing children's AST engagement and their environment should be considered within the intervention. Allocation of resources should also be matched to the needs of the school community. As noted in Chapter 2, schools of lower SES typically have a harder time accessing intervention support and resources (Collins & Kearns, 2010; Ederer et al., 2016). Providing more funding and support to AST projects in these schools can help to ensure that AST behaviours are being addressed equitably within the larger community.

Planning, school board, and policy officials should consider pedestrian infrastructure around schools. Ensuring that pedestrian infrastructure, such as sidewalks and pedestrian crossovers, are already in place or are being built to connect the school to existing routes allows for environments that are conducive to AST (Ikeda et al., 2018). Such environments lend themselves to intervention methods that have shown success at increasing rates of AST but require pedestrian infrastructure already be in place, such as walking school busses, an organized system of adult chaperones walking with children to/from school (Mendoza, Levinger, & Johnston, 2009; Smith et al., 2015). Pedestrian infrastructure also increases parents perceptions of safety (Nevelsteen, Steenberghen, Van Rompaey, & Uyttersprot, 2012). Rural communities are less likely to engage in AST as routes often lack pedestrian infrastructure and are deemed unsafe (Ji et al., 2017; Mammen et al., 2014). Ensuring that there are facilities for children to walk or bike to school can aid in reducing disparities in AST in these neighbourhoods. Furthermore, increasing safety can overcome disparities in AST participation based on children's gender (Valentine, 1997) or ethnic background (Karsten, 2015).

4.6 Recommendations for Future Research

To further understand how AST interventions address equity concerns within the population, it is suggested that the intervention action plans and methodologies of various community organizations are reviewed and evaluated. Such documents may contain more information about equity considerations made in the intervention than the published peer-reviewed articles or other evaluation reports. These documents may provide greater insights into the strategies that groups used to address equity.

Evaluations of AST interventions should also be undertaken with the aim of identifying which intervention components are most effective, for which populations, and in which contexts. Knowing which intervention components and strategies are most successful at achieving intervention goals will help practitioners increase efficiency, reduce resources needed, and streamline projects. Identifying outcomes of these strategies for different population subgroups enables understanding of interventions that can be used effectively to target populations with lower rates of AST. This information can be used to increase equity in AST interventions.

Since strong evidence exists as to correlates of children's AST among all levels of the socio-ecological model, it is suggested that future research focus less attention on identifying these correlates. Rather, interactions among levels of behavioural influence should be examined to provide further understanding as to how influences combine to shape behaviour (Sallis et al., 2006). As interventions founded in the socio-ecological model have had little effect on changing behaviour (Buttazzoni et al., 2019), understanding interactions may provide more effective intervention strategies. Research should also examine the use of other theories, such as the theory of planned behaviour, to understand and influence travel modes (Murtagh, Rowe, Elliott, McMinn, & Nelson, 2012). Evaluations of AST interventions should consider the role that the theoretical framework has on intervention outcomes and efficacy.

Future research should be undertaken using qualitative methods to provide further context to the findings of Chapters 2 and 3. Research with AST intervention facilitators and stakeholders is important to understand how environmental and social contexts

influence AST interventions. Using qualitative methods to engage parents and other community members can provide further insights into the barriers and facilitators faced by people of different gender, SES, ethnic background, and place. Such research can provide a further understanding of the norms experienced by the population and resulting AST behaviours.

Finally, future research should be undertaken with children. Children and parents have different perceptions of and interactions with their environment (Wilson et al., 2018). Moreover, IM boundaries are often renegotiated within families with input from children and parents (Crawford et al., 2017). While literature suggests that parents have a greater influence on children's AST and IM (Faulkner et al., 2010; Wilson et al., 2018), it is important to understand the role that children play in decisions governing AST to understand how to best align intervention strategies to influence family travel decisions.

4.7 Conclusions

Engaging children in AST presents a solution to the current public health concern of physical inactivity. To ensure that all children can benefit from interventions addressing AST, it is important to develop and implement equitable strategies within the population. The overarching purpose of this thesis is to identify intervention strategies to address equity in AST interventions. Findings from Chapter 2 suggest that equity considerations are seldomly reported in current evaluations of AST interventions. While gender and SES are more often reported, place and ethnicity are the least often included in studies of AST interventions. Lack of conclusive strategies addressing equity identifies a need to further understand differences in AST among subgroups of the population. Focusing on gender and children's IM specifically, Chapter 3 finds that barriers and facilitators of IM vary based on children's gender. Specifically, more intrapersonal, interpersonal, and physical environment factors and parental perceptions hindering girls' IM than boys' which maybe a key factor to reduced rates of AST and IM among girls. These results can be used to inform new strategies addressing girls' IM specifically to improve equity in AST. These findings have significant implications for researchers, policymakers, intervention practitioners, school staff, and children.

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Appendices

Appendix A: Data Extraction Table

Author Names and Year	All names and year published
Title of Study	Full Title
Data Extractor (initials)	
Title/Abstract: is sex/gender mentioned in the title or abstract? (Y/N)	Any mention of boys / girls / male / female / gender / sex / etc. will be given a YES
Title/Abstract: Copy text about sex/gender	Direct quote will be copy and pasted into this column
Title/Abstract: is ethnicity/'race'/ linguistic / immigrant communities mentioned in the title or abstract? (Y/N)	Any mention of specific ethnicity / race / language groups will be given a YES. Also, new immigrants and migrant communities would fit here.
Title/Abstract: Copy text about ethnicity/'race'/ linguistic / immigrant communities	Direct quote will be copy and pasted into this column
Title/Abstract: is SES mentioned in the title or abstract? (Y/N)	Mention of general SES (given as an index or even vague reference to high/low SES), Income, parental education / occupation, neighbourhood type related to income / SES (i.e., inner city neighbourhood)
Title/Abstract: Copy text about SES	Direct quote will be copy and pasted into this column
Title/Abstract: is place (focus on a type of place or place based differences, like rural/remote/urban/suburban) mentioned in the title or abstract? (Y/N)	Mention of different types of environments and places (e.g., Urban, Rural, Remote, Suburban). There also might be more specific place-based descriptions, like inner-City that should be included. May also focus on different types of environment within a group (e.g., low walkability urban vs high walkability urban; big city urban vs. small city urban. Think context of the place not location; Context = suburban low income neighbourhood; Location = Dallas, TX
Title/Abstract: Copy text about place (focus on a type of place or place based differences, like rural/remote/urban/suburban)	Direct quote will be copy and pasted into this column

