IMPACTS OF HOUSING AND NEIGHBORHOOD ENVIRONMENTS ON ELEMENTARY SCHOOL CHILDREN'S INDEPENDENT MOBILITY

A Dissertation

by

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ABSTRACT

Children's independent mobility (CIM) signifies their ability to move around in a neighborhood without adult supervision. It has declined steeply in recent decades despite its importance for children's physical, mental, and social development. This study examines the impacts of housing and neighborhood environments on two types of CIM: independent travel from home to non-school destinations and unsupervised outdoor play, captured as parental permission for these behaviors.

A bilingual (English and Spanish) parent/guardian survey was distributed to 24 public elementary schools in Austin, Texas and advertised through social media to gather information about CIM, perceptions of housing and neighborhood environments, and personal and social factors. Objective physical environments of children's homes and their immediate surroundings were assessed using Google Street View audits, while objective features of neighborhood environments were captured using Geographic Information Systems. Binary logistic regressions were employed to predict CIM using personal, social, and physical environmental factors (perceptions or objective measures).

The survey results (N = 883) showed that about half of the parents would allow independent non-school travel (50.8%) or unsupervised outdoor play (45.6%), with most of these activities limited to a five-minute walk from home and a few destinations. When using perceptions of physical environments as predictors, the presence of a friend's/relative's home was a positive predictor, while stranger danger was a negative predictor for both CIM outcomes. The presence of walking/biking trails was a negative

predictor of independent travel to non-school destinations, and the quality of surrounding environments was a positive predictor of this behavior.

When using objective environmental measures as predictors, the presence of registered sex offenders was a negative predictor of both outcomes. Home location on a corner lot of a dead-end was a positive predictor of parental license for unsupervised outdoor play, while higher Transit Score was a negative predictor. Results also showed that personal and social factors played a significant role in CIM.

This study demonstrates the impacts of physical environments on CIM and implies the importance of relevant interventions. The study findings are informative for policymakers, planners, or architects in guiding future efforts to develop more child-friendly environments.

DEDICATION

In memory of my dear father, Huadong Qiu. Although he led me all the way to pursue my doctoral degree, he was unable to see it. This is for him.

To my dear mother, Shanhui Li and brother, Liwei Qiu, for their love, encouragement, and patience.

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All other work conducted for the dissertation was completed by the student independently.

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NOMENCLATURE

CIM	Children's Independent Mobility
AISD	Austin Independent School District
GIS	Geographic Information System
GSV	Google Street View

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1. INTRODUCTION

1.1. Background and Significance

Children's independent mobility (CIM) refers to their roaming around in neighborhoods freely without adults' direct accompaniment (Hillman, Adams, & Whitelegg, 1990). It can be further specified as the freedom of traveling to places (i.e., independent travel) or playing outdoors without adult supervision (i.e., unsupervised play) (Bagheri & Zarghami, 2020; Oliver et al., 2011; Schoeppe, Duncan, Badland, Oliver, & Curtis, 2013). Independent mobility is important to children's physical, mental, and social development (M. Kyttä, 2004; Mackett, Brown, Gong, Kitazawa, & Paskins, 2007). It can also help develop a stronger sense of community in adolescence (Prezza & Pacilli, 2007). Nowadays, children face the increasing risk of being obese or overweight due to physical inactivity (Cooper, Page, Foster, & Qahwaji, 2003; Fox, 2004). Many studies have reported that CIM can help increase children's physical activity (Page, Cooper, Griew, Davis, & Hillsdon, 2009; Page, Cooper, Griew, & Jago, 2010; Schoeppe, Duncan, Badland, Oliver, & Browne, 2014), which is essential for their development of motor skills, bone health, and weight control (Armstrong, 1993; M. Kyttä, 2004; Loprinzi, Cardinal, Loprinzi, & Lee, 2012). Besides, children with greater independent mobility are less likely to experience negative emotions such as a lower sense of safety and loneliness (Pacilli, Giovannelli, Prezza, & Augimeri, 2013). Traveling or playing without adult supervision also allows children to have more opportunities to interact with peers and adults in their neighborhood (Prezza & Pacilli, 2007) and gain better social skills (Hillman et al., 1990; Joshi, MacLean, & Carter, 1999). It could also improve children's spatial awareness and navigation skills in outdoor

environments (Foster, Villanueva, Wood, Christian, & Giles-Corti, 2014; Joshi et al., 1999; Rissotto & Tonucci, 2002). Such enhanced competence and experiences would further help children build a sense of identity (Hillman et al., 1990; Malone, 2007; Rissotto & Giuliani, 2006) and promote their self-confidence and self-esteem (Hillman et al., 1990; Joshi et al., 1999).

Despite many recognized benefits, independent travel or play among children is not as common as it used to be. Recent years have observed a steep decline of CIM in many developed countries across the world (Fyhri, Hjorthol, Mackett, Fotel, & Kyttä, 2011; M. Kyttä, Hirvonen, Rudner, Pirjola, & Laatikainen, 2015; Schoeppe, Tranter, et al., 2016; Shaw et al., 2015). A similar trend was also observed for children's active travel (i.e., walking and biking to destinations), which often involves various unsupervised activities (Fyhri et al., 2011; McMillan, 2005). One study investigated the changes in Australian children's independent mobility between 1991 and 2012, and reported declines in both parental licenses for CIM and children's actual independent mobility behavior (Schoeppe, Tranter, et al., 2016). Also, studies showed that 80% of 7-8 year-old children in the UK were allowed to travel independently to school in 1971, while the proportion dropped to 9% in 1990 (Hillman et al., 1990) and 6% in 2010 (Shaw et al., 2015). Similar trends in CIM and active travel have also been reported in other countries such as the U.S. (Kontou, McDonald, Brookshire, Pullen-Seufert, & LaJeunesse, 2020; McDonald, Brown, Marchetti, & Pedroso, 2011), New Zealand (Witten, Kearns, Carroll, Asiasiga, & Tava'e, 2013), Finland, Germany, and Sweden (M. Kyttä et al., 2015; Shaw et al., 2015). In the U.S., based on the National Household Travel Survey, the percentage of children walking/biking to school dropped from 49.3% in 1969 to 10.9% by 2017, while travel by car increased from 12.2% in

1969 to 51.6% by 2017 (Federal Highway Administration, 1969, 2001, 2017; Kontou et al., 2020; McDonald et al., 2011).

The decline in CIM is closely linked with the decrease in total physical activity levels among children (Mackett et al., 2007; Marzi & Reimers, 2018; Page et al., 2009; Schoeppe et al., 2014), a key risk factor of childhood obesity (Whitzman, Romero, et al., 2010). A number of studies have focused on the correlates of children's active travel (i.e., walking and bicycling) to school, which were shown to be an effective way to boost children's physical activity during their daily routine (Faulkner, Buliung, Flora, & Fusco, 2009; Lee, Yoon, & Zhu, 2017; Merom, Tudor-Locke, Bauman, & Rissel, 2006). However, as argued by Hillman (2006), only half of the days in a year are actual school days (National Center for Education Statistics, 2018), and thus, more CIM studies are needed to further investigate children's travel and play activities during their leisure time. Furthermore, compared to adults, children rely more on their immediate surroundings, such as home and neighborhood environments, due to their physical and mental immaturity. Therefore, it is vital to understand the underlying relationship between housing and neighborhood environments and CIM during their leisure time, such as home-based independent travel to non-school destinations and unsupervised outdoor play in their home neighborhood. A better understanding of those significant environmental factors will enable architects, planners, and policymakers to develop child-friendly housing and neighborhoods and help promote CIM. However, the relationship between housing and neighborhood environments and CIM is still understudied, especially in the U.S. Based on our literature review, most of previous studies on CIM were conducted in European countries, Canada, and Australia (Qiu & Zhu, 2017).

1.2. Research Questions

This study addresses the gaps in knowledge by conducting a cross-sectional study on the relationship between housing and neighborhood environmental features and two modes of CIM—home-based independent travel to non-school destinations and unsupervised outdoor play in the neighborhood. The research questions address if and how the housing and neighborhood physical environments affect 1) children's home-based independent travel to non-school destinations and 2) children's unsupervised home-neighborhood outdoor play. The roles of personal and social factors such as the child's grade level, gender, health conditions, ethnicity, and social connection as well as neighborhood support and impact from peers, etc. will also be considered.

It is expected that findings from this study will improve our knowledge regarding the specific roles that the home and neighborhood environments play in encouraging or hindering CIM. The findings will also help architects, planners, and policymakers to develop child-friendly housing and neighborhood programs that can help promote CIM in the future. The remaining sections of this dissertation started with a literature review on the topic of children's independent mobility (Chapter Two), which summarizes concepts of child-friendly environments from multi-level perspectives, definitions and measurements for CIM applied in previous studies, and correlates of CIM identified by empirical studies from multiple levels. Then, the dissertation continues to demonstrate the research methodologies of this study (Chapter Three), introducing the research design and specific methods for data collection and analysis. It then proceeds to further illustrate results based on the examination of survey data with perceived environmental

data and objectively-measured environmental data and concludes with the study's contribution and implications for future research and practice.

2. LITERATURE REVIEW*

This literature review contains three sections. The first section aims to provide a comprehensive overview of the existing theories, conceptual frameworks, and guidelines for developing child-friendly environments from diverse perspectives and scales. Toward this aim, the researcher summarized various theories, concepts, and dimensions about environmental child-friendliness discussed in both gray literature and empirical studies. The second section outlines the specific definitions and measures of CIM widely adopted in relevant empirical studies, along with their strengths and limitations. The last section is a review of empirical studies that investigated the impact of physical environments on CIM. Significant physical environmental correlates of CIM are extracted and summarized; personal and social factors and their correlations with CIM were also examined and reported.

2.1. Child-Friendly Environments

Physical environments play a significant role in children's health and wellbeing. Thus, it is important to understand what kinds of environments are beneficial and friendly to children. This section provides a comprehensive summary of the frameworks and guidelines for creating child-friendly environments proposed in existing empirical studies and gray literature. Important indicators of environmental child-friendliness from social, cultural, policy, and physical levels

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were discussed. Relevant findings also helped inform the conceptualization and design of this dissertation, which focuses on creating child-friendly environments at the housing and neighborhood levels.

2.1.1. General Concepts of Child-friendly Environments from Multi-level Perspectives

"Child-friendly environments" have been conceptualized from multi-level perspectives, including social, cultural, and physical dimensions. For example, the United Nations International Children's Emergency Fund (UNICEF) provided the framework *Building Child Friendly Cities: A framework for action* to define and guide the development of "Child Friendly Cities" in 2004. According to UNICEF (2004), a Child Friendly City must guarantee the rights of every young citizen to:

> influence decisions about their city, express their opinion on the city they want, participate in family, community and social life, receive basic services such as health care, education and shelter, drink safe water and have access to proper sanitation, be protected from exploitation, violence and abuse, walk safely in the streets on their own, meet friends and play, have green spaces for plants and animals, live in an unpolluted environment, participate in cultural and social events, and be an equal citizen of their city with access to every service, regardless of ethnic origin, religion, income, gender or disability. (p.1)

Many of these are directly related to the physical environments to which children are exposed, and several specific physical environmental factors were also identified as fundamentals, such as safe water, safe street environments, green spaces, and unpolluted environments (UNICEF,

2004). The concept of independent mobility is also advocated in this framework as the right to "walk safely in the streets on their own," for which a safe street environment is indispensable.

Horelli (2007) proposed a holistic theoretical framework for "environmental child-friendliness" (ECF) that took physical, psychological, economic, political, and cultural environments into account. Ten normative dimensions were identified for defining a child-friendly environment by Horelli (2007), including:

> (1) housing and dwelling, (2) basic services, (3) participation, (4) safety and security, (5) family, peers, and community, (6) urban and environmental qualities, (7) provision and distribution of resources and poverty reduction, (8) ecology, (9) sense of belonging and continuity, and (10) good governance. (pp. 271-272)

Other researchers from different European countries examined Horelli (2007)'s framework in terms of the specific environmental contexts in their own countries (Chawla, 2002; Haikkola, Pacilli, Horelli, & Prezza, 2007; Nordström, 2010). Basic services, safety and security, and urban and environmental qualities were among the sets of essential factors identified by children in Finland (Broberg, Kyttä, & Fagerholm, 2013; Haikkola et al., 2007) and Sweden (Broberg, Kyttä, et al., 2013; Nordström, 2010). In another study on eight countries across six continents, basic services, the variety of activity settings, the freedom from physical dangers, positive environmental factors such as green areas, freedom of movement, and peer gathering places were reported as the primary indicators of environmental child-friendliness (Broberg, Kyttä, et al., 2013; Chawla, 2002). In addition, one study examined the role of the Child-Friendly City at the local government level and focused on children's right to use public spaces, portraying CIM as

one of their essential rights that the city should help ensure (Whitzman, Worthington, & Mizrachi, 2010).

2.1.2. Physical Planning and Design of Child-friendly Environments

As discussed above, several holistic theoretical frameworks have identified broad criteria for child-friendly environments and prompted the initial initiative to build Child Friendly Cities. However, researchers also indicated that most of these frameworks are too broad to be adopted practically, and detailed guidelines for the physical planning and design of child-friendly environments are needed. A couple of studies have focused on addressing CIM through the design of the physical environment of housing and neighborhoods. This section summarizes those relevant concepts, including children's place friendship, child-friendly communities, child-friendly housing, and design safety.

Children's place friendship. The definition of "place friendship" was proposed based on a literature review on childhood friendship, to help assess possibilities for a place to be considered by children as their friend. This definition employs an environment-behavior fit perspective to define child-friendly places in their everyday environments (Chatterjee, 2005, 2006). Broberg, Kyttä, et al. (2013) summarized the definition of child-friendly places proposed by Chatterjee (2006) and highlighted the necessary qualities or "affordances" as:

> (1) provide opportunities for children to develop an attitude of care and respect for places; (2) promote a meaningful person-environment exchange between child and place through the sharing of activities and interests in places; (3) offer opportunities for environmental learning and developing environmental competence in places; (4) allow

children to create and control territories; (5) provide privacy experiences and nurture childhood secrets; and (6) allow children to express themselves freely in place. (p.111)

Chatterjee (2006) further aggregated the six dimensions into four by illustrating that "creating and controlling territories" and "freedom of expression in place" could be included under the higher-level construct of "meaningful exchange with places," which introduces children to the affordances in outdoor spaces.

Child-friendly communities. An increasing number of studies has begun to examine the environmental factors of child-friendly communities, specifically at the neighborhood level, which is more closely related to children's everyday activities. A literature review conducted by Woolcock and Steele (2008) examined the role of physical environments in child-friendly communities and summarized the key themes from the literature into four dimensions, including: "(1) safety and security, (2) children's independence and mobility, (3) prioritizing children in community places, and (4) creating opportunities for children to engage in outdoor play" (pp. 19-25). Broberg, Kyttä, et al. (2013)'s study proposed the definition of child friendliness in terms of the two key dimensions of physical environments: the potential for children's independent mobility and their opportunities to actualize environmental affordances. These studies emphasized CIM as one of the criteria to evaluate the friendliness of community physical environments to children.

Child-friendly housing. Some other studies discussed and offered definitions of child-friendly housing at an environmental level that covers the child's home and immediate surroundings. One consistent focus in these discussions is how to provide high-quality indoor and outdoor spaces to accommodate children's safe play and other activities. For example, the

Portland Courtyard Housing Competition proposed the principles of child-friendly housing. First, outdoor play spaces should be provided in immediate proximity to their homes and be designed so that they can be supervised by parents and other caregivers from their homes (Pontikis, 2011). Second, outdoor spaces should accommodate a variety of play activities. While green spaces are important, the need for paved surfaces should not be overlooked, as they are used for many outdoor play activities (e.g., riding cycles, skating, games) (Pontikis, 2011). Third, site and community design which provides opportunities for casual interactions with other children and neighbors is important, as is the need for dwelling units to provide privacy and allow intrusions (physical, visual, and acoustic) to be controlled (Pontikis, 2011). Fourth, individual housing units should be designed with the needs of children in mind, providing spaces for indoor play for young children and sufficient numbers of bedrooms or other rooms that can accommodate the increasing needs for personal space as children mature (Pontikis, 2011). Finally, readily accessible storage space is needed for bulky items, such as strollers and bicycles (Pontikis, 2011).

Marcus and Sarkissian (1988) proposed site design guidelines for medium-density family housing in the book *Housing as if people mattered* and specifically discussed the importance of providing common open spaces to meet children's needs and creating purpose-built play areas to accommodate the diverse play activities of different age groups. They emphasize the need to consider many physical environmental factors such as creating varying spaces, designing with comfortable space dimensions, building the linkage between common open spaces and adjacent public streets, and providing a yard or balcony for different play needs. They also highlight CIM as one of children's basic needs that help children gain a sense of independence.

Design for safety. Safety—from both crime and traffic threats—is an essential indicator of child-friendly environments, and is emphasized in almost all related frameworks and guidelines. It is also the most frequently reported concern by parents who do not allow their children to travel independently or play without supervision. Several design concepts and guidelines have been proposed to address crime safety issues through design. One of the concepts is Defensible Space, which means a residential environment that gives the residents control over public spaces and the ability to ensure their security themselves (Newman, 1972). This concept focuses on crime prevention, social control, and public health in relation to neighborhood design for different types of housing (Newman, 1972, 1976, 1996). The concept operates by dividing large neighborhood public spaces and assigning them to individual and small groups to enhance the users' sense of control of the space, and thus help reduce crime. Another relevant concept is Crime Prevention through Environmental Design (CPTED), which emphasizes creating safer neighborhoods through built environments design strategies of territoriality, surveillance, access control, and maintenance (Jeffery, 1977). As an example, windows with view to the sidewalks and streets may increase perceptions of safety when pedestrians walk on sidewalks.

Traffic safety is another major concern, as children tend to play anywhere and everywhere, and streets are among the most commonly used places where children play (Moore, 2017). It is therefore important to manage the speed and volume of traffic on residential streets. Marcus and Sarkissian (1988) proposed design strategies to help create safe street environments for children by slowing traffic and placing adequate sidewalks along all streets. Their specific strategies of reducing traffic volume and speed include: (1) narrowing roadways, (2) limiting the

length of straight stretches, (3) creating cul-de-sacs, (4) closing off streets, (5) placing speed bumps at intervals in the roadway, (6) erecting barriers to eliminate thru traffic, and (7) routing thru traffic around the periphery of the neighborhood (Marcus & Sarkissian, 1988). Besides, a concept of a living street design called "Woonerf" has been developed in European countries (Ben-Joseph, 1995; Collarte, 2012). It stipulates that streets may retain a mixture of pedestrians, cyclists, and vehicles, but should guarantee the legal priority of street space to pedestrians and cyclists over motorists to help improve pedestrian and cyclist safety (Marcus & Sarkissian, 1988).

Overall, previous studies on child-friendly environments have identified CIM as an indispensable criterion to ensure the child friendliness of any physical environment. This further supports the significance of this proposed topic.

2.2. Definitions and Measurements for Children's Independent Mobility

CIM was initially defined as the freedom of children to move around without adult accompaniment by Hillman et al. (1990) in his book *One false move*. The behaviors can be specified as independent travel and unsupervised play, and further defined in terms of travel destinations or locations where play happens (Bagheri & Zarghami, 2020; Oliver et al., 2011; Schoeppe et al., 2013) (Figure 2-1). For example, independent travel could originate from home or other locations. Home-based independent travel includes travel to school, the most common destination of home-based trips among school-aged children, as well as travel to other non-school destinations which are often within their neighborhoods, such as neighborhood recreation centers, sports fields, playgrounds, or friends' homes (Hillman et al., 1990; Schoeppe, Duncan, Badland, Rebar, & Vandelanotte, 2016). For unsupervised play, as most children spend most of

their time either at home or school, it could be categorized as home-based play, school-based play, and play at other locations. Meanwhile, unsupervised play could happen both indoors and outdoors as long as adult supervision is not present.

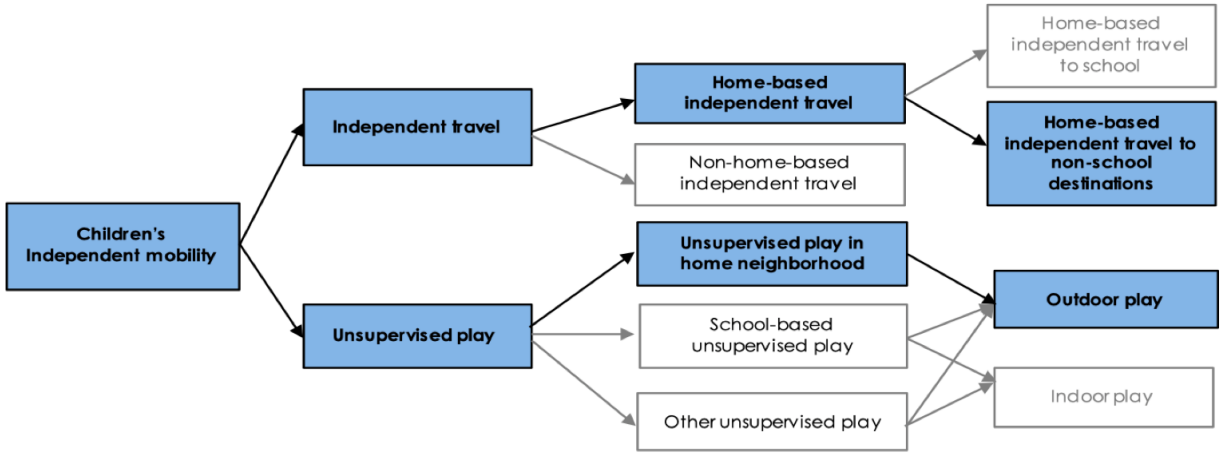

Figure 2-1 Different modes of children's independent mobility.

Previous studies have focused on different types of CIM (e.g., independent travel, unsupervised play, general CIM), and used various measures. As summarized by M. Kyttä (2004), there are three main types of measurements for CIM in previous studies based on the exact content being measured. The first type measures CIM as the geographic range and the distance that children can move around—travel or play—independently from their base locations, which are typically their homes. The second type of measurement captures CIM as mobility licenses or agreements issued by the parents to permit their children to travel to or play independently in the environment. Previous studies have also confirmed that parents' decision-making in CIM plays a crucial role in children's actual independent mobility (De Meester, Van Dyck, De Bourdeaudhuij, & Cardon, 2014; Marzi & Reimers, 2018). Therefore, a mobility

license from parents can reflect children's actual independent mobility to a reliable degree. The third approach measures CIM by checking children's actual fulfilment of independent travel to certain local destinations and/or independent play activities within a certain period of time. For example, children or parents may be asked about the number of independent trips the child makes to certain neighborhood locations, such as a school, recreation center, playground, or park within the past one or two weeks (Page et al., 2010).

Specific measures of CIM can also be classified into objective and self-report measures based on the methods of data collection. Objective measurements are often based on Global Position Systems (GPS) or GPS-based apps on portable equipment, such as cell phones, and are mostly seen in those studies that assess children' mobility in terms of geographic ranges. They can help measure geographic variables like distance, ranges, and active spaces. In contrast, self-report methods are more widely adopted than objective measures due to the cost of GPS devices, complexity of data identification and extraction, and feasibility-related challenges. Some of the previous CIM studies applied self-report measures for CIM, including surveys (Page et al., 2009; Schoeppe, Duncan, et al., 2016; Veitch et al., 2017), interviews (Goodman, Jones, Roberts, Steinbach, & Green, 2014), focus groups (Goodman et al., 2014), and child or parent drawn maps (Veitch, Salmon, & Ball, 2008; Villanueva et al., 2013). These subjective measurements are seen more commonly in studies addressing parental mobility licenses for children and children's self-reported mobility. One reviewed study proposed a protocol by using an interactive online-mapping software (softGIS survey) to measure CIM and children's travel modes to destinations (A. M. Kyttä, Broberg, & Kahila, 2012). A few studies have adopted both objective and self-report measures to examine CIM (Christensen, Mikkelsen, Nielsen, & Harder,

2011; Loebach & Gilliland, 2016). One study discussed the potential of using mixed methods, combining ethnographic fieldwork with GPS technology and an interactive survey as a valid triangulation method to enhance data accuracy in capturing children's mobility (Christensen et al., 2011).

2.3. Correlates of CIM

In addition to the review of the gray literature on general concepts of child-friendly environments, a review was also conducted to identify empirical studies that examined impacts of physical environments on CIM. The review was guided by Social Ecological Theory (McLeroy, Bibeau, Steckler, & Glanz, 1988), which was developed to guide research on human behaviors and environmental inventions from multiple levels. Guided by this theory, factors related to CIM in the reviewed studies were categorized and synthesized into personal, social, and physical environmental domains. The initial literature search was conducted using the Texas A&M University Library website and Endnote software's online search function in 2016. Databases used for the search included: MEDLINE Complete, MEDLINE (PubMed), PsynINFO, Annual Review, Urban Studies and Planning, Social Sciences Full Text, and Psychology and Behavioral Sciences Collection. Keywords included child(ren), independent mobility, physical activity, community, housing, and environment. Studies were selected if they are peer-reviewed empirical studies on correlates of CIM and written in English. Reports, briefs, letters, and editorials were excluded. Studies focusing on larger geographic dimensions beyond the community level were not included. Publications before the year of 2000 were excluded because CIM has shown a steep decline in recent years and neighborhood environments are constantly evolving. In this process, review papers were also used to help identify additional

empirical studies that were not captured in the initial search. They also helped the researcher gain an overview of relevant studies in the area. Initially, a total of 273 relevant studies were identified and a total of 42 full articles were retained after the screening process. After the initial review, some more recent studies were reviewed while the researcher was developing this study.

2.3.1. Physical Environment Factors Related to CIM

Influences of physical environments on CIM may also be domain-specific, with different physical environmental factors being important to particular types of independent mobility. Therefore, this section summarizes physical environmental correlates of CIM in terms of three types of independent mobility: home-based independent travel to non-school destinations, unsupervised outdoor play in the home neighborhood, and overall independent mobility, including both travel and play behaviors.

2.3.1.1. Physical Environment Correlates of Children's Home-based Independent Travel

In many studies, CIM was defined as the freedom and/or ability of children to travel around their neighborhoods without adult accompaniment. Some studies focused on children's travel distance or range from home or wandering time without specifying destinations, while other studies measured the counts of independent journeys to specific destinations (school or other neighborhood destinations) within a certain time period. This section summarizes physical environmental factors that have been identified as correlates of children's home-based independent travel to non-school destinations or non-specified destinations.

Some studies explored the relationship between physical environments and independent travel to certain neighborhood destinations, such as friends' homes, parks, shops, and recreation centers (Broberg, Salminen, & Kyttä, 2013; Christian et al., 2015; Lin et al., 2017). One study

from Finland reported that single-family housing, long distances to the nearest bus stop, and recreational facility were positive correlates of children's independent travel in 1) areas with large numbers of buildings and high proportion of single-family or semi-detached housing and 2) remote islands and coastal areas, while the dense urban residential structure is a positive correlate in densely built-up residential areas (Broberg, Salminen, et al., 2013). The authors did not provide further discussions about the counterintuitive result for longer distance to recreation facilities. One possible reason may be the unique unban structures and diverse study areas in Finland as specified above. The same study also reported that higher floor area ratios and a larger number of public transport hubs had negative influences on children's independent travel in areas featured with big buildings and more bus stops (Broberg, Salminen, et al., 2013). Furthermore, another study identified negative correlates of children's independent travel, including longer distances to destinations and the presence of alternative choices (Christian et al., 2015). Specifically, it reported that independent travel to local parks was less likely when the closest park is further away or when there are additional school grounds as alternative destinations (Christian et al., 2015). In another study, the increased distance to school was found to be a negative correlate for the number of children's independent trips after school (Lin et al., 2017).

Some other studies examined general independent travel without specifying the destinations. They also reported some significant environmental correlates of children's independent travel. A meta-analytic review examined the association between the built environment and children's independent travel, and reported that four physical environmental factors—dead-end street, percentage of residential land, percentage of commercial land, and

residential location type (urban-suburban)—have positive associations with children's independent travel, while vehicular street width, road density, intersection density, major road proportion, land use mix, availability of recreational facilities, residential density, and distance to destinations are negative correlates (Sharmin & Kamruzzaman, 2017). In addition, increased urbanization was found to be associated with decreased independent travel among children (Lopes, Cordovil, & Neto, 2014).

2.3.1.2. Physical Environment Factors Related to Outdoor Play

Based on the literature review, very few studies specifically focused on children's "unsupervised" outdoor play in their neighborhood. Therefore, we extended the scope of this review and included studies on the impacts of neighborhood and housing environments on all types of children's outdoor play in their neighborhood, no matter whether the play activity is supervised or independent. Several environmental factors were found to positively influence outdoor play among children in different age or gender groups, including the presence of sidewalks and several traffic safety-related environmental features, such as pedestrian crossings with or without traffic lights, traffic lights, speed bumps, parallel parking spaces, grouped parking lots, home zones, and roundabouts (Aarts, de Vries, Van Oers, & Schuit, 2012). The presence of green spaces (Brockman, Jago, & Fox, 2011; Grigsby-Toussaint, Chi, & Fiese, 2011), having a yard near home to play in (Marino, Fletcher, Whitaker, & Anderson, 2012), and the presence of cul-de-sacs in the neighborhood (Brockman et al., 2011) were also identified as positive factors facilitating children's outdoor active play. Children living in environments with higher scores of social norm (i.e., environmental measures about children on street, children to play with, and people walking and cycling around) would also have more time play outdoor

everyday (Page et al., 2010). The presence of intersections, street lighting, the number of formal outdoor play facilities (Aarts et al., 2012), and street density (Bringolf-Isler et al., 2010) were found to be negatively related to children's outdoor play. Among these findings, the negative impact from the number of formal outdoor play facilities is unexpected. The authors discussed that using number as an indicator did not capture the size and quality of these facilities, which might be more essential factors affecting children's outdoor play (Aarts et al., 2012). In addition to these neighborhood features, housing characteristics also showed significant impacts on children's outdoor play. For example, one study examined outdoor play among children in different gender and age groups, and reported that better maintenance of houses in the neighborhood was negatively related to outdoor play among boys aged 10–12 years but not in other five sub-groups (Aarts et al., 2012). One possible reason might be the unique developmental characteristics and behavioral preference of teenage boys, but that was not discussed in this study.

2.3.1.3. Physical Environment Factors Related to General Independent Mobility

Some studies examined overall CIM, combining unsupervised outdoor play in the neighborhood and home-based independent travel (Noonan, Boddy, Knowles, & Fairclough, 2016; O'brien, Jones, Sloan, & Rustin, 2000; Prezza et al., 2001). In those studies, CIM was measured through children's and/or parent's report of their actual behavior by indicating whether they walked or cycled to some local activities/destinations (excluding trips to school) in a period of time prior to the survey (Noonan et al., 2016; O'brien et al., 2000; Prezza et al., 2001). The activities included playing a team sport, swimming, going to a club or youth group, watching sports, taking music lessons, and taking a bus. The destinations included parks, playgrounds or

playing fields, friend's houses, family friend's houses, local shops, other shops, the post-box, the local library (not a school library), the movie cinema, and Sunday school/church. Using this measurement, the evaluation of CIM included not only independent trips to destinations, but also independent trips to play activities.

One study reported crime and neighborhood aesthetics as negative correlates of CIM among children living in areas of medium-to-high deprivation (Noonan et al., 2016). For the counterintuitive result for neighborhood aesthetics, the authors briefly discussed contrasting findings from previous studies and suggested more standardized methodologies for assessing aesthetics, but did not provide specific explanations for the finding itself (Aarts et al., 2012). In addition, higher levels of independent mobility were found among children who live in apartment buildings with courtyards, near parks, and in newly built neighborhoods (Prezza et al., 2001) as well as live in the new town (O'brien et al., 2000).

2.3.2. Individual Factors Related to CIM

Both children's and parents' personal factors play significant roles in CIM. In general, parents' socioeconomic status, age, gender, parenting style, education levels, income, occupation, and even language proficiency have been shown to affect their children's independent mobility (Pacilli et al., 2013; Schoeppe et al., 2015; Schoeppe, Duncan, et al., 2016). Child's age (grade) and gender were the widely studied personal variables and reported to be significant in most studies (Bringolf-Isler et al., 2010; Ghekiere et al., 2017; Lopes et al., 2014; O'brien et al., 2000; Pacilli et al., 2013; Prezza et al., 2001).

Individual factors related to home-based independent travel to non-school destinations. Parents with lower education levels were reported to have stricter restrictions for

their children's independent travel distance and the outdoor play range (Schoeppe et al., 2015). Being a girl and of a younger age were found to have a significant negative role on children's independent travel to neighborhood destinations by multiple studies (Ghekiere et al., 2017; Prezza et al., 2001). Parental perceptions of children's cycling and traffic skills were found to be positively associated with independent cycling (Ghekiere et al., 2017). Other positive personal correlates of independent travel to neighborhood destinations included having an older sibling (of the same gender or not), the number of older siblings, and dog ownership (Christian et al., 2016).

Individual factors related to home-based unsupervised play. Parents' education levels were also identified as a significant correlate of children's outdoor play. One study indicated that parents, especially mothers, with a lower education level were less likely to grant children greater distances for unsupervised outdoor play (Schoeppe et al., 2015). However, another study reported that parental education levels had a significant negative impact on children's outdoor play (Aarts et al., 2012). Also, mothers with higher levels of perceived neighborhood safety and neighborhood relations allowed children to play more often with their friends (Prezza et al., 2001). Inversely, parental concern about traffic safety negatively affected children's outdoor play (Bringolf-Isler et al., 2010). A study conducted in Switzerland reported that children's gender as a boy, language-spoken as German (vs. French), non-Swiss nationality, and having younger siblings (Bringolf-Isler et al., 2010) significantly increased children's vigorous outdoor play time.

Individual factors related to general independent mobility which combine travel and play. One study reported that dog-walking significantly increased children's opportunity of

walking in the neighborhood and playing in the street and yard (Christian et al., 2014). Girls and minority children were found to have more restrictions on their freedom to move around in and use public spaces (O'brien et al., 2000; Pacilli et al., 2013). Foster et al. (2014) identified that parents' fear of strangers had negative impacts on CIM, while parents' belief of informal social control (i.e., people in neighborhood would look out for children) played a positive role in predicting CIM for girls. In addition, two opposite parenting styles were both identified as positive correlates of CIM by Pacilli et al. (2013). The two parenting styles are 1) hostile and intruding style (i.e., parents focus more on themselves and force children to comply with their demands) and 2) loving and supportive style (i.e., a parenting style with less maternal and paternal intrusiveness) (Pacilli et al., 2013).

2.3.3. Social Factors Related to CIM

Social factors have also been identified as essential correlates of CIM. Important social factors include socioeconomic status (SES), neighborhood social cohesion, parenting social norms, and informal social control (i.e., residents in neighborhood look out for local children) in the neighborhood. Parenting social norm and parents' perception of neighborhood safety were reported to have significate associations with home-based independent travel to non-school destinations (Christian et al., 2015). Parents' perceptions of neighborhood cohesion and neighborhood connection showed positive associations with independent travel to non-school destinations (Lin et al., 2017). In addition, parents who perceived stronger neighborhood social cohesion were more likely to allow their children to travel greater distances for both independent travel and unsupervised outdoor play (Schoeppe et al., 2015).

2.4. Summary

This literature review summarizes the existing frameworks and guidelines about creating child-friendly environments from multiple levels. The specific definitions and measures of CIM that have been applied in relevant empirical studies were also outlined. In addition, significant correlates of children's independent travel, outdoor play, and general independent mobility were extracted and reported from personal, social, and environmental levels.