Introduction: was sex/gender discussed in the introduction as being relevant to effectiveness or outcomes?	Any mention of boys / girls / male / female / gender / sex / etc. will be given a YES
Introduction: copy text mentioning sex/gender	Direct quote will be copy and pasted into this column
Introduction: was ethnicity/'race'/ linguistic / immigrant communities discussed in the introduction as being relevant to effectiveness or outcomes?	Any mention of specific ethnicity / race / language groups will be given a YES. Also, new immigrants and migrant communities would fit here.
Introduction: copy text mentioning ethnicity/'race'/ linguistic / immigrant communities	Direct quote will be copy and pasted into this column
Introduction: was SES discussed in the introduction as being relevant to effectiveness or outcomes?	Mention of general SES (given as an index or even vague reference to high/low SES), Income, parental education / occupation, neighbourhood type related to income / SES (i.e., inner city neighbourhood)
Introduction: copy text mentioning SES	Direct quote will be copy and pasted into this column
Introduction: was place (focus on a type of place or place based differences, like rural/remote/urban/suburban) discussed in the introduction as being relevant to effectiveness or outcomes?	Mention of different types of environments and places (e.g., Urban, Rural, Remote, Suburban). There also might be more specific place-based descriptions, like inner-City that should be included. May also focus on different types of environment within a group (e.g., low walkability urban vs high walkability urban; big city urban vs. small city urban. Think context of the place not location; Context = suburban low income neighbourhood; Location = Dallas, TX
Introduction: copy text mentioning place (focus on a type of place or place based differences, like rural/remote/urban/suburban)	Direct quote will be copy and pasted into this column
Theory: what theory (usually in the study design or abstract) formed the author's orientation for the study in relation to equity? indicate 'not reported' if no theory was considered.	e.g. Social-Cognitive Behavior applied to gender
Theory: Direst Quotes from text	Direct quote will be copy and pasted into this column

Study design?	What type of study design was used for this paper? Cross-sectional, Pre-post with control, Random Control Trial, Quasi Experimental, etc.
STUDY LOCATION CITY/COUNTRY	If multiple sites, list all
Methods: did the authors report how sex/gender were considered?	Any mention of boys / girls / male / female / gender / sex / etc. will be given a YES
Methods: copy text about sex/gender	Direct quote will be copy and pasted into this column
Methods: did the authors report how ethnicity/'race'/ linguistic / immigrant communities were considered?	Any mention of specific ethnicity / race / language groups will be given a YES. Also, new immigrants and migrant communities would fit here.
Methods: copy text about ethnicity/'race'/ linguistic / immigrant communities	Direct quote will be copy and pasted into this column
Methods: did the authors report how SES were considered?	Mention of general SES (given as an index or even vague reference to high/low SES), Income, parental education / occupation, neighbourhood type related to income / SES (i.e., inner city neighbourhood)
Methods: copy text about SES	Direct quote will be copy and pasted into this column
Methods: did the authors report how place (focus on a type of place or place based differences, like rural/remote/urban/suburban) were considered?	Mention of different types of environments and places (e.g., Urban, Rural, Remote, Suburban). There also might be more specific place-based descriptions, like inner-City that should be included. May also focus on different types of environment within a group (e.g., low walkability urban vs high walkability urban; big city urban vs. small city urban. Think context of the place not location; Context = suburban low income neighbourhood; Location = Dallas, TX
Methods: copy text about place (focus on a type of place or place based differences, like rural/remote/urban/suburban)	Direct quote will be copy and pasted into this column
Primary outcome: does STUDY describe primary outcome [Y/N]	**Yes or No** [If yes: Direct quote will be copy and pasted into this column]
Primary outcome: list primary outcome if specified. If not, list all outcomes.	In models, they should define the dependent variable (i.e., Active travel behavior; safety literacy; use of

Note: Only school-based active travel related variables are to be included.	intervention). Primary outcome will be addressing the objectives/research questions.
Other outcomes. Note: Only school-based active travel related variables are to be included.	Secondary variables clearly stating that they are the secondary one.
Recruitment methods, are they described for schools and/or children? Specify for each (Y / N)	Recruitment of schools and recruitment of children can both be included here. Specify which was recorded; For example: Y (school) N (Children)
Recruitment methods: paste description	Direct quote will be copy and pasted into this column
Sample Size: Number of children/participants in the study	Total sample size in the study.
Number of groups / schools in the study (if applicable)	
Population (how was population defined?)	General characteristics of the target population (e.g., elementary school children; 4th graders in low-income schools; 10 to 14 year old girls)
Is study: 1) targeted to disadvantaged populations; 2) universal (aimed at everyone)?	1 or 2
Is population defined as disadvantaged or vulnerable across PROGRESS+? [Y/N]	http://methods.cochrane.org/equity/projects/evidence-equity/progress-plus
Additional information about the population	Anything else not already covered by the above. For example, if they focused on children with disabilities, other vulnerable groups, please specify here.
Population: was population reported according to sex/gender (Y/N)?	Any mention of boys / girls / male / female / gender / sex / etc. will be given a YES
Population: how was population described by sex/gender? Written Description Only	Direct quote will be copy and pasted directly **FROM TEXT (not tables)** into this column
Population: how was populations described by sex/gender? description	Table # + Variable names (do not include data values) if presented in table
Population: was population reported according to ethnicity/'race'/ linguistic / immigrant communities (Y/N)?	Any mention of specific ethnicity / race / language groups will be given a YES. Also, new immigrants and migrant communities would fit here.