During the review process, it was noticed that these CIM studies have diverse contexts, cultural backgrounds, as well as different study designs with various measures of CIM and sample characteristics. The interpretation of their study findings should be carefully situated within their context. Based on the summary of reviewed articles, 43% of them were from Europe, while only 17% of them were from North America and most of those are from Canada (Qiu & Zhu, 2017). The researcher also noticed that all reviewed studies were conducted in an urban or suburban setting, while CIM in rural areas is highly understudied. A metal-analytic review on the association between built environments and CIM also reported that 75% of the identified studies were conducted in developed countries in Europe (50%), and only 8% of the reviewed studies were from North America (Sharmin & Kamruzzaman, 2017). This limitation implies that the identified environment correlates from previous studies may not be generalizable and applicable for other contexts. For example, some previous studies were conducted in European countries where children have the highest independent mobility in the world, supported by the unique urban features and vibrant biking culture. The identified correlates from these European studies may not be applicable in more auto-oriented countries, such as the U.S. and Australia (Shaw et al., 2015; Woolcock & Steele, 2008). Similarly, environmental features

such as the dead-end-street, which was identified as a significant correlate of children's unsupervised outdoor play in developed countries, may not be applicable in less developed countries and areas for promoting children's unsupervised outdoor play (Sharmin & Kamruzzaman, 2017). Contextual issues should be fully considered in future studies and practice.

3. RESEARCH METHODOLOGY*

3.1. Conceptual Framework

Based on the findings from the literature review, a conceptual framework was proposed to examine the correlation between housing and neighborhood physical environments and CIM (Figure 3-1). This framework initially refers to the Social Ecological Theory (McLeroy et al., 1988), which has been widely applied to guide research on contextual influences for human behavior from multiple levels, including intrapersonal factors, interpersonal processes and primary groups, institutional factors, community factors, and public policy; and to optimize relevant inventions. Compared to other theories such as the Health Belief Model (Rosenstock, 1974), Transtheoretical Model (Prochaska & DiClemente, 2005), Theory of Planned Behavior (Ajzen, 1985), Social Learning Theory (Bandura & McClelland, 1977), and Social Cognitive Theory (Bandura, 1998), which mainly focused on changes in human's behavior from an intrapersonal or social factor level, the Social Ecological Theory provides a holistic perspective by incorporating factors from multiple dimensions. Stokols (1992) also further emphasized the hierarchical structure of environmental factors and the influence on multilevel health behavior and wellbeing. In addition, this study also refers to the Social Ecological Model for Child Development proposed by Bronfenbrenner (1979), which specifically emphasized the

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significance of children's immediate environments on their development. This stems from the notion that a child's biological and psychological makeup is based on individual and genetic developmental history, but also continues to be affected and modified by the child's immediate physical and social environments (microsystems), as well as interactions among the systems within the environment (mesosystems). Furthermore, this framework was informed by the ecological approach to creating active living communities proposed by (Sallis et al., 2006), which emphasizes the importance of both perceived physical environments and the objective physical environmental features. On the basis of these previous theories and frameworks, this study's proposed conceptual framework focuses on CIM, taking relevant multi-level factors into account and synthesizing them into a three-level model, including personal, social, and physical environmental factors, with a primary focus on modifiable physical environmental factors.

Within this framework, the objective housing and neighborhood environmental factors are the independent variables. The dependent variable (CIM) is measured through both parents' approval of their children's independent travel or play (i.e., CIM license) and children's actual fulfillment/behavior of independent mobility (e.g., time of independent travel and unsupervised play, locations, and the corresponding spatial range). Parents' approval is a crucial determinant that affects their children's actual implementation of travel and play, and was widely used to represent CIM in previous studies (Cordovil, Lopes, & Neto, 2015; De Meester et al., 2014; Marzi & Reimers, 2018). In addition, this framework considers the perceptions of physical environment as mediators between objective environmental features and CIM, while children's and parents' personal and social factors act as confounding variables.

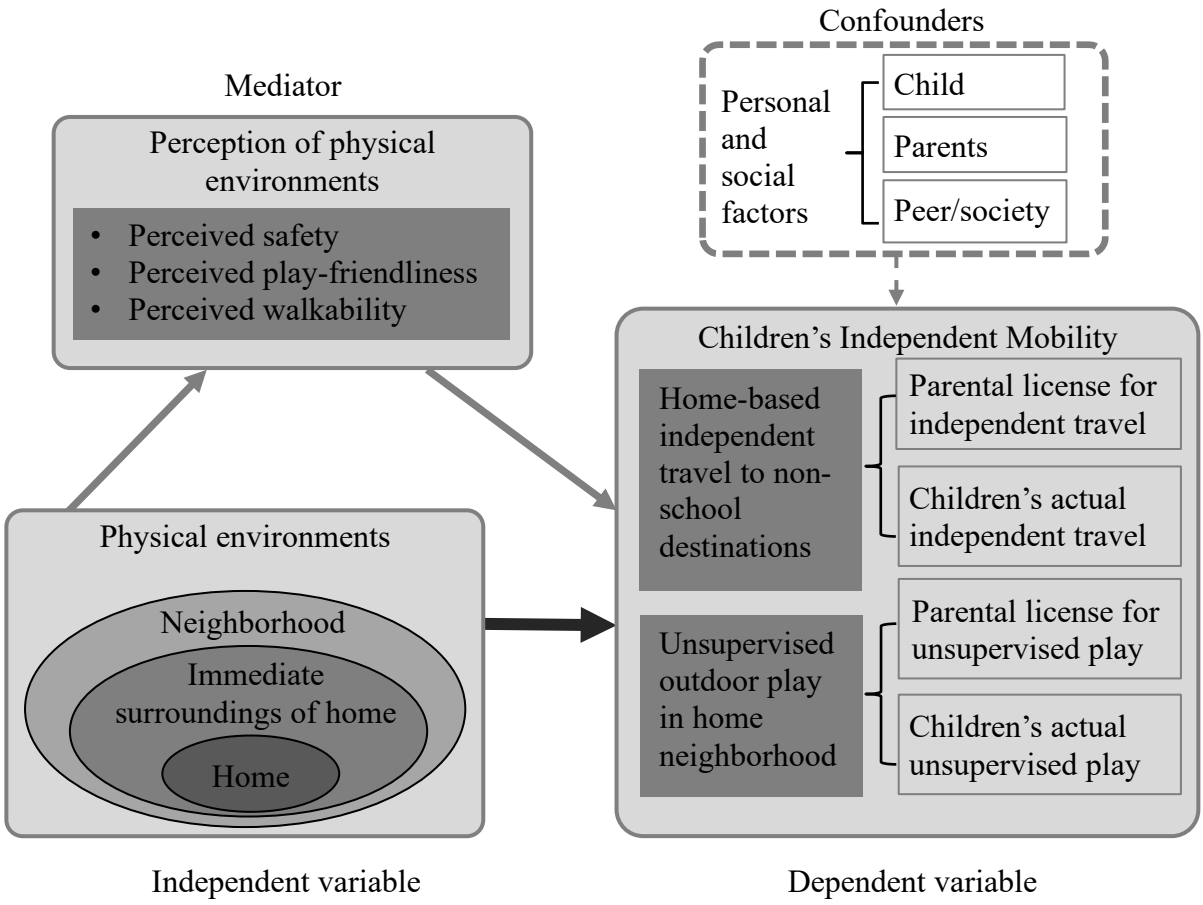

Figure 3-1 Conceptual framework of the multi-level factors which affect two modes of children's independent mobility (updated from Figure 1 in (Qiu & Zhu, 2021)).

3.2. Research Design

This is a cross-sectional study that focuses on children attending a public elementary school in the Austin Independent School District (AISD) or living within the city boundary of Austin, Texas. The aim is to examine the impact of housing and neighborhood environments on children's home-based independent mobility, including home-based independent travel to non-school destinations and unsupervised outdoor play in neighborhood. The roles of personal and social factors were also considered.

The specific hypotheses are: 1) housing and neighborhood environments (including the home environment, the home and its immediate surrounding environments, and neighborhood environments) have significant impacts on parental license for children's home-based independent travel to non-school destinations and unsupervised outdoor play; and 2) personal and social factors also play a significant role in parents' decision making of their children's home-based independent travel to non-school destinations and unsupervised outdoor play.

The protocol of this study, survey instruments, and other materials for contacting study participants and schools were reviewed and approved by the Institutional Review Board at Texas A&M University (IRB2018-0270D). Surveys, Geography Information System (GIS) measures, and Google Street View (GSV) audits were used to collect the study variables. Descriptive analyses were applied to examine the overall level of parental license for children's independent non-school travel and unsupervised outdoor play, children's actual behavior of independent travel and unsupervised outplay, and the distribution of all study variables. Binary logistic regressions were used for data analysis to test the proposed framework and predict CIM.

3.2.1. Study Setting and Population

The study setting is composed of the AISD and a small area that is outside of the AISD but within the boundary of the City of Austin, Texas (Figure 3-2). This area features a distinct mixture of diverse sociodemographic characteristics and varying community environments. Based on the Texas Academic Performance Report, AISD had an enrollment of 79,787 students in the academic year of 2018-2019. More than half of them were Hispanic and the rate of economically disadvantaged students (i.e., those eligible for free or reduced-price meals under the National School Lunch and Child Nutrition Program) was 53.5% (Texas Education Agency,

2019). Among 42,599 students attending a public elementary school in AISD, 56.1% of them were Hispanic (N=23,877), and 57.0% of total students were eligible for free or reduced-price lunch (N=24,297).

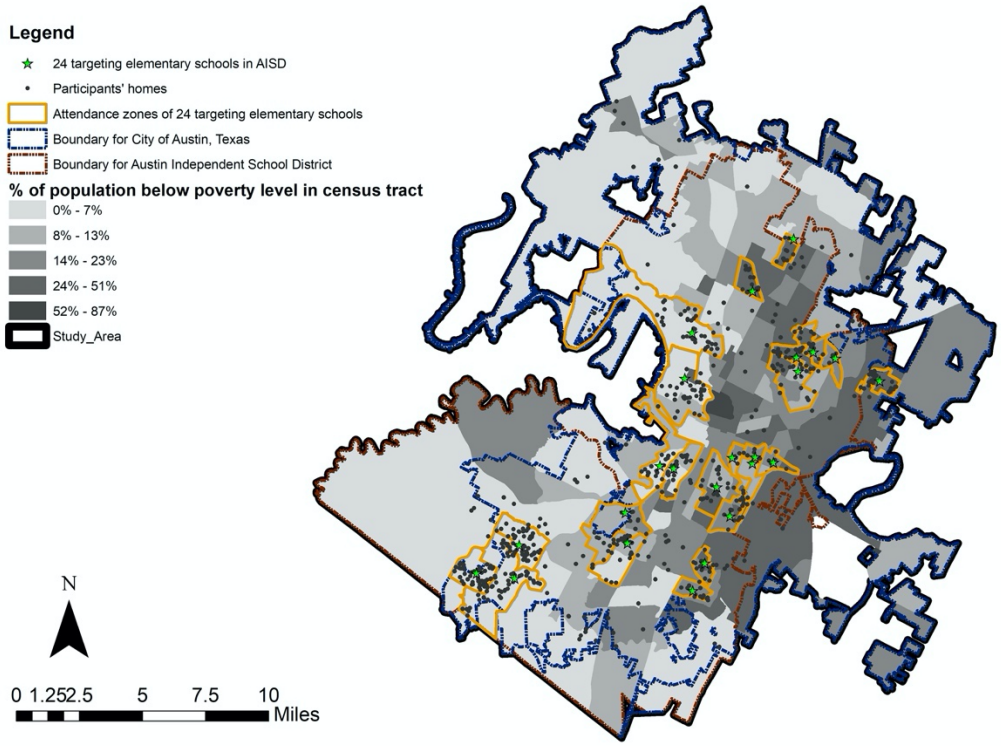

Figure 3-2 Study area and home locations of study participants (modified from Figure 2 in (Qiu & Zhu, 2021)).

The study population is all elementary school students from the study area and their parents/guardians. Elementary school children were chosen as the target population due to their specific developmental characteristics at this unique developmental stage—increased ability of performing actions in reality and developed levels of autonomy and socialization—which are basic skills for a fulfillment of independent travel or unsupervised play (Piaget, 1952, 1962). Meanwhile, elementary school children are just starting to independently explore outdoor

environments and are highly reliant on environmental supports (Evans, 2006; Villanueva et al., 2016). On the other hand, for children younger than the elementary-school age, it is not feasible or meaningful to study their independent mobility because of their physiological and sociological immaturity. Therefore, this study chose elementary-school-aged children from the study area as the study population to examine CIM and the corresponding multi-level correlates.

3.2.2. Data Collection

The data collection process consisted of two phases. In Phase I, a bilingual (English and Spanish) survey was developed and distributed to parents or guardians who lived in the study area and had a child attending a public elementary school to collect information about children's independent travel and play behaviors, their perceptions of housing and neighborhood environmental factors, as well as parents' and child's personal and social factors. In Phase II, GSV audits were conducted to collect objective environmental data about the participant's home and its immediate surroundings. GIS was employed to capture neighborhood-level environmental factors. Additional data for objective environmental features included the public tax appraisal data from Travis and Williamson County's Central Appraisal District; and the Walk Score, Bike Score, and Transit Score of each home location obtained from the Walk Score™ website (https://www.walkscore.com/) (Walk Score, Seattle, WA, USA).

3.2.2.1. Phase I: Parent/Guardian Survey Data Collection

The survey instrument (Appendix A) was created based on two previously validated survey instruments—the Safe Routes to School Survey (Zhu & Lee, 2008) and the Neighborhood Environment Walkability Scale (NEWS)-Youth Survey (Rosenberg et al., 2009), as well as findings from the researchers' literature review (Qiu & Zhu, 2017). The survey instrument has

four sections. The first section asks about children's daily travel. In addition to items from the Safe Routes to School Survey, which primarily assess children's school travel and parents' concerns and attitudes toward walking to/from school, questions about the range and destinations for children's independent non-school travel and parents' attitudes toward children's independent travel were also included. The second section collects information about children's unsupervised outdoor play, including play time, spatial range, and actual locations of play directly around the home and within the neighborhood. A question about parents' attitudes toward children's unsupervised outdoor play is also included. Questions in this section were developed based on findings from the researchers' literature review. The third section asked about the overall perceptions of neighborhood environments, such as access to services, neighborhood surroundings, neighborhood safety, and crime safety, with items from the NEWS-Youth survey. The fourth and final section captures children's and parents'/guardians' sociodemographic factors, other personal information, housing type, and household-related factors.

During the survey instrument development process, cognitive interviews were conducted in April 2018. A convenience sample of ten participants, who 1) had a child attending a public elementary or middle school in the local area, 2) were the main caregiver of their child, and 3) could read and speak English, were recruited from the researcher's institution. They were invited to take the survey with the researcher's accompaniment. During the survey taking process, the participant was asked to read questions one by one loudly, and report any questions, concerns, or comments they had, while the researcher took notes of their comments. The researcher also asked about the reasons for any hesitation that the participation demonstrated while taking the survey. The survey instrument was further tested and finalized after incorporating the comments

and feedback from cognitive interview participants. In addition, considering the high proportion of the Hispanic population in the study area, after the English version was finalized, the research team worked with two undergraduate students with proficient Spanish language skills to create a Spanish version of the survey through a two-way translation process. After paper surveys were finalized, online versions of the English and Spanish surveys with the same content were developed using Qualtrics, an online survey platform widely used for scholarly research (Qualtrics, Seattle, WA).

The survey data collection was conducted between November 2018 and July 2019. Through collaboration with the City of Austin's Safe Routes to School Program, hard copies of the bilingual surveys were delivered to 24 public elementary schools in the AISD. The 24 schools were selected by Zhu and Lee (2009)'s earlier study that used a stratified sampling method to represent the diverse sociodemographic characteristics and neighborhood environmental features in the study area. Parents or guardians were invited to fill out the paper survey and return the survey to their child's school teacher or complete the survey online using the link provided in the cover letter attached to the paper survey. After that, two rounds of survey invitations were posted in the local neighborhood forum—NextDoor—in May and June 2019. The entire survey data collection process was closed at the end of July 2019.

3.2.2.2. Phase II: GIS and GSV Data Collection

After the survey process was closed, participants' home locations were geocoded using the addresses provided in the survey. ArcMap 10.8 (ESRI, Redlands, CA) was applied to measure neighborhood-level objective environmental factors in four spatial units for neighborhood areas around the home, including a half-mile aerial buffer, quarter-mile aerial

buffer, half-mile street network buffer, and quarter mile street network buffer (Figure 3-3). An aerial buffer means a circular area around the participant's home within the radius of a specified distance. A network buffer defines the movement area of people who move along the street network from a start point. For example, a half-mile network buffer in this study defines the area within a half-mile distance of an individual's home. Since there is limited literature about the extent of the neighborhood area that is the most influential for CIM, testing different spatial units in this study allows the researcher to examine which unit is the most crucial in this study context.