Population: how was population described by ethnicity/'race'/ linguistic / immigrant communities? Written Description Only	Direct quote will be copy and pasted directly **FROM TEXT (not tables)** into this column
copy text on ethnicity/'race'/ linguistic / immigrant communities description (if not available write "nr or tabulated form) & (Table # + Variable names (do not include data values) if presented in table)	Table # + Variable names (do not include data values) if presented in table
Population: was population reported according to SES (Y/N)?	Mention of general SES (given as an index or even vague reference to high/low SES), Income, parental education / occupation, neighbourhood type related to income / SES (i.e., inner city neighbourhood)
Population: how was population described by SES? Written Description Only	Direct quote will be copy and pasted directly **FROM TEXT (not tables)** into this column
copy text on SES description (if not available write "nr or tabulated form) & (Table # + Variable names (do not include data values) if presented in table)	Table # + Variable names (do not include data values) if presented in table
Population: was population reported according to place (focus on a type of place or place based differences, like rural/remote/urban/suburban) (Y/N)?	Mention of different types of environments and places (e.g., Urban, Rural, Remote, Suburban). There also might be more specific place-based descriptions, like inner-City that should be included. May also focus on different types of environment within a group (e.g., low walkability urban vs high walkability urban; big city urban vs. small city urban. Think context of the place not location; Context = suburban low income neighbourhood; Location = Dallas, TX
Population: how was population described by place (focus on a type of place or place based differences, like rural/remote/urban/suburban)Written Description Only	Direct quote will be copy and pasted directly **FROM TEXT (not tables)** into this column
copy text on place (focus on a type of place or place based differences, like rural/remote/urban/suburban)descriptio n (if not available write "nr or tabulated form) & (Table # + Variable names (do	Table # + Variable names (do not include data values) if presented in table

not include data values) if presented in table)	
Results: was data disaggregated by sex/gender?	Any mention of boys / girls / male / female / gender / sex / etc. will be given a YES
Results: copy text about sex/gender analysis	Direct quote will be copy and pasted into this column
Results: was data disaggregated by ethnicity/'race'/ linguistic / immigrant communities?	Any mention of specific ethnicity / race / language groups will be given a YES. Also, new immigrants and migrant communities would fit here.
Results: copy text about ethnicity/'race'/ linguistic / immigrant communities analysis	Direct quote will be copy and pasted into this column
Results: was data disaggregated by SES?	Mention of general SES (given as an index or even vague reference to high/low SES), Income, parental education / occupation, neighbourhood type related to income / SES (i.e., inner city neighbourhood)
Results: copy text about SES analysis	Direct quote will be copy and pasted into this column
Results: was data disaggregated by place (focus on a type of place or place based differences, like rural/remote/urban/suburban)?	Mention of different types of environments and places (e.g., Urban, Rural, Remote, Suburban). There also might be more specific place-based descriptions, like inner-City that should be included. May also focus on different types of environment within a group (e.g., low walkability urban vs high walkability urban; big city urban vs. small city urban. Think context of the place not location; Context = suburban low income neighbourhood; Location = Dallas, TX
Results: copy text about place (focus on a type of place or place based differences, like rural/remote/urban/suburban) analysis	Direct quote will be copy and pasted into this column
Primary outcome: does STUDY describe primary outcome [Y/N]	**Yes or No** [If yes: Direct quote will be copy and pasted into this column]
Primary outcome: list results relating to primary outcome if specified. Note: Only school-based active travel related variables are to be included.	State results related to objectives/research questions

List results related to other outcomes. Note: Only school-based active travel related variables are to be included.	State results related to secondary objectives
Sub-group analysis justification: was there a justification (e.g. based on a theory or previous finding) for sub-group analysis?	Sub-group
Sub-group analysis justification: copy text	Direct quote will be copy and pasted into this column
Was a sub-group analysis or a meta regression or any sort of modelling approach carried out based on sex/gender?	Any mention of boys / girls / male / female / gender / sex / etc. will be given a YES
Sub-group analysis: copy text about sex/gender	Direct quote will be copy and pasted into this column
Was a sub-group analysis or a meta regression or any sort of modelling approach carried out based on ethnicity/'race'/ linguistic / immigrant communities?	Any mention of specific ethnicity / race / language groups will be given a YES. Also, new immigrants and migrant communities would fit here.
Sub-group analysis: copy text about ethnicity/'race'/ linguistic / immigrant communities	Direct quote will be copy and pasted into this column
Was a sub-group analysis or a meta regression or any sort of modelling approach carried out based on SES?	Mention of general SES (given as an index or even vague reference to high/low SES), Income, parental education / occupation, neighbourhood type related to income / SES (i.e., inner city neighbourhood)
Sub-group analysis: copy text about SES	Direct quote will be copy and pasted into this column
Was a sub-group analysis or a meta regression or any sort of modelling approach carried out based on place (focus on a type of place or place based differences, like rural/remote/urban/suburban)?	Mention of different types of environments and places (e.g., Urban, Rural, Remote, Suburban). There also might be more specific place-based descriptions, like inner-City that should be included. May also focus on different types of environment within a group (e.g., low walkability urban vs high walkability urban; big city urban vs. small city urban. Think context of the place not location; Context = suburban low income neighbourhood; Location = Dallas, TX

Sub-group analysis: copy text about place (focus on a type of place or place based differences, like rural/remote/urban/suburban)	Direct quote will be copy and pasted into this column
DISCUSSION: Did the authors discuss the implications or applicability or generalizability of sex/gender analyses or whether lack of these analyses could have affected the results?	For example: IF a study does not disaggregate the data by sex gender, do they acknowledge that the findings may be limited. Do they suggest this kind of analysis needs to take place in the future?
Discussion: Copy Text about sex/gender	Direct quote will be copy and pasted into this column
DISCUSSION: Did the authors discuss the implications or applicability or generalizability of ethnicity/'race'/ linguistic / immigrant communities analyses or whether lack of these analyses could have affected the results?	Any mention of specific ethnicity / race / language groups will be given a YES. Also, new immigrants and migrant communities would fit here.
Discussion: Copy Text about ethnicity/'race'/ linguistic / immigrant communities	Direct quote will be copy and pasted into this column
DISCUSSION: Did the authors discuss the implications or applicability or generalizability of SES analyses or whether lack of these analyses could have affected the results?	Mention of general SES (given as an index or even vague reference to high/low SES), Income, parental education / occupation, neighbourhood type related to income / SES (i.e., inner city neighbourhood)
Discussion: Copy Text about SES	Direct quote will be copy and pasted into this column
DISCUSSION: Did the authors discuss the implications or applicability or generalizability of place (focus on a type of place or place based differences, like rural/remote/urban/suburban) analyses or whether lack of these analyses could have affected the results?	Mention of different types of environments and places (e.g., Urban, Rural, Remote, Suburban). There also might be more specific place-based descriptions, like inner-City that should be included. May also focus on different types of environment within a group (e.g., low walkability urban vs high walkability urban; big city urban vs. small city urban. Think context of the place not location; Context = suburban low income neighbourhood; Location = Dallas, TX
Discussion: Copy Text about place (focus on a type of place or place based differences, like rural/remote/urban/suburban)	Direct quote will be copy and pasted into this column

ANY OTHER EQUITY MENTIONS IN THE PAPER NOT CAPTURED IN PREVIOUS ITEMS? IF SO, WHERE? PASTE TEXT	Anything not captured in extraction that could be relevant.

Appendix B: Parent Letter of Information (redacted)

Research Project To Evaluate The Impact Of School Travel Planning on Children's Use Of Active Travel To And From School

Dear parent or guardian,

Dr. Jason Gilliland and his research team from Western University invite you and your child to participate in a study aimed at understanding how School Travel Planning may impact your child's use of active transportation to and from school. The study involves students from grades 4 through 8 at participating elementary schools across the counties of Elgin, Middlesex, Oxford, and the cities of London and St.Thomas.

What is being studied?

Our team is studying the barriers to active transportation to and from school, and the effectiveness of the School Travel Planning program in increasing the number of children and their families who choose active transportation. Through the distribution of family and youth surveys, we aim to learn what concerns you and your child(ren) have with the journey to and from school, and how that journey changes after action is taken to address identified concerns.

What will happen in this study?

If your child agrees to participate in our project, **your child will be asked to:**

Complete the *School Travel Planning Youth Survey*. Only children in grades 4 through 8 are invited to participate in the Youth Survey. This survey primarily asks children about the nature of, and how they feel about their travel to and from school. Surveys usually take about 15-20 minutes to fill out and will be done in their classroom at a time decided by their teacher. (Note: students not filling out the survey will be given quiet activities by their teacher to do at their desks).

As the child's parent/guardian, **you will be asked to:**

Complete the *School Travel Planning Family Survey*. The survey asks many of the same questions as the Youth survey, as well as questions about your household and your child's physical activity schedule. It usually takes about 10-15 minutes to fill out. The Parent Survey is completely voluntary – your child can still join the study themselves even if you decide not to fill out the Parent Survey. However, as the survey gives us critical information from the point of view of parents, we would really appreciate your participation. Family surveys will be sent home with each child in grade 4-8 and the youngest (or oldest) child in JK-Grade 3. If you receive more than one family survey, fill out a survey for each child in Grade 4-8, and only fill out a survey for your child(ren) in JK-Grade 3 if the walk to and from school is different from your child(ren) in Grade 4-8.

Do we have to participate in this study?

Your participation in this study is completely voluntary. You and your child do not have to

participate. You can each refuse to answer any survey questions, and can choose to leave the study at any time.

What are the benefits and risks if my child participates?

Research shows physical activity through active transportation to and from school can; improve physical and mental health, improve traffic and safety around your school, improve air quality and help the environment, have students arrive at school alert and ready to learn, and increase community connectivity. This study will help us to better understand the barriers of active transportation to and from school. The results will allow your School Travel Planning committee to develop an action plan to remove existing barriers to active transportation.

There is little risk to your child if he/she participates in this study, but there is a slight chance that you or your child may be uncomfortable sharing details of your family, such as economic status, to the researchers, which may be seen by your child's teacher while the survey is being collected. This is being minimized as follows. You or your child will not be personally identified or identifiable by name in any of the documents related to the study. All of the information collected in this study is kept strictly confidential. You and your child will be assigned a unique identification code – your name will not appear on any materials or data files except for this consent form. We will also be collecting postal codes to estimate the path your child(ren) take to and from school. The postal codes will be stored separate from other survey data. Furthermore, materials and data files will ONLY be viewed by members of the research team and will be stored in a locked filing cabinet until transferred onto a password protected computer in a secure facility at the University of Western Ontario. The results of this study will only be presented for groups so that children will never be individually identifiable.

If you or your child decides to leave the study at any time (even up to 30 days AFTER the study has been completed), any data collected from you or your child will be immediately destroyed and excluded from the analysis.

You do not waive any of the legal rights you would otherwise have as a participant in a research study.

Who do I contact if I have any other questions?

Should you have any questions or concerns about participating in this project, you can contact the lead researcher, Dr. Jason Gilliland, at the University of Western Ontario.
Phone: [redacted]

If you have any further questions regarding your rights as a study participant, please contact the Office of Research
Ethics at [redacted]

This letter is for you to keep. Please complete the research registration section on the School Travel Planning Consent form for you and your child(ren).

Appendix C: Parent consent form (redacted)

Parent / Guardian Consent Form (Grades 4-8)

To learn the concerns your child(ren) have with the journey to and from school, we ask that you allow your child(ren) in grades 4-8 to complete a *'youth survey'* during class time. The surveys are coded to match the parent and youth surveys together and to keep your names unknown. Please review the ***Letter of Information*** found at the end of the survey before providing your child consent.