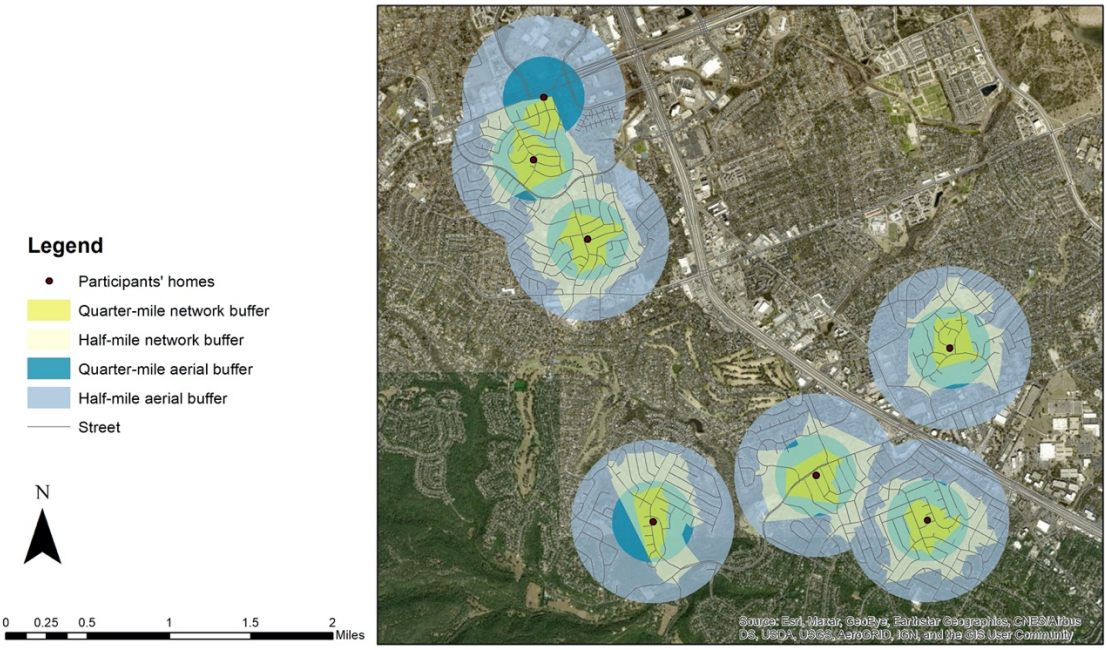

Figure 3-3 Four spatial units of analysis for neighborhood areas around participants' homes.

As identified in previous studies and our conceptual framework, both perceived and objective environmental features can be important for promoting CIM, and empirical knowledge about their roles can inform targeted interventions. In order to measure objective neighborhood

environmental features that may be important for CIM, the researcher collected secondary public data about the study area, such as violent crime data (2016-2019), street centerlines, sidewalk segments, land uses, parks, playgrounds, water features, and tree canopy, from the City of Austin Open Data Portal. Crash data from 2010 to 2019 for Travis County, Hays County, and Williamson County were obtained from the Texas Department of Transportation Crash Records Information Systems. Home addresses of registered sex offenders in Travis, Hays, and Williamson County were downloaded from the Texas Public Sex Offender website. The data about access points of parks were shared by the research team of the Project titled "Physical Activity Impacts of a Planned Activity-Friendly Community: The What, Where, When and Why of Environmental Approaches to Obesity Prevention" at Texas A&M University. The GIS variables were calculated using normalized measurements for each of the four spatial units of analysis (buffer areas as explained above) around each participant's home. The process of GIS data collection and processing was conducted between April 2020 and May 2021. Captured variables included traffic danger, crime danger, land use, neighborhood destinations, public transportation, street connectivity, sidewalk density, tree canopy, and water features.

The objective features of outdoor spaces of participants' homes and their immediate surroundings were measured using GSV audits. The audit instrument (Appendix B) was developed based on a validated tool titled TCOPPE (Texas Childhood Obesity Prevention Policy Evaluation) School Environmental Audit Tool, which is designed to provide reliable evaluations of streets at/around schools and school site environments for safety and walkability related to children's school travel (Lee, Kim, Dowdy, Hoelscher, & Ory, 2013). Items from this instrument include land use along the street segment, street characteristics, walking and biking conditions,

sidewalk characteristics, pollution, and perceptions of the street environments. In addition, a few more items were added to capture housing and neighboring physical environmental features that may be important to child's outdoor play, such as whether the home is in a gated community, the location of the home's parcel lot along the street (i.e., a middle lot of a dead-end street, a middle lot of a regular street, a corner lot of a dead-end street, a corner lot of a regular street, an end lot at a cul-de-sac), the presence of home's outdoor spaces (i.e., front yard, backyard, porch, driveway, frontage street), the presence of nearby neighbors' outdoor spaces (i.e., porch, yard, driveway, frontage street), the presence of shared common areas (i.e., parking lot, yard/lawn, driveway, frontage street), and the presence of apartment complex amenities (i.e., swimming pool, playground, park, sports filed, barbeque/grill/picnic area). The GSV data collection was conducted between September 2020 and May 2021.

3.2.2.3. Other Data Collection

Among a total of 883 valid survey responses, 758 responses included a valid home address, and were geocoded for the analysis of the objective physical environment. The appraisal data for the 753 homes located in Travis County were further extracted from public appraisal data obtained from the Central Appraisal District of Travis County (https://www.traviscad.org/) in November 2019. For five additional homes located in Williamson County, the information about their appraisal data was manually collected from the Central Appraisal District of Williamson County (https://www.wcad.org/). The property appraisal data provide information about the specific housing type or land use, such as whether a single-family residence, condos, duplex, fourplex, multifamily, commercial, or vacant lot. The information was further used to

justify accuracy of the home addresses and housing type collected in surveys for later objective environmental data collection and analysis.

Furthermore, the Walk Score, Bike Score, and Transit Score were also gathered from the Walk Score™ website (http:// www.walkscore.com accessed in March, 2020) (Walk Score, Seattle, WA) for each valid home. Walk Score™ is a company that provides scores on a scale from 0–100 to estimate walkability for a given location (Walk Score), whether a location is good for biking (Bike Score), and how well a location is served by public transit (Transit Score). The Walk Score has been identified as a reliable and valid tool to evaluate neighborhood walkability by many studies (Carr, Dunsiger, & Marcus, 2011; Duncan, Aldstadt, Whalen, & Melly, 2013; Duncan, Aldstadt, Whalen, Melly, & Gortmaker, 2011). The Transit Score has also proven a valid tool to measure transit availability (Bree, 2020). Though the validity of the Bike Score has not been fully testified, the correlation between bikeability and cyclist safety (Osama, Albitar, Sayed, & Bigazzi, 2020), biking behavior (Winters, Teschke, Brauer, & Fuller, 2016), and other biking-related urban and human issues has been identified by recent studies (Fuller & Winters, 2017).

3.2.3. Study Variables and Measures

3.2.3.1. Children's Independent Mobility

Children's home-based independent travel to non-school destinations and unsupervised outdoor play in their home neighborhood were measured through parents' or guardians' report of their parental license for CIM, which represents their permission for the activity; and (2) their child's actual behavior of autonomous travel and play without adult accompaniment. The mobility licenses were assessed using two multiple-choice questions, including "How far away

from home is your child allowed to go without adult accompaniment (alone or with other child(ren))?" and "How far away from home is your child allowed to play in outdoor areas without adult accompaniment (alone or with other child(ren))?" Six options were provided for each question, including "never allowed," "less than 5 min walk," "6–10 min walk," "11–15 min walk," "16–20 min walk," and "more than 20 min walk." With these questions, any travel or play behaviors that were conducted alone or with peers/siblings were considered as CIM for this study, as long as there was no adult accompaniment or supervision. Due to the highly skewed distribution of participants who responded "never allowed," two secondary, binary variables about children's home-based independent travel to non-school destinations and unsupervised outdoor play in their home neighborhood were further created by recoding the responses as "never allowed" and "allowed" (Table 3-1). In addition, parents or guardians were also asked to report specific non-school neighborhood destinations to which the child actually independently travelled. The specific question asked in the survey is "What neighborhood destinations other than school does your child actually go to without adult accompaniment (alone or with other child(ren))?" Information about the daily average time that their child spent on unsupervised outdoor play in total and at specific neighborhood locations (e.g., park, playground, sports filed) and directly near their homes (e.g., own yard, own driveway, frontage street) was also collected in the survey through questions such as the following: "Do you have any of the following located in your neighborhood?" "Do you have any of the following around you home?" "If yes, how many minutes per day does your child play there without adult accompaniment?" The minutes were requested for both min/per weekday and min/per weekend day.

Table 3-1 Definitions, Coding Scheme/Units, and Measures of Dependent Variables.

Variables	Definition	Coding Scheme / Units	Measure
Home-based independent travel to non-school destinations	Parental license for children's independent non-school travel	0 = never allowed; 1 = allowed	Secondary variable created based on survey data
	Neighborhood destinations to which the child travelled without adult accompaniment	Numbers and types of the destinations	Survey
Unsupervised outdoor play in home neighborhood	Parental license for children's unsupervised outdoor play	0 = never allowed; 1 = allowed	Secondary variable created based on survey data
	Daily time of a child's actual unsupervised outdoor play at places directly near home and in home neighborhood	Minutes per weekday Minutes per weekend day	Survey

3.2.3.2. Housing and Neighborhood Physical Environments

Physical housing and neighborhood environments were assessed across three spatial scales/ranges (Figure 3-4), including the participant's home, immediate surroundings of the home, and the surrounding neighborhood. Home environmental variables include housing type, the presence of a home's own outdoor spaces, and a secondary variable that reflects housing type and the presence of its own yard(s). Housing type was initially asked in the survey with a multiple-choice question including six options: "a one-family house detached from any other house," "a one-family house attached to one or more houses (e.g., townhouse)," "a building with 2 to 4 apartments or units," "a building with 5 or more apartments or units," "a mobile home or trailer," and "other." The collected information was further examined and validated using the public appraisal data, because some participants seemed to be unclear about the definitions of certain housing types, such as a building with two-to-four apartments or units (e.g., a duplex, fourplex) and a one-family house attached to one or more houses (e.g., a townhouse). If an inconsistency was noticed between the survey response and the record in the appraisal data of the

dwelling unit, information on the housing type from the appraisal data was used in the analyses. GSV audits were also conducted to further confirm the housing type of those homes and collect the housing type for a few homes that missed the relevant information either in the survey or the public appraisal data. A series of binary variables related to home physical environments, such as the presence of their own front yard, backyard, or driveway, or having a frontage street were also initially measured according to parents'/guardians' responses to the survey and were further checked and validated through GSV audits (Table 3-2). Based on these original measures and assessment of their distributions, a set of dichotomous variables including the presence of a porch, the presence of an open front/side yard, and the presence of an enclosed front/side yard were further created (Table 3-2).

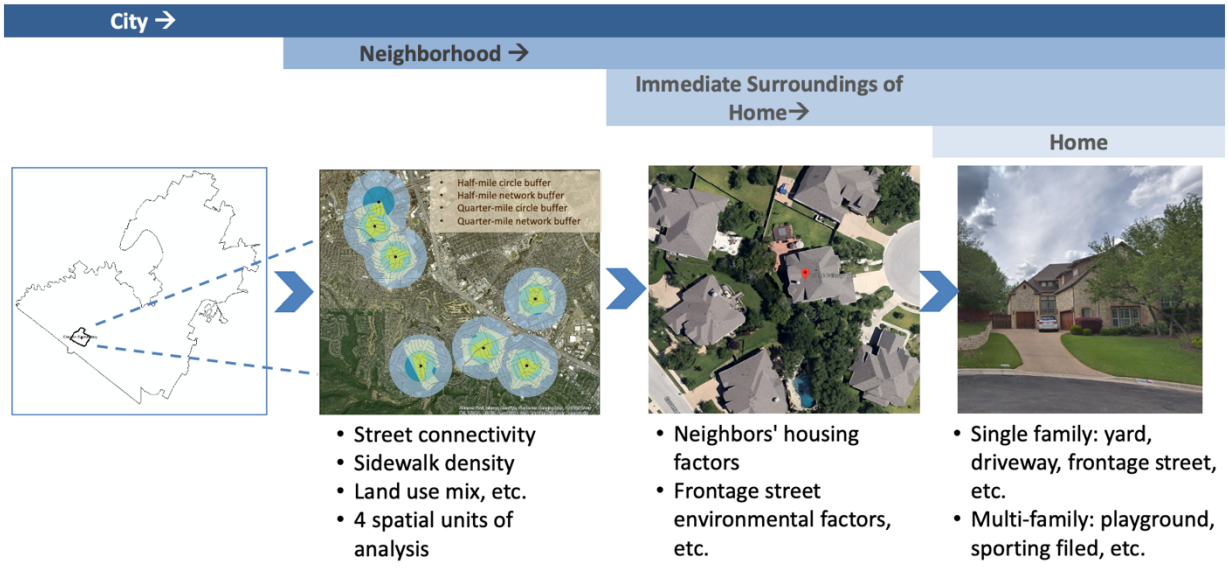

Figure 3-4 Three spatial ranges of objective environmental variables.

Table 3-2 Definitions, Coding Scheme, and Measures of Home Environment-Related Variables.

Variables	Definition	Coding Scheme	Measure
Housing type	Different dwelling types used for homes	0 = a non-single-family home and inside an apartment complex; 1 = a non-single-family home and not inside an apartment complex; 2 = a single-family home	Survey, public appraisal data, and GSV audit
Home's own outdoor spaces	Presence of a home's own outdoor spaces Open front/side yard Enclosed front/side yard Backyard Driveway Frontage street Porch	0 = no; 1 = yes	Survey and GSV audit GSV audit
Housing type and presence of own yard space	Combination of housing type- and yard-related variables	0 = non-single-family without own yard 1 = non-single-family home but own at least one yard; 2 = single-family home	Secondary variable created based on data from the survey, appraisal districts, and GSV audit

Variables for the home's immediate surroundings include those about the 1) presence of certain neighboring spaces, 2) the presence of apartment amenities, 3) characteristics of frontage streets, and 4) characteristics of sidewalks (Table 3-3). The specific variables for neighboring spaces near a participant's home include the presence of 1) an open or enclosed front/side yard, a backyard, front porch, driveway, and frontage street for single-family residences; 2) an open or enclosed front/side yard, a backyard, front porch, driveway, and frontage street for non-single-family residences; and 3) a shared common area for multi-family housing (i.e., parking lot, yard/lawn, driveway, frontage street). Variables about specific apartment amenities include the presence of a swimming pool, playground, park, sports filed, and barbecue/grill/picnic area. Variables related to the characteristics of the frontage street include the presence of a sidewalk, street type (e.g., cul-de-sac/end-end street, one-way street, school zone designated), the presence

of posted speed limits, the presence of street parking, number of lanes, number of street lights, number of driveways and street intersections, the presence of traffic calming device(s) (e.g., speed bump or hump, reduced speed sign, roundabout), the presence of different signs (e.g., crime watch, child safety, stop sign, bike route), number of marked crosswalks, the presence of marked crosswalk connectivity, the presence of drainage problems, average number of stories of buildings along the frontage street, number of windows overlooking the frontage street from both sides of it, number of porches/balconies along the frontage street, and immediate land use along the frontage street. There are also specific variables representing characteristics of the sidewalks, such as ground material, the presence of obstructions along the sidewalk, completeness of the sidewalk, connectivity of the sidewalk, shade and protection from rain along the sidewalk, surface condition (e.g., the presence of holes and cracks, bumps and uneven surfaces, weeds, and litter), and the presence of a buffer between sidewalks and vehicle roadways. All above variables were measured using GSV audits. The frontage street was defined as the street segment right in front of the home and between its two nearest intersections; that is, if a home owns an individual parcel lot (e.g., single-family homes). For homes that do not own their own individual parcel lot (e.g., a unit inside an apartment complex) and do not have available GSV, the frontage street was defined as the street segment in front of the residential building in the center of the complex, and the environmental information was captured using Google Map 3D views instead of real GSV. In addition, as 208 out of 732 homes (28.4%) had no sidewalk along either side of the frontage street, the specific variables related to the characteristics of sidewalks were not included in the later statistical analyses due to the significant loss of sample size.

Table 3-3 Definitions, Coding Scheme/Equations, and Measures of Variables for Immediate Surrounding Environments of Participants' Homes.

Definition	Coding Scheme/Equation	Measure
Home neighboring outdoor spaces		
Presence of neighboring single-family's own outdoor spaces	0 = no; 1 = yes	GSV audit
Open front/side yard		
Enclosed front/side yard		
Front porch		
Driveway		
Frontage street		
Presence of neighboring non-single-family's own outdoor spaces		
Open front/side yard		
Enclosed front/side yard		
Front porch		
Driveway		
Frontage street		
Presence of neighboring non-single-family's shared common outdoor spaces		
Parking lot		
Yard/lawn		
Driveway		
Frontage street		
Presence of any shared amenities in a home's apartment complex (e.g., swimming pool, playground, park, sports filed, Barbeque/grill/picnic area)		
Frontage street environments		
Adjacent buildings		
Height of buildings immediately along both sides of the frontage street segment	Average number of stories of buildings	
Number of windows along both sides of the frontage street segment	Total number of windows overlooking the street	
Number of porches/balconies along both sides of the frontage street segment	Total number of porches/balconies overlooking the street	
Presence of land use along both sides of the frontage street	0 = no; 1 = yes	
Residential		
Single-family housing		
Multifamily housing		
Mobile home		
Commercial		
Educational, office, and service		
Recreational		
Street and sidewalk characteristics		
A cul-de-sac/dead end street	0 = no; 1 = yes	GSV audit
Speed limit posted		
Speed parking	0 = no; 1 = yes, on one end; 2 = yes, on both ends	

Table 3-3 Continued.

Definition	Coding Scheme/Equation	Measure
Number of lanes	Total number of lanes along the frontage street segment	
Number of driveways & street intersections	0 = 0-3; 1 = 4-10; 2 = 11+	
Number of street lights	Total number of street lights along the frontage street segment	
Presence of traffic calming device(s) along the frontage street	0 = no; 1 = yes	
Presence of marked crosswalk connectivity of the frontage street segment		
Presence of marked crosswalk connectivity of the frontage street segment		
Presence of sidewalks along the frontage street		
Walking and biking conditions		
Presence of signs along the frontage street	0 = no; 1 = yes	
Community/cultural/religious/political message or event/historical marker		
Crime watch/surveillance warning/home security service (e.g., ADT)		GSV audit
Stop sign		
No parking/towing enforced		
Presence of unattractive items		
Perceptions of the frontage street		
Surveillance (easily observed from the windows, porches, or yards nearby)	1 = poor; 2 = fair; 3 = good; 4 = very good; 5 = excellent	
Street/sidewalk maintenance (free of cracks, holes, overgrown grass/weeds, etc.)		
Street/sidewalk cleanliness (free of litter, rubbish, broken glass, discarded items, etc.)		
Cleanliness and maintenance of buildings and gardens (clean, well-kept, free of litter, discarded items, etc.)		
Visual quality of street (everything visible from the street)		GSV audit
Visual quality of buildings		
Visual quality of trees/vegetation		
Condition/health of trees/vegetation		
Attractiveness in walking		
Attractiveness in bicycling		
Comfort in walking		
Comfort in bicycling		
Safety in walking (for upper-year elementary school children)		
Safety in bicycling (for upper-year elementary school children)		

The neighborhood-level physical environments were assessed using GSV audits and GIS analysis. A binary variable was created to indicate if a home was located in a gated community, and a categorical variable was generated to represent the different locations of the parcel lot in relation to the street (i.e., a middle lot of a regular street, a middle lot of a dead-end street, a corner lot of a regular street, a corner lot of a dead-end street, an end lot at a cul-de-sac) after capturing the information using GSV audits (Table 3-4).

Other neighborhood-level objective environmental variables were processed in ArcMap by normalized measurements (percentages of densities) for four spatial units (buffer areas) around each participant's home, including half-mile aerial buffers, quarter-mile aerial buffers, half-mile network buffers, and quarter-mile aerial buffers (Table 3-4). The variables include traffic danger (i.e., crash density, proportion of different classifications of roads, presence of highway), crime danger (i.e., violent crime density, registered sex offenders density, presence of registered sex offenders), land uses (i.e., percentage of residential land use, land use mix), street connectivity (i.e., street intersection density, street density), sidewalk density, tree canopy density, water features (density of water features, presence of water features), neighborhood destinations (i.e., park density, distance to nearest park, playground density, distance to nearest playground), and public transportation (i.e., density of public transportation stops, distance to nearest transit stop). These variables were created based on secondary public data such as street centerlines, sidewalk segments, land use inventory, annual crime data (2016-2019), water features, and tree canopy, which were requested and obtained from the City of Austin open data portal (https://data.austintexas.gov).

Table 3-4 Definitions, Coding Scheme/Equations, and Measures of Neighborhood Environment-Related Variables[a].

Variables	Definition	Coding Scheme/Equation	Measure
Home in a gated community	A community only accessible to residents and their guests		
Home parcel lot location	The location of the home parcel vs. street a middle lot of a regular street a middle lot of a dead-end street a corner lot of a regular street a corner lot of a dead-end street an end lot at a cul-de-sac	0 = no; 1 = yes	GSV audits
Traffic danger	Crash density	Total accumulated number of crashes from 2011-2019 in a home buffer/total area of a home buffer; Total accumulated number of crashes from 2011-2019 in a home buffer/total length of streets in a home buffer	GIS
	Density of different classifications of roads	Total length of different classifications of roads in a home buffer/total area of a home buffer	
	Presence of high function roads (e.g., highway)	Presence of high function roads in a home buffer	
	Presence of other classifications of roads	Presence of other classifications of roads in a home buffer	
Crime danger	Violent crime density (sex offenses excluded due to the lack of location information)	Total accumulated number of violent crimes from 2016-2018 in a home buffer/total area of a home buffer	
	Sexual crime danger	Total accumulated number of registered sex offenders in a home buffer Presence of sex offender(s) in a home buffer	
Street connectivity	Street density	Total length of street segments in a home buffer/total area of a home buffer	
	Street intersection (≥ three-way) density	Total number of street intersections (≥ three-way) in a home buffer/total area of a home buffer; Total number of street intersections (≥ three-way) in a home buffer/total length of street segments in a home buffer	
	Cul-de-sac density	Total number of cul-de-sacs in a home buffer/total area of a home buffer; Total number of cul-de-sacs in a home buffer/total length of street segments in a home buffer	

Table 3-4 Continued.

Variables	Definition	Coding Scheme/Equation	Measure
Pedestrian facility	Sidewalk density	Total length of sidewalk segments in a home buffer/total area of a home buffer; Total length of sidewalk segments in a home buffer/total length of street segments in a home buffer	GIS
Land use	Percentage of residential land use	Total area of residential land use in a home buffer/total area of a home buffer	
	Land-use mix (entropy index)	Negative proportion of land use (p) of type 1 times the log of that proportion, plus proportion of land use (p) of type 2 times the log of that proportion, and so on for each of "k" land-use categories all divided by the log of "k." (Song & Knaap, 2004; Song & Rodríguez, 2005)	
Public transportation	Transit stop density	Total number of transit stops in a home buffer/total area of a home buffer	
	Distance to nearest transit stop	Network distance to the nearest transit stop Straight-line distance to the nearest transit stop	
Neighborhood destination—park	Park area density	Total area of the park in a home buffer/total area of a home buffer	
	Distance to nearest park entrance point	Network distance to the nearest park entrance point Straight-line distance to the nearest park entrance point	
	Presence of park	0 = no; 1 = yes	
Neighborhood destination—playground	Playground density	Total number of playgrounds in a home buffer/total area of a home buffer	
	Distance to nearest playground	Network distance to the nearest park entrance point Straight-line distance to the nearest park entrance point	
	Presence of playground	0 = no; 1 = yes	
Urban tree canopy	Tree canopy density	Total area of tree canopies in a home buffer/total area of a home buffer	
Water features	Water feature density	Total area of water features in a home buffer/total area of a home buffer	
	Presence of water features	0 = no; 1 = yes	
Walk Score	A number measures the walkability of a specific location	1 = almost all errands car-dependent; 2 = most errands car-dependent; 3 = walkable	https://www.walkscore.com/
Bike Score	A number measures the bikeability of a specific location	1 = somewhat bikeable; 2 = bikeable; 3 = very bikeable	
Transit Score	A number measures how well a location is served by public transit	1 = minimal transit; 2 = some transit; 3 = good transit	

[a] All neighborhood-level percentage- and density- related variables were measured using ArcGIS. The units of analysis were four different buffer areas around the participants homes: half-mile aerial buffers, quarter-mile aerial buffers, half-mile network buffers, and quarter-mile network buffers.

3.2.3.3. Personal and Social Factors

Children and parents'/guardians' personal sociodemographic factors were captured using the survey. The variables related to children's personal factors include the child's grade level, gender, ethnicity, health conditions, and eligibility for free or reduced-price lunch. The variables related to parents/guardians or the household were the parents'/guardians' highest education level and occupation, home language, years lived in the current residence, pet ownership, and parents'/guardians' negative attitudes toward CIM.

Social factors were also measured using relevant items in the survey. Participants were asked to indicate their agreement with certain statements, such as "People in the neighborhood are willing to help each other," "The neighborhood is a tight community," "People in the neighborhood share the same norms and values" by selecting from a 4-point Likert scale, ranging from "strongly disagree" to "strongly agree."

3.2.4. Data Analysis

Statistical Package for the Social Sciences (SPSS) 27.0 was used to perform all data analyses. Descriptive analyses were first applied to the survey data to gain an understanding of the sociodemographic features of the full study sample and their current levels of CIM. Descriptive statistics of all other variables were also reviewed to help detect outliers and errors, abnormal distributions, and missing values, and to facilitate the decision-making of data recoding, imputation, and reduction, as needed, as well as the next step of statistical analysis.

The two outcome variables about parental license for children's home-based independent non-school travel and unsupervised outdoor play were found to be highly skewed with a larger portion of "never allowed." As a result, they were recoded as binary variables with two

categories (i.e., never allowed vs. allowed) for final analyses using binary logistic regressions. Some other variables with highly skewed distribution were also further recoded. For example, child's ethnicity was recoded as Hispanic and non-Hispanic, instead of four categories of African American, Hispanic, White, non-Hispanic, and others, due to the low percentages of other ethnicities.

Full sample analysis predicting CIM using personal factors, social factors and perceived physical environmental factors. The statistical analysis was first conducted based on the survey data with a full sample size (N=883) to examine the roles of personal, social, and perceived physical environment factors in predicting CIM. Factor analysis and bivariate analyses were used for guiding variable reduction. The percentages of missing data among Likert-scale variables from NEWS items about neighborhood environments and questions developed based on the researchers' literature review were examined, and the range varies from 1.9% to 4.6%. Means were then used for missing value imputation among these variables. Six environment-related factor variables were generated based on the factor analysis, including the quality of the surrounding neighborhood environments, stranger danger, crime danger and barriers for walking, the presence of a sidewalk and buffer in the neighborhood, access to services, and neighborhood surveillance and lighting conditions, as well as one social factor—neighborhood support and impacts from peers. Children's personal factors—grade level, gender, ethnicity, and health conditions—as well as social factors were remained in all final regression models because of their theoretical importance. For other independent and confounding variables, binary logistic regressions were applied to test their bivariate relationships with each outcome variable. Only those with significant bivariate relationships with the outcome variables (p<0.05) were kept for

the later multivariate binary logistic regressions. Six multivariate binary logistic regression models were employed with additional blocks of variables in sequence to examine the roles of personal, social, and housing and neighborhood environmental factors in predicting the outcome variables (Table 3-5).

Table 3-5 Simplified Six Multivariate Binary Logistic Regression Models Predicting CIM.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Predictors	Child's personal factors	Child's personal factors Parental and household's factors	Child's personal factors Parental and household's factors Social factors	Child's personal factors Parental and household's factors Social factors Home environmental factors	Child's personal factors Parental and household's factors Social factors Home environmental factors Neighborhood environmental factors	Child's personal factors Parental and household's factors Social factors Home environmental factors Neighborhood environmental factors Survey version and language; Recruitment channel; School membership

Considering the possible bias caused by different survey versions and survey language, a categorical variable was created to capture these attributes, including the categories of a paper survey in Spanish, paper survey in English, and online survey (all in English). A dummy variable was created to indicate the recruitment channel (i.e., school vs. NextDoor message) and accounts for the possible bias. In addition, considering the possible spatial clustering around schools, a set of dummy variables for students' school membership was generated. There was a total of 23 schools with more than 10 responses, and corresponding dummy variables were created. These additional variables were also tested for their bivariate relationship with each outcome variable,

and those having significant bivariate relationships with the outcome variables were included in the fitting process for the final multivariate models. The person who took the survey (e.g., the mother, father, other guardians) was also tested for its relationship with the outcome. However, it did not show significance in the bivariate analysis and thus was not included in the final models.

Sub-group sample analysis predicting CIM using personal factors, social factors, and objective physical environmental factors. After checking the home address provided in the survey, objective environmental data were collected using GIS and GSV audits for 758 valid home addresses. Similar to the analysis of the survey data for the full sample, factor analysis and bivariate analysis were applied first to facilitate data reduction for the sub-group sample. The social factor variable was generated and included in statistical analysis for this sub-group. For physical environment, instead of perceived measures, the objective environmental data captured by GSV audits and GIS were used to predict two outcome variables. All independent and confounding variables' bivariate relationships with each outcome variable were examined, respectively. Only those variables with a significant (p<0.05) relationship with the outcome variable were retained for the final multivariate binary logistic regressions.

For multivariate binary logistic regression analyses, a base model with only personal and social factors was examined first. Then, the objective environmental variables that were significant during the bivariate tests were added to the base model one by one, while the corresponding impact on the R^2 value of the binary logistic regression model was observed. If adding the variable did not change the R^2 value, then the variable was excluded from the multivariate binary logistic regression model. For multivariate binary logistic regression predicting parental license for children's unsupervised outdoor play, stepwise regression analysis

was performed for housing and neighboring environmental variable reduction for two noticed reasons during the analysis process. First, there were too many variables that were significant during bivariate analyses. Also, high collinearity was detected among some variables such as housing type, home outdoor spaces, neighboring spaces, and land use along the frontage street. The stepwise regression helped identify and keep the most significant housing- and neighboring-level environmental factors in the regression model. For neighborhood-level environmental variables, if different variables were calculated to represent one environmental feature, all variables were also added to the existing model individually, and the one which increased the R^2 value the most was retained in the model for the next step analysis. For example, the crash density was calculated in two ways. One was to divide the accumulated total number of crashes by the total area of the defined buffer, and the other was to divide the accumulated total number of crashes by the total length of the street segment in the defined buffer. The two crash density indexes were tested by adding them into the model individually, and the one generating a greater increase in the R^2 was retained in the model. When adding neighborhood-level environmental variables to the multivariate binary logistic regression analysis, four separate models were tested using variables at four different spatial unites (i.e., half-mile aerial buffer, half-mile network buffer, quarter-mile aerial buffer, and quarter-mile network buffer) to investigate the potential difference across these four units' impacts on CIM. Similar to the analysis of full sample survey data, considering the potential bias, the final model for the sub-group also further included a categorical variable for the survey version and language (i.e., paper survey in Spanish, paper survey in English, online survey all in English), the dummy variables indicating recruitment

channel (i.e., school vs. NextDoor message), and the dummy variables for school membership that showed significant bivariate relationships with the outcomes.

4. RESULTS

4.1. Study Sample

A total of 952 responses were initially received from online and paper surveys, and four of them disagreed to participate in the study. A completeness check of the survey responses was conducted; 920 responses with a completeness greater than 95% were remained. Then, the information of reported children's attending schools was also examined. After excluding responses for children in middle or high school, 896 responses were retained. Those participants' homes were further geocoded and examined in ArcMap. Thirteen of them were excluded as their geocoded home locations did not fall within the study area (i.e., within the AISD boundary or the City of Austin boundary). Ultimately, a total of 883 responses, including 125 responses without a valid home address but with valid school membership, were kept for the survey data-based analysis.

Within this whole sample of 883 responses, a sub-group of 758 responses (735 with a valid home address within the AISD area and 23 with a valid home address outside of the AISD area but within the city boundary) remained for objective environmental data collection and relevant analysis based on survey data and objectively-measured environmental data. This chapter summarizes results from 1) the analysis of descriptive statistics; 2) the analysis of survey data for the full sample (N=883) that predicts two outcome variables using personal, social, and perceived environmental factors; and 3) the analysis that predicts two outcome variables using personal and social factors from the survey data, and objective environmental data from GSV audits and GIS analysis for the sub-group sample (N=758).

4.2. Descriptive Statistics

This section summarizes the characteristics for the full study sample (N = 883) from the survey data. Descriptive statistics were reviewed to understand the study sample's sociodemographic characteristic and their current level of independent mobility.

4.2.1. Sociodemographic Characteristics of the Study Sample and Study Population

Characteristics of students included in the survey data analysis and the study population are provided in Table 4-1. The average grade level of the full study sample was 2.2, which is the same as the average grade level of the study population. Among the study sample, around half of them are girls (49.3%); 43.2% of them are Hispanic, and 39.3% are eligible for free or reduced-price lunch. Compared to the study population, this study sample has a smaller proportion of students who are minorities or eligible for free or reduced-price lunch. Table 4-1 also includes the sociodemographic characteristics of the slightly smaller sub-group (N = 758), for which objective environmental data were also collected and analyzed. Compared to the full sample, the sub-sample has a higher portion of students who are Hispanic (46.1% vs. 43.2%) or eligible for free or reduced-price lunch (42.5% vs. 39.3%).

Table 4-1 Sociodemographic Characteristics of the Full Study Sample, the Sub-Group Sample, and the Study Population.

Sociodemographic characteristics		N (%) or mean (range)		
		Full sample	Sub-group sample	Study population[a]
Child's grade level		2.2 (range: K-5)	2.1 (range: K-5)	2.2 (range: PK-12)[b]
Child's gender (female)		425 (49.3)	372 (50.0)	20,720 (48.7)
Race/ ethnicity	African American	24 (2.9)	22 (3.0)	2,918 (6.9)
	Hispanic	360 (43.2)	334 (46.1)	23,877 (56.1)
	White, non-Hispanic	364 (43.7)	300 (41.4)	12,368 (29.1)
	Other	85 (10.2)	69 (9.5)	3,396 (8.0)
Eligibility for free or reduced-price lunch		338 (39.3)	316 (42.5)	24,297 (57.1)
Total		883	758	42,559

[a] Data source: National Center for Education Statistics, CCD public school data 2018-2019, 2019-2020 school years.
[b] Among all 87 schools, one school had grade levels from PK to 12, and another school had grade levels from 1 to 12.

4.2.2. Descriptive Statistics of CIM

Descriptive statistical analyses were employed to examine the current level of two modes of CIM. The proportion of parental license for children's home-based independent travel to non-school destinations and unsupervised outdoor play are shown in Figure 4-1. For the whole sample ranging from kindergarteners to fifth graders, 49.2% of the parents/guardians would never let their children travel independently to non-school destinations, and the percentage of the parents/guardians who would never permit their child's home-based outdoor play without supervision is 54.4%. When looking at different spatial ranges of mobility, the percentage of parental license for both children's home-based independent travel and unsupervised outdoor play decreased as the mobility range increased (Figure 4-1). This is probably due to increased concerns about children's safety if they are farther away from home.