WE NEED YOUR PERMISSION TO HAVE YOUR CHILD FILL OUT THE SURVEY AT SCHOOL

I agree for my child _____ ***(please print child's full name)*** to fill out the youth survey.

_____
Teacher's Name

_____ _____
Parent / Guardian's signature Date

Completed consent forms should be returned to the school with the child who brought it home by [redacted]

If you have any questions, please contact: STP Facilitator: [redacted]

Appendix D: Parent Survey

Answer Selection: Correct = ● Incorrect = ⊗ ✓ ⊖

School Travel Planning: Family Survey

We need your help to make the School Travel Planning a success and to learn how to make your neighbourhood safer for walking. Your honest answers to the items in this survey are very important to us. This will not take long to complete.

A. Household Information

1. Please provide the following information for **each** child attending this school.

	Age					Grade				Sex	
										Male	Female
Child 1	③	④	⑤	⑥		Ⓚ	①	②		O	O
	⑦	⑧	⑨	⑩		③	④	⑤			
	⑪	⑫	⑬	⑭		⑥	⑦	⑧			
Child 2	③	④	⑤	⑥		Ⓚ	①	②		O	O
	⑦	⑧	⑨	⑩		③	④	⑤			
	⑪	⑫	⑬	⑭		⑥	⑦	⑧			
Child 3	③	④	⑤	⑥		Ⓚ	①	②		O	O
	⑦	⑧	⑨	⑩		③	④	⑤			
	⑪	⑫	⑬	⑭		⑥	⑦	⑧			
Child 4	③	④	⑤	⑥		Ⓚ	①	②		O	O
	⑦	⑧	⑨	⑩		③	④	⑤			
	⑪	⑫	⑬	⑭		⑥	⑦	⑧			

2. What is your relationship to the child (taking part in the study)?

   O Mother

   O Father

   O Primary caregiver/Guardian

   O Other: _____

3. Postal code of your child's primary home: ___ ___ ___ - ___ ___ ___

   a. How many days a week do they live at this address?

   ① ② ③ ④ ⑤ ⑥ ⑦

4. Postal code of your child's secondary home (if applicable): ___ ___ ___ - ___ ___ ___

5. How many motor vehicles in working order (cars, vans, trucks, and motorcycles) are there at your household?

   ① ② ③ ④

6. Do any of your children have any medical or physical limitation which prevents them from engaging in physical activity?

   O Yes O No

B. Additional Household Information

1. Please select the highest level of education the **child's mother** has completed.

   Grade: ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬

   College/University O

   Graduate School O

   Not applicable O

2. Please select the highest level of education the **child's father** has completed.

   Grade: ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬

   College/University O

   Graduate School O

   Not applicable O

3. Which of the following best describes the current work status of the **child's mother**?

O	Employed full-time	O	Employed part-time
O	At home with children	O	Unemployed
O	Student	O	Other _____
O	I prefer not to answer	O	Not applicable

4. Which of the following best describes the current work status of the **child's father**?

O	Employed full-time	O	Employed part-time
O	At home with children	O	Unemployed
O	Student	O	Other _____
O	I prefer not to answer	O	Not applicable

C. School Travel Planning

1. Do you support ongoing School Travel Planning efforts to make the school area safer, healthier and better connected to the community, by focusing on ways to reduce the number of children travelling to and from school by car?

O Yes O No

D. Your Child's Trip To and From School

The following questions are about how your child gets to and from school each day. Please check the best answer for your child and his/her school.

1. Does your child live within walking distance of their school (from their primary residence)?

O Yes O No

2. Is your child eligible to take a school bus to and from school (i.e., live in an area with a school bus)?

O Yes O No

3. Number of days per week your child **usually** travels to school by:

For example, if your child always rides a school bus to school, check the 5 box in the row 'School Bus.'

Walking	⓪	①	②	③	④	⑤
Bicycle/Scooter	⓪	①	②	③	④	⑤
Skateboard/Rollerblades	⓪	①	②	③	④	⑤
Car/personal vehicle	⓪	①	②	③	④	⑤
School Bus	⓪	①	②	③	④	⑤
City Bus	⓪	①	②	③	④	⑤

a. When your child travels to school (or the bus stop if bused), who do they travel with (Check all that apply)?

O	Nobody	O	Parent(s)
O	Brother(s) or Sister(s)	O	Other Adult(s)
O	Friend(s)	O	Other Student

b. If **your child is bused**, how does your child get to the bus stop (Check all that apply)?

O Not Bused

O Walking

O Car/personal vehicle

O Other (Please specify): _____

c. If you **drive your child** to school, where do you go after you **drop them off**?

O Not driven

O Go to work

O Go home

O Go to other destinations (please specify): _____

4. Number of days per week your child **usually** travels **from** school by:

For example, if your child always rides a school bus from school, check the 5 box in the row 'School Bus.'

Walking	⓪	①	②	③	④	⑤
Bicycle/Scooter	⓪	①	②	③	④	⑤
Skateboard/Rollerblades	⓪	①	②	③	④	⑤
Car/personal vehicle	⓪	①	②	③	④	⑤
School Bus	⓪	①	②	③	④	⑤
City Bus	⓪	①	②	③	④	⑤

a. When your child travels home **from** school (or the bus stop if bused), who do they travel with (Check **all** that apply)?

O	Nobody	O	Parent(s)
O	Brother(s) or Sister(s)	O	Other Adult(s)
O	Friend(s)	O	Other Student

b. If **your child is bused**, how does he/she travel home **from** the bus stop (Check **ALL** that apply)?

O Not Bused

O Walking

O Car/personal vehicle

O Other (Please specify): _____

c. If you **drive your child** home **from** school, where are you coming **from** before you pick them up?

O Not driven

O Go to work

O Go home

O Go to other destinations (please specify): _____

d. If you **drive your child** home **from** school, where do you go after you **pick them up**?