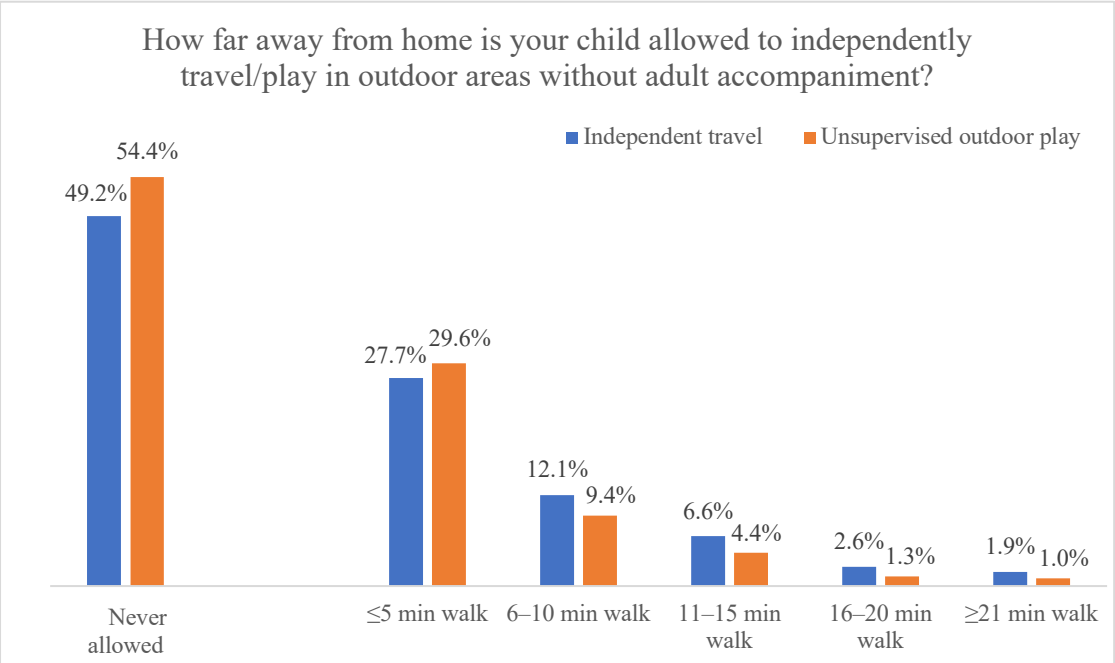

Figure 4-1 Parental license for independent travel to non-school destinations and unsupervised outdoor play.

In addition, the percentage of parents/guardians who would never permit either of the two studied CIM modes is much greater among those with younger children. For example, the percentages of parents/guardians who would never allow children's home-based non-school independent travel for kindergarteners, 1st graders, and 2nd graders measure 67.0%, 61.5%, and 53.1%, respectively (Figure 4-2). Meanwhile, the percentages of parents/guardians who would never allow children's home-based non-school independent travel for 3rd graders, 4th graders, and 5th graders are smaller, at 33.3%, 30.2%, and 29.0%, respectively (Figure 4-2). The percentages of parents/guardians who would never permit their children's unsupervised outdoor play for kindergarteners, 1st graders, and 2nd graders measure 73.9%, 70.6%, and 54.0%, respectively, whereas the percentages for 3rd graders, 4th graders, and 5th graders are also much

smaller at 37.8%, 37.5%, and 34.0%, respectively (Figure 4-3). The results are consistent with previous studies in which children of older ages or higher grade levels showed a significant role in predicating more independent travel to neighborhood destinations (Ghekiere et al., 2017; Prezza et al., 2001) and more autonomy to move around and use public spaces (O'brien et al., 2000; Pacilli et al., 2013).

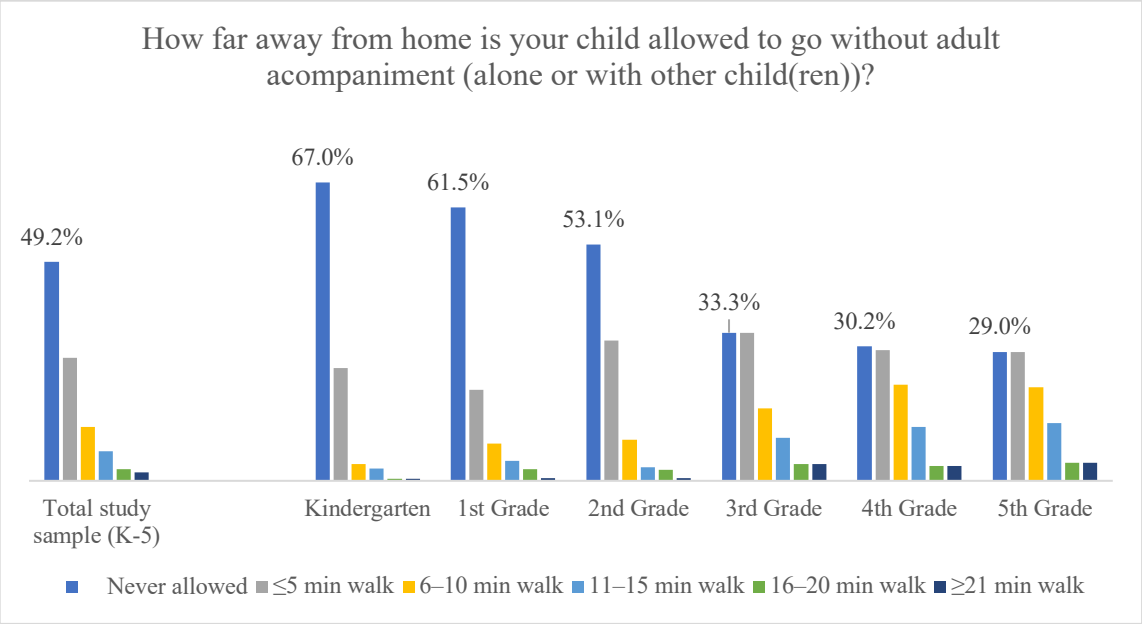

Figure 4-2 Parents' allowed distance of children's independent travel to non-school destinations from home by children's grade level.

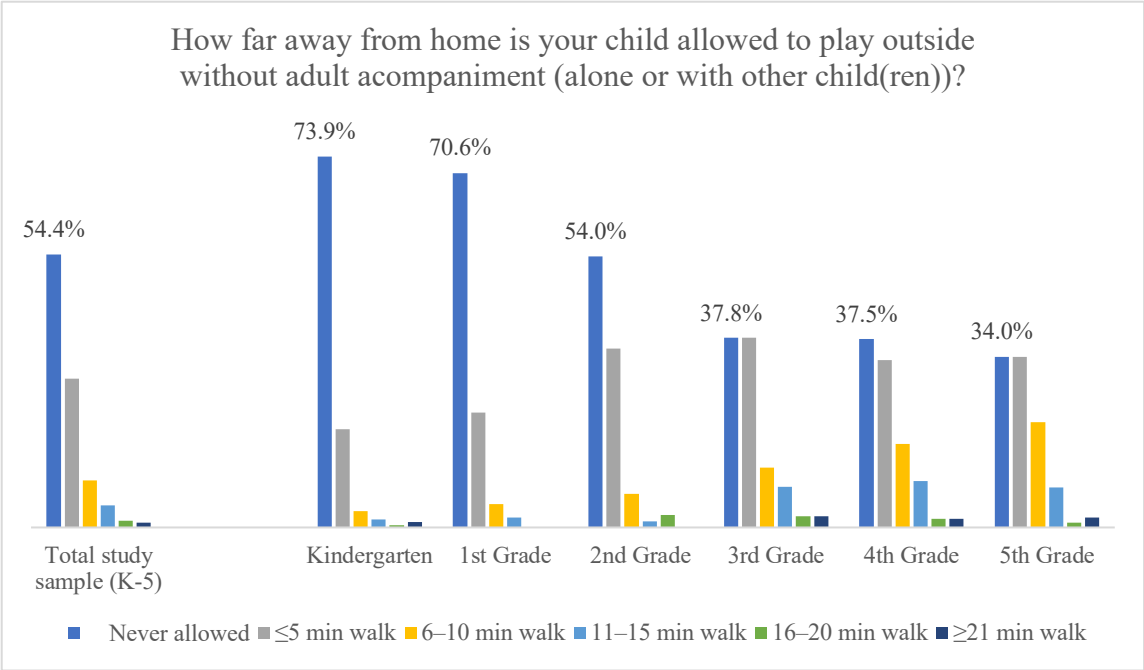

Figure 4-3 Parents' allowed distance of children's unsupervised outdoor play from home by children's grade level.

The descriptive statistics were also reviewed to examine the differences in parental license for CIM between Hispanic and non-Hispanic children, as well as between those who are eligible for free or reduced-price lunch and those who are not. In our sample, the percentage of parents of children who are Hispanic (43.2%) or eligible for free or reduced-price lunch (39.3%) is much smaller than those who are non-Hispanic (56.8%) or not eligible for free or reduced-price lunch (60.7%) (Table 4-1). Based on survey data, for Hispanic children, the percentage of parents or guardians who would never allow them to independently travel to non-school destinations is 65.2%, while only 38.4% of the parents of non-Hispanic children would never allow them to do so (Figure 4-4). For children who are eligible for free or reduced-price lunch, 70.3% of their parents or guardians would never allow them to independently travel to non-

school destinations, while the percentage of "never allowed" is 35.4% for parents of children with no eligibility for free or reduced-price lunch (Figure 4-5).

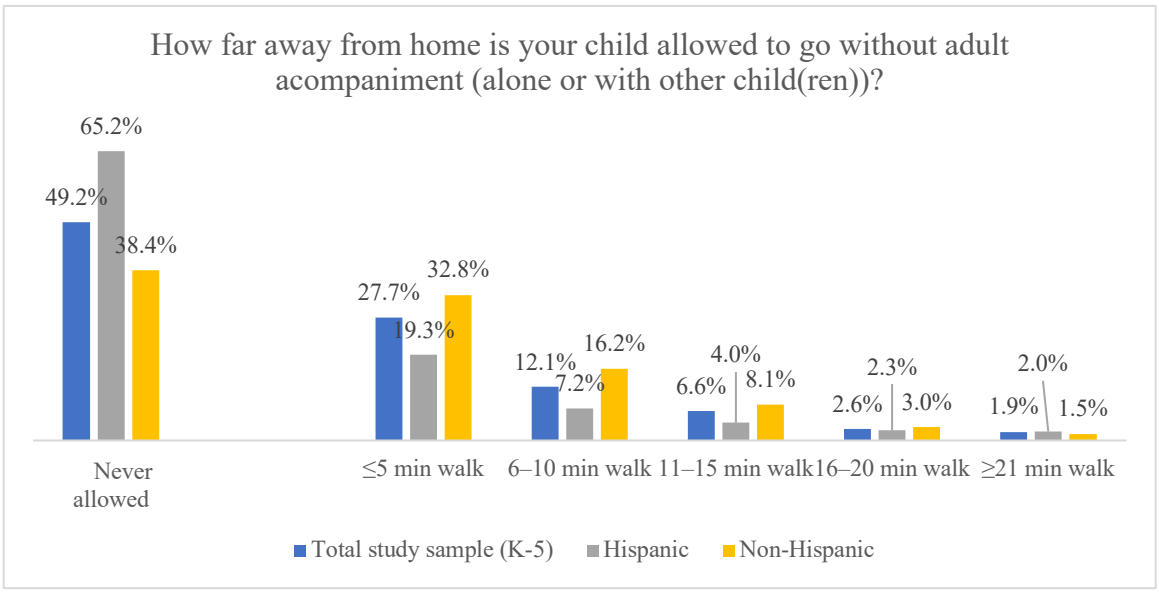

Figure 4-4 Parents' allowed distance of children's independent travel to non-school destinations from home by children's ethnicity.

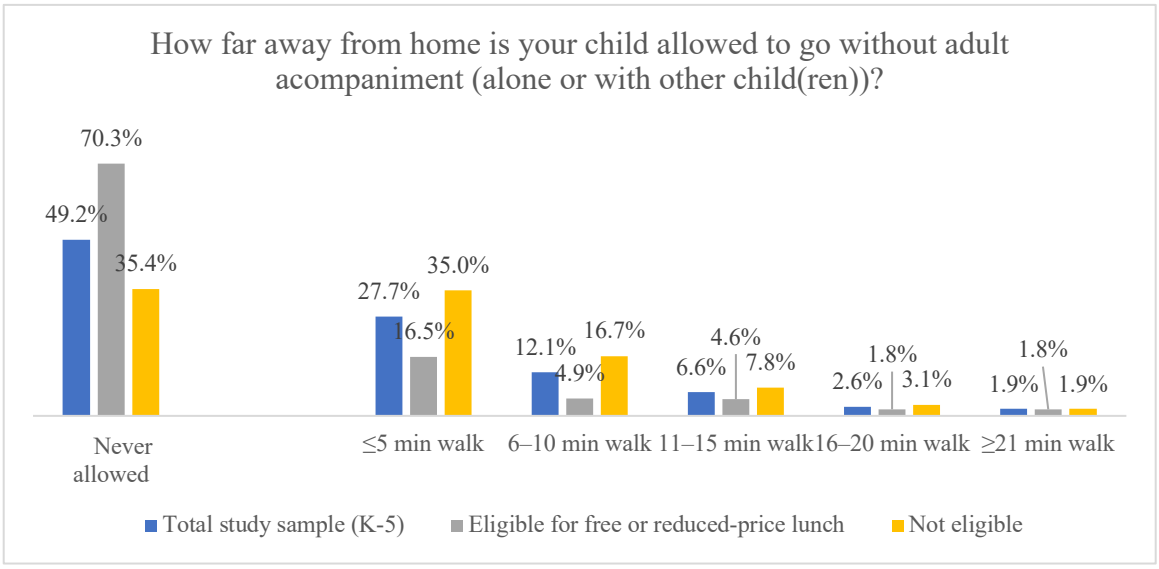

Figure 4-5 Parents' allowed distance of children's independent travel to non-school destinations from home by children's eligibility for free or reduced-price lunch.

For children's unsupervised outdoor play, 70.7% of Hispanic children's parents or guardians would never allow them to do so, while the percentage of "never allowed" is 42.4% for non-Hispanic children's parents or guardians (Figure 4-6). Furthermore, for children who are eligible for free or reduced-price lunch, 72.3% of their parents would never allow unsupervised outdoor play, while for children who are not eligible for free or reduced-price lunch, only 42.2% of their parents would never allow this behavior (Figure 4-7). Overall, parents of children who are Hispanic or eligible for free or reduced-price lunch had stricter restrictions on both CIM modes.

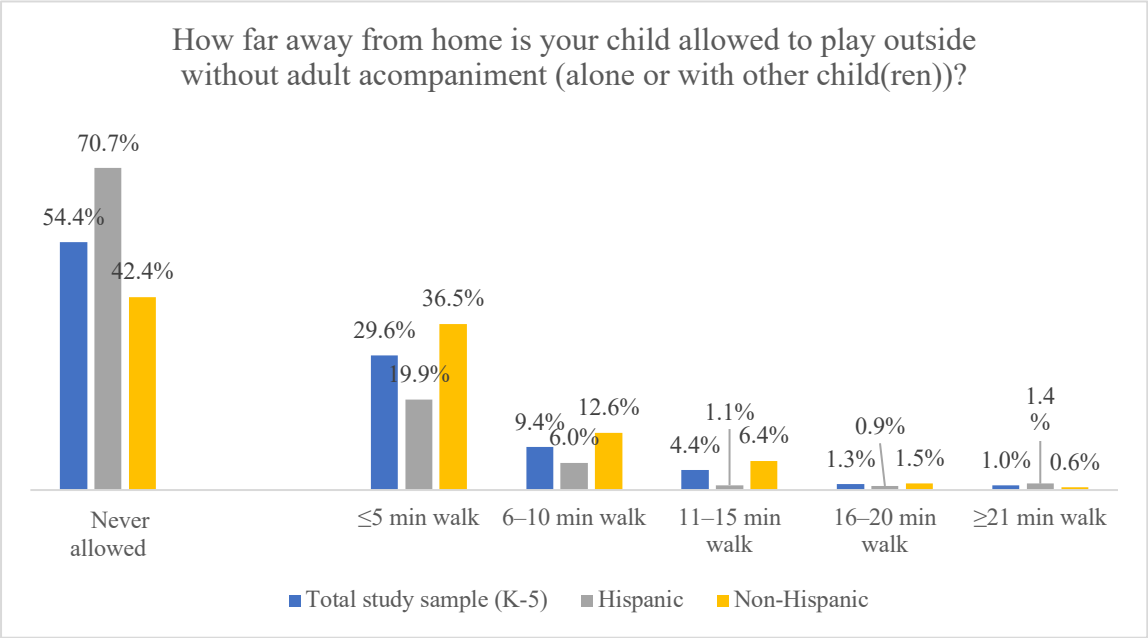

Figure 4-6 Parents' allowed distance of children's unsupervised outdoor play from home by children's ethnicity.

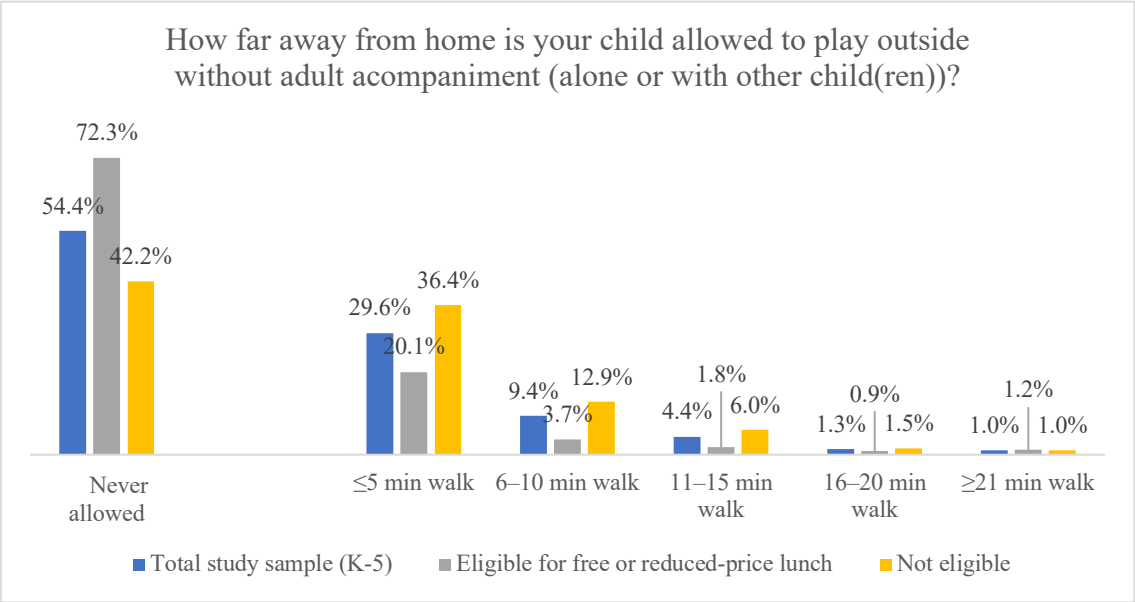

Figure 4-7 Parents' allowed distance of children's unsupervised outdoor play from home by children's eligibility for free or reduced-price lunch.