- O Home
- O After school activities
- O Go to other destinations (please specify): _____

5. If your child walks or bikes to or from school, how long does it **usually** take him/her (one way)?

- O Between 1 and 10 minutes
- O Between 11 to 20 minutes
- O More than 20 minutes
- O My child does not walk/bike to/from school

6. How long does it **usually** take your child to get to/from school each day (one way)?

- O Between 1 and 10 minutes
- O Between 11 to 20 minutes
- O More than 20 minutes

7. If you had your ideal choice, how would you most like your child to get to and from school each day?

- O Walk
- O Driven in a car
- O Ride bicycle or scooter
- O Take school bus
- O Ride skateboard or rollerblades
- O Take city bus

8. When you were a child, how did you typically travel to school?

- O Walk
- O Driven in a car
- O Ride bicycle or scooter
- O Take school bus
- O Ride skateboard or rollerblades
- O Take city bus

E. Barriers to walking and biking to school

1. Is your child allowed to walk to/from school (some or all days)?

- O Yes
- O No

2. Is your child allowed to bike to/from school (some or all days)?

O Yes O No

It is difficult for my child to walk or bike to school or their bus stop because…	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
3. It is too far or takes too much time	O	O	O	O
4. There are not enough sidewalks	O	O	O	O
5. There are not enough bike paths / lanes	O	O	O	O
6. The route is boring	O	O	O	O
7. It feels unsafe due to traffic on the route	O	O	O	O
8. There are too many busy streets to cross	O	O	O	O
9. They get too hot and sweaty	O	O	O	O
10. There is no one to walk with	O	O	O	O
11. It's not fun for them to walk	O	O	O	O
12. They have too much stuff to carry	O	O	O	O
13. It is easier to drive them there	O	O	O	O
14. It feels unsafe because of crime (example: strangers, gangs, drugs)	O	O	O	O
15. They might get bullied or teased along the way	O	O	O	O
16. There is nowhere to leave a bike safely at school	O	O	O	O
17. They are too young to walk/bike to school	O	O	O	O
18. They don't have cycling skills to ride a bike safely on the street	O	O	O	O
19. Other reason: _____	O	O	O	O

F. Streets in our neighbourhood

Please check the answer that best applies to you and your neighbourhood	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
1. There are enough sidewalks on the streets in our neighbourhood	O	O	O	O
2. There are walking trails in or near our neighbourhood that are easy to get to	O	O	O	O
3. There are bicycle lanes or trails in or near our neighbourhood that are easy to get to	O	O	O	O
4. There are lots of trees along the streets in our neighbourhood	O	O	O	O
5. We know a lot of people in our neighbourhood	O	O	O	O

G. Neighbourhood Safety

Please check the answer that best applies to you and your neighbourhood	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
1. There is so much traffic along the street we live on that it makes it difficult or unpleasant for my child to walk.	O	O	O	O
2. There is so much traffic along other streets near our home that it makes it difficult or unpleasant for my child to ride their bike or play on the streets in our neighbourhood.	O	O	O	O
3. Most drivers go too fast while driving in our neighbourhood.	O	O	O	O
4. There is a lot of crime in our neighbourhood.	O	O	O	O
5. If feels unsafe to let my child walk alone around our neighbourhood during the day.	O	O	O	O
6. It feels unsafe to let my child walk around with friends or siblings in our neighbourhood during the day.	O	O	O	O
7. I am worried about my child being or walking alone in my neighbourhood and local streets because I am afraid of him/her being taken or hurt by a stranger.	O	O	O	O

Appendix E: Child assent form

Western

How Do You Get To School?

active & safe routes to school
ST. THOMAS ELGIN LONDON MIDDLESEX OXFORD

Hello! We are researchers from Western University and we are doing a study in your school. We need students in Grades 4 through 8, like you, to help us learn how to make it easier to choose active transportation to and from school!

What are we going to study?
We all know that active transportation is great for the environment and your health. We'd like to know how you get to school or your bus stop and what is making traveling actively difficult in your neighbourhood.

What would you have to do?
If you agree to be in the study, we would like you to fill out a short survey on how you get to and from school, what you like about the journey, and what you would change about it. You will fill out the survey during class time with your peers. It takes about 15-20 minutes to finish but you can take as much time as you need.

Do you have to join this project?
No – you only join if you want to. You can also decide at any time that you would like to stop. We will never share your information with anyone else, even your parents, but you can ask to see it at any time. You can ALWAYS talk to your teacher or the researchers if you have any questions or worries.

I want to participate in this study!
If you would like to join this study, choose one of the following two options:

☐ I want to participate in the study

First and Last Name _____

Sign your name _____ Date _____

Signature of Teacher_____ Date _____

Appendix F: Child Survey

Answer Selection: Correct = ● Incorrect = ☒ ✓ ⊖

School Travel Planning: Youth Survey

We need your help to better understand how to make your neighborhood safer and encourage active travel (e.g., walking and bicycling). Your honest answers to the items in this survey are very important to us. This will not take long to complete. Remember….

- We want to know what you think,
- There are no right or wrong answers, and
- Everything you tell us will be kept strictly confidential (secret).
- Try to answer all the questions.

Please answer these questions thinking about the house and neighborhood that you live in the most.

A. General Information

1. I am a O Girl O Boy
2. How old are you? ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭
3. What grade are you currently in? ④ ⑤ ⑥ ⑦ ⑧
4. How many people live (including yourself) in your main home?
   ② ③ ④ ⑤ ⑥ +
5. How many children (including yourself) live in your main home?
   ① ② ③ ④ ⑤ ⑥
6. Postal code at your main home (or closest main intersection): ___ ___ ___ ___ ___ ___
7. How many days a week do you live in your main home?
   ① ② ③ ④ ⑤ ⑥ ⑦
8. If you have a second home (where you sleep some nights), what is the postal code (or closest main intersection): ___ ___ ___ ___ ___ ___
9. Do you have asthma or regularly have breathing problems? O Yes O No
   a. If yes, do you use an inhaler? O Yes O No

10. Do you have a dog? O Yes O No

    a. If yes, on how many days last week did YOU walk your dog?

    ⓪ ① ② ③ ④ ⑤ ⑥ ⑦

11. Have you and your family moved within the last 2 years? O Yes O No

B. Your Trip To and From School

The following questions are about how you get to and from school each day. Please check the best answer.

1. Do you own a bike? O Yes O No
2. Do you live within walking distance of your school? O Yes O No
3. How often in a normal week do you travel **TO SCHOOL** by:

	Never (0 Days)	Almost never (1 or 2 days per month)	Sometimes (1 to 2 days per week)	Frequently (3 to 4 days per week)	Always (5 days per week)
Walking	O	O	O	O	O
Bicycle/Scooter	O	O	O	O	O
Skateboard/Rollerblades	O	O	O	O	O
Car/Personal Vehicle	O	O	O	O	O
School Bus	O	O	O	O	O
City Bus	O	O	O	O	O

a. When you travel from home TO SCHOOL (or the bus stop if your bused), who do you usually travel with (Check ALL that apply)?

O Nobody
O Brother(s) or Sister(s)
O Friend(s)
O Parent(s)
O Other Adult(s)
O Other Student(s)

b. Do you usually stop on the way to school?

O No
O Yes: Please specify (i.e., friend's house, variety store, before school activities)

4. How often in a normal week do you travel **FROM SCHOOL** by:

	Never (0 Days)	Almost never (1 or 2 days per month)	Sometimes (1 to 2 days per week)	Frequently (3 to 4 days per week)	Always (5 days per week)
Walking	O	O	O	O	O
Bicycle/Scooter	O	O	O	O	O
Skateboard/Rollerblades	O	O	O	O	O
Car/Personal Vehicle	O	O	O	O	O
School Bus	O	O	O	O	O
City Bus	O	O	O	O	O

a. When you travel **FROM SCHOOL** (or the bus stop if your bused) to home, who do you usually travel with (Check **ALL** that apply)?

O Nobody
O Brother(s) or Sister(s)
O Friend(s)
O Parent(s)
O Other Adult(s)
O Other Student(s)

b. Do you usually stop on the way home from school?

O No
O Yes: Please specify (i.e., friend's house, variety store, after school activities)

_____

5. If you walk or bike to or from school, how long does it **USUALLY** take you (one way)?

O Between 1 and 10 minutes
O Between 11 to 20 minutes
O More than 20 minutes
O I don't usually walk/bike to or from school

6. If you had **YOUR** ideal choice, how would you **MOST** like to get to school each day **(Choose 1)**?

O Walk
O Ride skateboard or rollerblades
O Take school bus
O Ride bicycle or scooter
O Driven in a car
O Take city bus

C. Barriers to walking and biking to school

1. Are you allowed to walk to school (some or all days)? O Yes O No
2. Are you allowed to bike to school (some or all days)? O Yes O No

Does this stop you from walking/biking to school or to your bus stop?	Always No	Usually No	Usually Yes	Always Yes
3. It is too far or takes too much time	O	O	O	O
4. There are not enough sidewalks	O	O	O	O
5. There are not enough bike paths / lanes	O	O	O	O
6. The route is too boring	O	O	O	O
7. It feels unsafe due to traffic on the route	O	O	O	O
8. There are too many busy streets to cross	O	O	O	O
9. I get too hot and sweaty	O	O	O	O
10. There is no one to walk or bike with	O	O	O	O
11. It is not fun	O	O	O	O
12. I have too much stuff to carry	O	O	O	O
13. It is easier for someone to drive me	O	O	O	O
14. It feels unsafe because of crime (e.g., strangers, gangs, drugs)	O	O	O	O
15. I might get bullied / teased along the way	O	O	O	O
16. There is nowhere to safely leave a bike if I ride my bike to school	O	O	O	O
17. I don't think I have the skills to ride my bike safely	O	O	O	O
18. Other reason: _____	O	O	O	O

D. Streets in Your Neighbourhood

Please tell us about your neighbourhood streets.	Completely No	Mostly No	Mostly Yes	Completely Yes
1. There are enough sidewalks on the streets in my neighbourhood	O	O	O	O
2. There are walking trails in or near my neighbourhood that are easy to get to	O	O	O	O
3. There are bicycle lanes or trails in or near my neighbourhood that are easy to get to	O	O	O	O
4. There are lots of trees along the streets in my neighbourhood	O	O	O	O
5. I know a lot of people in my neighbourhood	O	O	O	O

E. Neighbourhood Safety

Please tell us about your neighbourhood's safety.	Completely No	Mostly No	Mostly Yes	Completely Yes
1. There is so much traffic along the street we live that it is difficult or unpleasant to walk	O	O	O	O
2. There is so much traffic along other streets near my home that it makes it difficult to ride my bike or play on the street	O	O	O	O
3. Most drivers go too fast while driving in our neighborhood	O	O	O	O
4. There is a lot of crime in my neighbourhood	O	O	O	O
5. It feels unsafe to walk by myself around my neighbourhood during the day	O	O	O	O
6. It feels unsafe to walk with friends or siblings in my neighbourhood during the day	O	O	O	O
7. I am worried about being alone or walking by myself in my neighbourhood and local streets because I am afraid of being taken or hurt by a stranger	O	O	O	O

You're finished! Thank you for all your help!

Appendix G: A Research Ethics Approval Forms and use of Human Participants (redacted)

Western Research

Research Ethics

Western University Health Science Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Dr. Jason Gilliland
Department & Institution: Social Science\Geography,Western University

NMREB File Number: 105635
Study Title: Active and Safe Routes to School Committee's School Travel Planning Evaluation
Sponsor:

NMREB Initial Approval Date: September 23, 2014
NMREB Expiry Date: July 31, 2018

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Instruments	Youth Survey for children in Grades 4 to 8	2014/09/01
Caregiver Letter of Information & Consent	Parental Consent for Grade 4 to 8 Students	2014/09/01
Instruments	Parent Survey	2014/09/01
Letter of Information	Cover Letter for Parents with Children in Grades JK to 3	2014/09/01
Western University Protocol		
Assent		2014/09/05
Revised Letter of Information & Consent		2014/09/05

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number [redacted]

Ethic [redacted] Hinson, NMREB Chair, or Board Member designee

Ethics Officer to Contact for Further Information

Erika Basile [redacted]	Grace Kelly [redacted]	Mina Mekhail [redacted]	Vikki Tran [redacted]

This is an official document. Please retain the original in your files.