Parents' negative attitudes toward CIM were also examined in these different groups. Parents' negative attitudes toward children's independent travel were captured by asking parents how much they agreed with the statement that "Parents should NOT let children of this age travel to and from places without an adult's supervision" (1= strongly disagree,… 5= strongly agree). Parents' negative attitudes toward unsupervised outdoor play were captured by asking about the level of agreement for the statement that "Parents should NOT let children of this age play alone or with peers in the neighborhood without an adult's supervision" (1= strongly disagree,… 4= strongly agree). Overall, the parents of children who are Hispanic or eligible for free or reduced-price lunch had stronger negative attitude toward both children's independent travel and unsupervised outdoor play (Table 4-2). Meanwhile, it should be noted that Hispanic children and those who are eligible for free or reduced-price lunch are somewhat underrepresented in this

study, and this might have led to some biases in our study results. Future studies should focus on sampling efforts to ensure sufficient representation of these more disadvantaged populations, and thereby improve the accuracy of CIM levels captured in the study, as well as the generalizability of the results.

Table 4-2 Parents' Negative Attitude toward Independent Travel and Unsupervised Outdoor Play by Children's Ethnicity and Eligibility for Free or Reduced-Price Lunch.

	Parents should NOT let children of this age:					
	Travel to and from places without an adult's supervision. (1 = strongly disagree,… 5 = strongly agree)			Play alone or with peers in the neighborhood without an adult's supervision. (1 = strongly disagree,… 4 = strongly agree)		
	N (%)	**Mean**	**SD**	**N**	**Mean**	**SD**
Hispanic	360 (43.2%)	4.05	1.34	360 (43.2%)	3.2	1.07
Non-Hispanic	473 (56.8%)	3.11	1.42	473 (56.8%)	2.33	1.07
Eligible for free or reduced-priced lunch	338 (39.3%)	4.14	1.31	338 (39.3%)	3.26	1.03
Not eligible for free or reduced-priced lunch	521 (60.7%)	3.11	1.4	521 (60.7%)	2.33	1.08
Total	883	3.52	1.45	883	2.71	1.15

For children's actual independent travel to non-school destinations, based on the parents'/guardians' survey responses, 41.4% of them selected a friend's or relative's home within the neighborhood as the most popular neighborhood destination that their children actually independently travel to from their home (Figure 4-8). Other popular neighborhood destinations are neighborhood streets (16.2%), playgrounds (11.%), and parks (10.0%). This finding is also consistent with previous studies that reported a friend's or relative's home in the neighborhood as the most frequently visited neighborhood destination for children's non-school independent travel (Mackett et al., 2007; Villanueva et al., 2013).

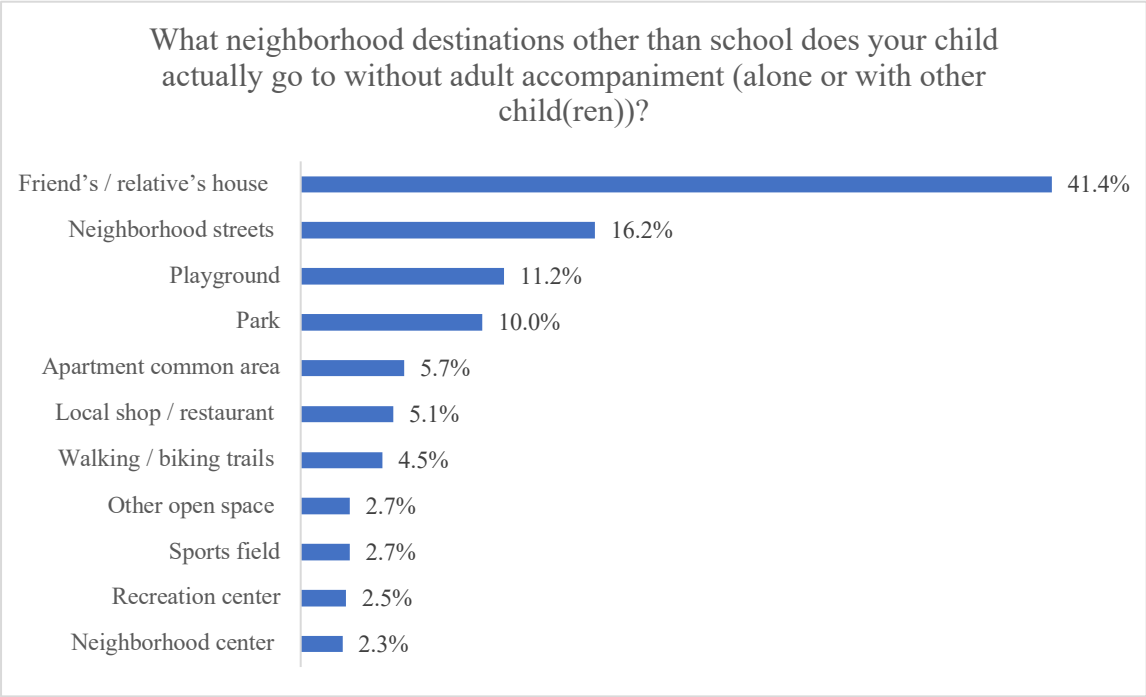

Figure 4-8 Non-school neighborhood destinations to which children independently travel.

Aiming to better understand the spatial and temporal patterns of children's unsupervised outdoor play, the survey also asked about the availability of neighborhood destinations and places around home, and the length of time that the child played there on a typical week day and weekend day without an adult's supervision. Table 4-3 shows that the average time that children spent playing at an available neighborhood destination on a weekday and a weekend day based on the full study sample (N=883).

Table 4-3 Length of Time of Children's Unsupervised Outdoor Play at Different Neighborhood Locations (N=883).

Neighborhood destinations	Weekend day (min/day)		Weekday (min/day)	
	Mean	SD	Mean	SD
Friend's/relative's house	17.1	36.6	8.5	21.7
Park	6.5	19.7	3.0	12.4
School	2.9	13.1	2.8	10.2
Playground	5.1	16.8	2.7	12.7
Other open space	3.0	12.8	1.9	11.5
Apartment common area[a]	2.2	13.5	1.7	9.8
Walking/biking trails	3.0	12.2	1.4	6.6
Neighborhood/recreation center	1.1	8.4	0.9	6.4
Sports field	1.8	9.6	0.8	5.1

[a] The presence of apartment common area was adjusted according to audit data.

Figure 4-9 illustrates the percentages of participants with available destinations in their neighborhood and their child's average play time at those places on a typical weekday and weekend day. Park is the neighborhood destination with the highest availability (67.6%), followed by school (66.2%) and playground (66.1%). However, children spent relatively less time playing unsupervised at any of those three neighborhood destinations. On average, children only spent 4.8 minutes on a weekday and 10.8 minutes on a weekend day playing at park without adult supervision, while they spent most of their unsupervised play time at a friend's or relative's home in their neighborhood on a weekday (an average of 19.7 minutes per day) and a weekend day (an average of 40.6 minutes per day). Meanwhile, less than half of the participants (48.1%) reported the presence of a friend's or relative's home in their neighborhood. For other locations, the popularity varied between weekdays and weekend days. Other open neighborhood spaces, a sports field, and an apartment common area are the most popular places for unsupervised outdoor play following a friend's or relative's home on weekdays. A sports field, other open spaces, and a park are the most popular neighborhood play places following a friend's or relative's home on weekend days.

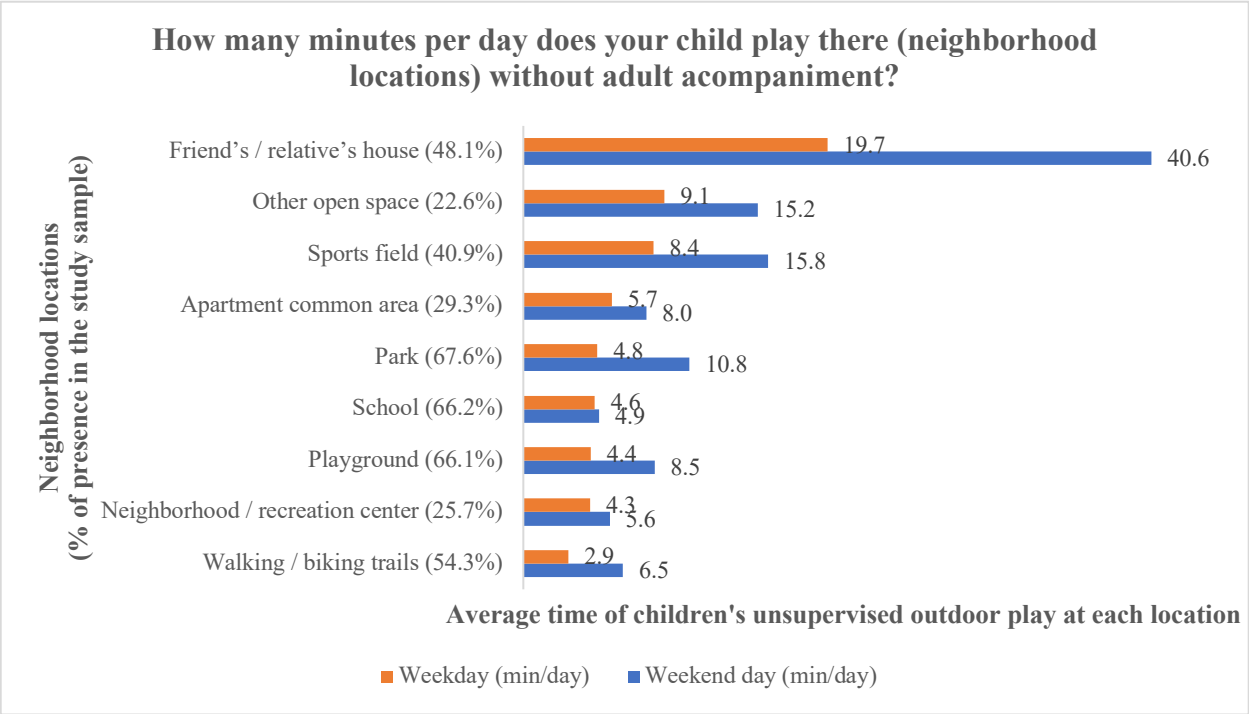

Figure 4-9 Percentages of participants with specific neighborhood amenities and among them the length of time their child engaged in unsupervised outdoor play at each location.

For children's unsupervised outdoor play at places directly near the home, Table 4-4 displays the average time that children spent on a weekday and weekend day at those places based on the full study sample (N=883). Figure 4-10 shows the percentages of participants who own a backyard (74.5%), front yard (75.5%), driveway (70.0%), and frontage street (60.6%). Among families with those places, children spent the most time playing in their own yards, especially backyards, without supervision. On average, children spent 21.0 minutes playing in their own backyards on a typical weekday, and 43.8 minutes on a typical weekend day, unsupervised. The average unsupervised play time they spent in own front yard was 16.6 minutes on a weekday and 34.2 minutes on a weekend day. The findings are similar to those reported by

a qualitative study investigating children's free time play by interviewing their parents (Veitch, Bagley, Ball, & Salmon, 2006).

Table 4-4 Length of Time of Children's Unsupervised Outdoor Play in Places Near Home (N=883).

Places near home[a]	Weekend day (min/day)		Weekday (min/day)	
	Mean	SD	Mean	SD
Own backyard	31.7	42.0	15.3	20.3
Own front yard	24.9	42.7	12.3	23.2
Own driveway	15.4	33.6	8.0	16.1
Frontage street	9.8	30.7	5.0	15.7

[a] The presence of home outdoor spaces was adjusted according to audit data.

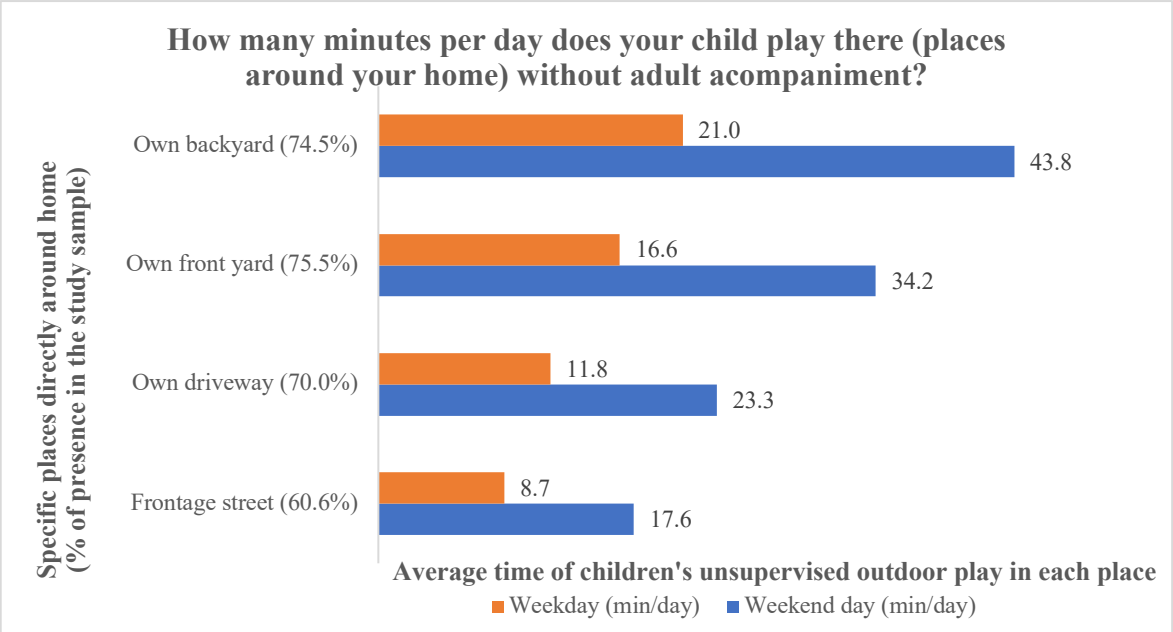

Figure 4-10 Percentage of participants with specific places directly near home and the length of time their child spent in each place engaged in unsupervised outdoor play.

4.3. Statistical Analysis

Two sets of binary logistic regression models were tested. The first set predicted two outcome variables using personal, social, and perceived environmental factors from the survey data for the full sample (N=883). The second set of models predicted the two same outcomes

using personal and social factors from the survey and the objective environmental factors from GSV audits and GIS analysis for the sub-group (N=758). For each outcome variable in this second set of models, four separate models with different spatial units of analysis (buffers around participants' homes) were tested. These different regression models were compared in terms of the coefficients and levels of significance for specific predictors and the pseudo R^2 of the whole model.

4.3.1. Predicting CIM Using Personal, Social, and Perceived Environmental Factors

In this section, the results from the data reduction process (i.e., bivariate and factor analyses) are illustrated first. Then, the results from two multivariate binary logistic regression models predicting parental license for independent non-school travel and unsupervised outdoor play are presented, respectively.

4.3.1.1. Factor and Bivariate Analysis

By using factor analysis, six environment-related factors and one social factor were extracted from the NEWS-Youth items included in this survey, and additional survey questions were developed based on the researchers' literature review. The six environment-related factor variables are: 1) the quality of the surrounding neighborhood environment, 2) stranger danger, 3) crime danger and barriers for walking, 4) the presence of sidewalks and buffers in the neighborhood, 5) access to services, and 6) neighborhood surveillance and lighting conditions. The social factor-related factor variable is neighborhood support and impacts from peers. Among all 40 original survey items, 33 of them were loaded on one primary factor with moderate loadings (0.4-≤0.6 for three factors) or high loadings (>0.6 for four factors).

Table 4-5 illustrates the results from the bivariate data analyses that tested the correlation between each independent variable and each outcome variable. Child's personal and social factors were included in the final model, regardless of their significance in these bivariate analyses because of their theoretical importance. Other potential predictors were included in the final model only if they significantly predicted the outcome variable in the bivariate test.

Table 4-5 Descriptive Statistics of Predictors and the Bivariate Relationship between Each Predictor and Each Outcome Variable (Unadjusted, Full sample, N=883).

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Child's personal factors				
Child's gender	0 = female, 1 = male	50.7	1.130	1.078
Child's grade level	0 = kindergarten, 1 = first grade …, 5 = fifth grade	2.180 (1.648)	1.464***	1.490***
Child's ethnicity	0 = non-Hispanic, 1 = Hispanic	43.2	0.332***	0.316***
Eligibility for free or reduced-price lunch	0 = no, 1 = yes	39.3	0.231***	0.296***
Child's health conditions	The total number of health conditions a child has	0.23 (0.590)	0.882	0.737*
Parental and household factors				
Parent's highest education	1 = elementary or less …, 6 = graduate or professional degree	4.48 (1.548)	1.552***	1.402***
Parent's occupation—employed	0 = no, 1 = yes	66.2	1.574**	1.776***
English as home language	0 = no, 1 = yes	69.0	2.500***	2.400***
Year(s) living in current residence	1 = < 2 years; 2 = 2-<4 years; 3 = 4-<6 years; 4 = 6-<8 years; 5 = 8-<10 years; 6 = 10 years or longer	3.41 (1.810)	1.246***	1.163***
Home ownership	0 = rent, 1 = own	59.2	3.800***	3.779***
Reason for choosing current residence				
Quality of neighborhood	0 = no, 1 = yes	54.4	2.919***	2.745***
Easy to walk around	0 = no, 1 = yes	26.0	1.991***	1.913***
Household's car ownership	Number of motor vehicles in the household	1.825 (0.734)	1.541***	1.384**

Table 4-5 Continued.