Western Research

Date: 20 August 2018

To: Dr. Jason Gilliland

Project ID: 105635

Study Title: Active and Safe Routes to School Committee's School Travel Planning Evaluation

Application Type: NMREB Amendment Form

Review Type: Delegated

Full Board Reporting Date: September 7 2018

Date Approval Issued: 20/Aug/2018

REB Approval Expiry Date: 23/Sep/2018

Dear Dr. Jason Gilliland,

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the WREM application form for the amendment, as of the date noted above.

Documents Approved:

Document Name	Document Type	Document Date	Document Version
NM105635_ASRTS_Protocol-UWO_R3_2018-07-24_Clean	Protocol	24/Jul/2018	
NM105635_Tools_Invitation_OnlineSurvey	Recruiting Advertisements	24/Jul/2018	1
NM105635_Tools_LOIConsent_OnlineSTP_2018-07-24_clean	Written Consent/Assent	24/Jul/2018	

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario. Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB. The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB [redacted]

Please do not hesitate to contact us if you have any questions.

Sincerely,

Kelly Patterson, Research Ethics Officer on behalf of Dr. Randal Graham, NMREB Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Appendix H: Thames Valley District School Board approval form (redacted)

January 8, 2016

Dear Dr. Gilliland:

The continuation of your project, entitled "London and Area School Travel Plan Pilot" has been approved by Learning Support Services at the Thames Valley District School Board. You are welcome to begin data collection for your study. Please ensure that all members of your research team who will be assisting with data collection involving students have an up-to-date criminal record check.

The continued willingness of our faculty to participate in research studies is greatly enhanced by pertinent feedback of findings. Please find attached the Thames Valley District School Board Study Completion Form. Once you have completed your research in our board, please complete this form and submit it to Dr. Steve Killip. This form should be submitted within two years of receiving approval. It is also suggested that direct feedback be provided to the school(s), staff, students, and/or families involved in the study.

All the best with your research. Please feel free to contact me if I can be of further assistance.

Sincerely,

[redacted]

Steve Killip, Ph.D.
Manager - Research and Assessment Services
Thames Valley District School Board

/sd

cc: M. Deman, Superintendent of Student Achievement

Appendix I: London District Catholic School Board approval form (redacted)

CATHOLIC EDUCATION CENTRE
5200 Wellington Road S. London, Ontario N6E 3X8 Canada
T 519-663-2088 F 519-663-9250

December 7, 2015

Dr. Andrew Clark
Human Environments Analysis Laboratory
Department of Geography, Western University

Dear Andrew:

Re: Approval of Active and Safe Routes To School Project Ref: # 201308

Please consider this letter as formal written approval of the London District Catholic School Board's participation in the Active & Safe Schools Route research project.

The project aims to provide a better understanding of what barriers exist that impede active travel to school, and address the identified barriers through the creation and implementation of a comprehensive travel plan for each school by a team of relevant stakeholders from within the school and wider community.

The research proposal was reviewed and approved by the Board's Research Advisory Committee. Approval was originally provided in the spring of November 2013 via an email correspondence, as well as in a telephone conversation to Diane Szoller who at the time served as a Co-chair ELMO ASRTS Steering Committee.

Please let me know if you require any additional information at this time.

Sincerely

[redacted]

Terry Spencer
Research and Evaluation Officer
London District Catholic School Board

Board Office: [redacted]
Cell: [redacted]
Email [redacted]
Website: www.ldcsb.on.ca

Curriculum Vitae

Name:	Alina Medeiros
Post-secondary Education and Degrees:	Western University London, Ontario, Canada 2014-2018 B.HSc. (Honors) Western University London, Ontario, Canada 2018-2020 M.Sc.
Honours and Awards:	IPPH Travel Award – CPHA Conference 2020
Related Work Experience	Teaching Assistant Western University 2018-2020 Research Assistant Human Environments Analysis Laboratory 2018-Current

Publications:

Wray, A., Martin, G., Ostermeier, E., Medeiros, A., Little, M., Reilly, K., Gilliland, J., 2020. *Physical activity and social connectedness interventions in outdoor spaces among children and youth: a rapid review.* Heal. Promot. Chronic Dis. Prev. Canada 40, 104–115. https://doi.org/10.24095/hpcdp.40.4.02

Conference Presentations:

Oral Presentation
Medeiros, A., Buttazzoni, A. N., Coen, S. E., Clark, A., Wilson, K., & Gilliland, J.
Review of Equity Considerations in Active School Travel Interventions.
Annual Meeting of the GeoHealth Network
Toronto, Ontario, April 2019

Oral Presentation
Medeiros, A., Buttazzoni, A. N., Coen, S. E., Clark, A., Wilson, K., & Gilliland, J.
Review of Equity Considerations in Active School Travel Interventions.
Annual Meeting of the Canadian Association of Geographers – Ontario Division
Guelph, Ontario, October 2019

Oral Presentation
Martin, G., Clark, A., Medeiros, A., Graat, M. & Gilliland, J. *Perceived neighborhood safety moderates the relationship between active school commuting and children's mental health.*
International Association People-Environment Studies Conference
Monitored from Québec City, Canada due to the Covid-19 pandemic, June 2020

Poster Presentation
Medeiros, A., Reilly, K., Martin, G., Clark, A., & Gilliland, J. *Student-Led and Gender-Equitable Active School Travel Interventions: An Exploratory Qualitative Study.*
Annual Meeting of the Canadian Public Health Association
October 2020 (postponed due to the Covid-19 pandemic)