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Dog ownership	0 = no, 1 = yes	44.4	1.339*	1.372*
Parent's negative attitude toward independent travel ("Parents should NOT let children of this age travel to and from places without an adult's supervision.")	1 = strongly disagree …, 5 = Strongly agree	3.517 (1.452)	0.476***	N/A
Parent's negative attitude toward unsupervised outdoor play ("Parents should NOT let children of this age play alone or with peers in the neighborhood without an adult's supervision.)	1 = strongly disagree …, 4 = strongly agree	2.709 (1.149)	N/A	0.302***
Social factors				
Social connection ("I feel connected to people in my neighborhood.")	1 = strongly disagree …, 5 = strongly agree	3.590 (1.234)	1.414***	1.503***
Neighborhood support and impacts from peers	Factor (range: -3.00623, 2.17103)	0.000 (0.997)	1.569***	1.881***
Housing and neighborhood environmental factors				
Housing type and presence of own yard space (ref: non-single-family without own yard)[a]	0 = non-single-family without own yard; 1 = non-single family but have at least one own yard; 2 = single-family housing			
Non-single-family but have at least one own yard		8.5	1.307	0.961
Single-family housing		67.0	4.007***	3.502***
Housing type and presence of own yard space (ref: single family-housing)				
Non-single-family but have at least one own yard		8.5	0.326***	0.274***
Non-single-family without own yard		24.5	0.250***	0.286***
Presence of… around home[a]	0 = no, 1 = yes			
Own driveway		65.6	N/A	3.460***
Frontage street		74.0	N/A	2.635***
Presence of… in neighborhood	0 = no, 1 = yes			
School		66.2	1.281 †	0.853
Park		67.6	1.243	1.041
Playground		66.1	1.486**	1.426*
Sports field		40.9	1.240	1.126
Walking/biking trails		54.3	1.644***	1.347*
Neighborhood/recreation center		25.7	0.980	0.997
Friend's/relative's house		48.1	2.881***	3.012***

Table 4-5 Continued.

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Apartment common areas[a]		29.6	0.298***	0.301***
Other open space		23.9	1.293	1.101
Quality of surrounding neighborhood environment	Factor (range: -3.34584, 2.88142)	0.000 (0.997)	1.261**	1.159*
Stranger danger	Factor (range: -2.63015, 2.27150)	0.000 (0.997)	0.496***	0.456***
Crime danger and barriers for walking	Factor (range: -2.88790, 3.50552)	0.000 (0.997)	0.832**	0.879†
Presence of sidewalks and buffers in neighborhood	Factor (range: -2.91318, 2.32176)	0.000 (0.997)	0.921	0.837**
Access to services	Factor (range: -2.56332, 2.74505)	0.000 (0.997)	0.890†	0.882†
Neighborhood surveillance and lighting conditions	Factor (range: -2.74431, 2.64756)	0.000 (0.997)	1.005	1.002
Walk Score (ref: almost all errands car-dependent)	1 = almost all errands car-dependent;	31.8		
Most errands car-dependent	2 = most errands car-dependent;	34.3	1.018	0.963
Walkable	3 = walkable	33.9	0.494***	0.510***
Walk Score (ref: walkable)		33.9		
Most errands car-dependent		34.3	2.060***	1.889***
Almost all errands car-dependent		31.8	2.025***	1.962***
Transit Score (ref: minimal transit)	1 = minimal transit;	24.5		
Some transit	2 = some transit; 3 = good transit	66.9	0.474***	0.516***
Good transit		8.6	0.287***	0.310***
Transit Score (ref: good transit)		8.6		
Some transit		66.9	1.652†	1.663†
Minimal transit		24.5	3.481***	3.225***
Bike Score (ref: somewhat bikeable)	1 = somewhat bikeable;	40.0		
Bikeable	2 = bikeable; 3 = very bikeable	42.5	0.999	1.124
Very bikeable		17.6	0.992	0.840
Bike Score (ref: very bikeable)		17.6		
Bikeable		42.5	1.007	1.338
Somewhat bikeable		40.0	1.008	1.190
Survey version and language (ref: paper survey in Spanish)	1 = paper survey in Spanish;	22.8		
Paper survey in English	2 = paper survey in English;	52.9	1.987***	1.406
Online survey (all in English)	3 = online survey	24.3	6.028***	4.264***

Table 4-5 Continued.

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Recruitment channel	0 = NextDoor message, 1 = school	93.7	0.365**	0.487*
School membership[b]	0= no, 1 = yes			
Mills Elementary		9.9	2.085**	1.377
Clayton Elementary		8.3	2.101***	2.622***
Overton Elementary		7.1	0.307***	0.398**
Kiker Elementary		6.7	3.363***	2.898***
Casey Elementary		5.3	2.990**	3.698***
Harris Elementary		4.1	0.408*	0.999
Wooten Elementary		4.0	0.374*	0.481
Highland Park Elementary		5.3	1.702	1.983*
Houston Elementary		3.7	0.164***	0.194**
Brook Elementary		2.2	0.559	0.217*
Sanchez Elementary		1.9	0.135**	0.359
Survey taken by mother	0 = no, 1 = yes	83.1	0.883	0.914

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; SD = standard deviation; OR = odds ratio.
[a] Variables were adjusted according to audit data.
[b] 22 school membership variables were tested in the bivariate analysis; only significant variables are listed in this table.

4.3.1.2. Multivariate Binary Logistic Regression Analyses

Six multivariate binary logistic regression models (see Table 3-5) were employed in a sequential order to predict the odds of each of the two dependent variables—parental license for independent travel to non-school destinations and parental license for unsupervised outdoor play, respectively. The Nagelkerke R^2 was applied as an estimate for the percentage of variance explained by each model and for the comparison of six models (Table 4-6). For independent travel to non-school destinations, the base model (i.e., Model 1) with only the child's personal factors explained 26.6% of the variance in predicting parental license for this CIM mode. After adding parental and household factors, Model 2 explained 40.8% of the variance. Models 3 and

4, which contain additional social factors and home environmental factors, only slightly increased the percentage of the explained variance to 40.9% and 41.1%, respectively. Model 5, which added neighborhood environmental variables, increased the explained variance to 47.4%. Model 6 (the final full model) with further added variables indicating the survey version and language, recruitment channel, and school membership, increased the R^2 value to 0.510.

Table 4-6 Nagelkerke R^2 of Multivariate Binary Logistic Regression Models Predicting CIM.

	Predictors in the model	Nagelkerke R^2	
		Outcome 1: parental license for independent travel to non-school destinations	**Outcome 2: parental license for unsupervised outdoor play**
Model 1	Child's personal factors	0.266	0.255
Model 2	All the above + Parental and household's factors	0.408	0.488
Model 3	All the above + Social factors	0.409	0.506
Model 4	All the above + Home environmental factors	0.411	0.513
Model 5	All the above + Neighborhood environmental factors	0.474	0.565
Model 6	All the above + Survey version and language, recruitment channel, and school membership	0.510	0.596

Similarly, for models predicting parental license for unsupervised outdoor play, the base model (i.e., Model 1) with only the child's personal factors explained 25.5% of the variance. With the addition of parental and household factors, the percentage of variance explained by Model 2 increased to 48.8%. Furthermore, after adding social factors and home environmental variables, the percentage of variance explained by Models 3 and 4 were 50.6% and 51.3%, , respectively. The percentage of variance explained was further increased to 56.5% when the model included all predictors from personal, social, and physical environment levels. The final full model with additional variables indicating the survey version and language, recruitment

channel, and school membership explained 59.6% of the variance in predicting parental license for unsupervised outdoor play.

Table 4-7 shows the results from the two adjusted final full models predicting parental license for independent travel to non-school destinations and unsupervised outdoor play using personal, social, and perceived physical environment factors. In the model predicting parental license for independent travel to non-school destinations, higher grade levels (odds ratio (OR) = 1.380, 95% confidence interval (CI) = 1.211, 1.573, $p<0.001$) and more years lived in the current residence (OR = 1.181, 95% CI = 1.046, 1.333, $p<0.01$) were significantly associated with the increased odds of parental license for this CIM behavior. Meanwhile, the number of health conditions of the child (OR = 0.652, 95% CI = 0.434, 0.981, $p<0.05$) and parents' or guardians' negative attitude toward children's independent travel (OR = 0.588, 95% CI = 0.499, 0.693, $p<0.001$) were significantly associated with the reduced likelihood of children being granted approval to do so by parents or guardians. However, neither of the two social factors were significant at the $p<0.05$ level in predicting parental license for independent non-school travel. Being employed was marginally associated with a reduced likelihood for parents to allow children's independent travel to non-school destinations ($0.05\leq p<0.1$).

Table 4-7 Binary Logistic Regressions Predicting Parental License for Independent Travel to Non-School Destinations and Unsupervised Outdoor Play Using Personal, Social, and Perceived Physical Environment Factors (Adjusted Final Model, Full Sample, N=883).

Predictors	Coding scheme or range of factors	OR (95% CI)	
		Model 1: predicting parental license for independent travel to non-school destinations (N = 724)	Model 2:predicting parental license for unsupervised outdoor play (N = 734)
Child's personal factors			
Child's gender	0 = female, 1 = male	0.949 (0.637, 1.413)	0.993 (0.648, 1.523)
Child's grade level	0 = kindergarten, 1 = first grade …, 5 = fifth grade	1.380 (1.211, 1.573)***	1.461 (1.272, 1.679)***
Child's ethnicity	0 = non-Hispanic, 1 = Hispanic	1.465 (0.800, 2.682)	1.032 (0.531, 2.005)
Eligibility for free or reduced-price lunch	0 = no, 1 = yes	0.690 (0.350, 1.359)	1.621 (0.757, 3.472)
Child's health conditions	The total number of health conditions a child has	0.652 (0.434, 0.981)*	0.491 (0.307, 0.785)**
Parental and household factors			
Parent's highest education	1 = elementary or less …, 6 = graduate or professional degree	1.033 (0.812, 1.313)	1.059 (0.812, 1.382)
Parent's occupation—employed	0 = no, 1 = yes	0.643 (0.392, 1.054) †	1.364 (0.801, 2.324)
English as home language	0 = no, 1 = yes	1.129 (0.588, 2.165)	1.638 (0.784, 3.420)
Year(s) living in current residence	1 = < 2 years; 2 = 2-<4 years; 3 = 4-<6 years; 4 = 6-<8 years; 5 = 8-<10 years; 6 = 10 years or longer	1.181 (1.046, 1.333)**	1.019 (0.894, 1.161)
Home ownership	0 = rent, 1 = own	1.338 (0.627, 2.856)	1.638 (0.697, 3.849)
Reason for choosing current residence	0 = no, 1 = yes		
Quality of neighborhood		1.189 (0.681, 2.076)	0.565 (0.308, 1.036)†
Easy to walk around		1.147 (0.698, 1.887)	1.653 (0.981, 2.785)†
Household's car ownership	Number of motor vehicles in the household	1.135 (0.809, 1.593)	0.909 (0.640, 1.290)
Dog ownership	0 = no, 1 = yes	0.757 (0.494, 1.161)	0.640 (0.398, 1.031)†
Parent's negative attitude toward independent travel	1 = strongly disagree …, 5 = Strongly agree	0.588 (0.499, 0.693)***	N/A
Parent's negative attitude toward unsupervised outdoor play	1 = strongly disagree …, 4 = strongly agree	N/A	0.356 (0.279, 0.454)***
Social factors			
Social connection—"I feel connected to people in my neighborhood."	1 = strongly disagree …, 5 = strongly agree	0.852 (0.677, 1.072)	0.901 (0.706, 1.150)
Neighborhood support and impacts from peers	Factor (range: -3.00623, 2.17103)	1.104 (0.824, 1.480)	1.625 (1.179, 2.240)**

Table 4-7 Continued.

Predictors	Coding scheme or range of factors	OR (95% CI) Model 1: predicting parental license for independent travel to non-school destinations (N = 724)	OR (95% CI) Model 2:predicting parental license for unsupervised outdoor play (N = 734)
Housing and neighborhood environmental factors			
Housing type and presence of own yard space (ref: non-single-family without own yard)[a]	0 = non-single-family without own yard; 1 = non-single family but have at least one own yard;		
Non-single-family but have at least one own yard	2 = single-family housing	1.018 (0.388, 2.671)	0.646 (0.174, 2.395)
Single-family housing		1.052 (0.320, 3.463)	0.896 (0.159, 5.048)
Presence of… around home[a]	0 = no, 1 = yes	N/A	
Own driveway			1.349 (0.421, 4.322)
Frontage street			1.197 (0.396, 3.619)
Presence of… in neighborhood	0 = no, 1 = yes		
Playground		1.122 (0.686, 1.834)	1.211 (0.717, 2.043)
Walking/biking trails		0.629 (0.396, 0.997)*	0.678 (0.413, 1.113)
Friend's/relative's house		2.676 (1.739, 4.119)***	2.136 (1.352, 3.373)**
Apartment common areas		1.975 (0.733, 5.319)	1.271 (0.429, 3.761)
Quality of surrounding neighborhood environment	Factor (range: -3.34584, 2.88142)	1.304 (1.014, 1.677)*	1.246 (0.951, 1.631)
Stranger danger	Factor (range: -2.63015, 2.27150)	0.599 (0.479, 0.748)***	0.568 (0.444, 0.727)***
Crime danger and barriers for walking	Factor (range: -2.88790, 3.50552)	0.982 (0.790, 1.221)	N/A
Presence of sidewalks and buffers in neighborhood	Factor (range: -2.91318, 2.32176)	N/A	1.032 (0.796, 1.338)
Walk Score (ref: almost all errands car-dependent)	1 = almost all errands car-dependent;		
Most errands car-dependent	2 = most errands car-dependent;	0.719 (0.396, 1.307)	0.911 (0.481, 1.723)
Walkable	3 = walkable	0.680 (0.336, 1.378)	0.974 (0.448, 2.118)
Transit Score (ref: minimal transit)	1 = minimal transit; 2 = some transit;		
Some transit	3 = good transit	1.358 (0.700, 2.636)	0.712 (0.369, 1.371)
Good transit		1.507 (0.534, 4.259)	0.582 (0.197, 1.720)
Survey version and language (ref: paper survey in Spanish)	1 = paper survey in Spanish; 2 = paper survey in English; 3 = online survey		
Paper survey in English		0.571 (0.243, 0.343)	0.202 (0.077, 0.527)**

Table 4-7 Continued.

Predictors	Coding scheme or range of factors	OR (95% CI) Model 1: predicting parental license for independent travel to non-school destinations (N = 724)	OR (95% CI) Model 2:predicting parental license for unsupervised outdoor play (N = 734)
Online survey (all in English)		1.557 (0.567, 4.278)	0.519 (0.170, 1.582)
Recruitment channel	0 = NextDoor message, 1 = school	1.375 (0.525, 3.604)	1.851 (0.683, 5.018)
School membership	0 = no, 1 = yes		
Mills Elementary		3.203 (1.511, 6.789)**	N/A
Clayton Elementary		1.999 (0.817, 4.890)	1.930 (0.780, 4.775)
Overton Elementary		0.312 (0.105, 0.923)*	0.565 (0.180, 1.773)
Kiker Elementary		3.429 (1.314, 8.951)*	2.759 (1.085, 7.013)*
Casey Elementary		1.075 (0.392, 2.946)	1.312 (0.426, 4.038)
Harris Elementary		0.444 (0.130, 1.518)	N/A
Wooten Elementary		0.602 (0.212, 1.704)	N/A
Highland Park Elementary		N/A	1.641 (0.593, 4.543)
Houston Elementary		0.395 (0.105, 1.487)	0.737 (0.184, 2.961)
Sanchez Elementary		0.243 (0.043, 1.359)	N/A
Brook Elementary		N/A	0.757 (0.133, 4.294)
		Cox & Snell R Square: 0.383; Nagelkerke R Square: 0.510	Cox & Snell R Square: 0.446; Nagelkerke R Square: 0.596

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; OR = odds ratio; CI = confidence interval.
[a] Variables were adjusted according to audit data.

For physical environments, the presence of a friend's or relative's home in the neighborhood (OR = 2.676, 95% CI = 1.739, 4.119, $p<0.001$) and the quality of surrounding neighborhood environments (OR = 1.304, 95% CI = 1.014, 1.677, $p<0.05$) were two positive correlates of parental license for independent non-school travel. Changing from not having a friend's or relative's home in the neighborhood to having one would increase the likelihood that parents would allow their child to travel independently by 167.6%. A one-unit increase in the quality of surrounding neighborhood environments would increase this likelihood by 30.4%. In contrast, the presence of walking/biking trails in the neighborhood (OR = 0.629, 95% CI =

0.396, 0.997, $p<0.05$) and stranger danger (OR = 0.599, 95% CI = 0.479, 0.748, $p<0.001$) were negative predictors. The negative impact of walking/biking trails is unexpected, and might be related to the fact that some existing trails are not as safe as necessary (e.g., too close to wilderness and/or lack of surveillance). In addition, attending Mills Elementary (OR = 3.203, 95% CI = 1.511, 6.789, $p<0.01$) or Kiker Elementary (OR = 3.429, 95% CI = 1.314, 8.951, $p<0.05$) was positively associated with this outcome, while school membership as Overton Elementary (OR = 0.312, 95% CI = 0.105, 0.923, $p<0.05$) played a negative role. Neither survey version and language nor the recruitment channel was significant.

In the model predicting the parental license for unsupervised outdoor play in the neighborhood (Table 4-7), a higher grade level (OR = 1.461, 95% CI = 1.272, 1.679, $p<0.001$) still plays a significant positive role in promoting the likelihood of this behavior being approved by parents or guardians. The number of child's health conditions (OR = 0.491, 95% CI = 0.307, 0.785, $p<0.01$) and parents' or guardians' negative attitude toward unsupervised outdoor play (OR = 0.356, 95% CI = 0.279, 0.454, $p<0.001$) were associated with a reduced likelihood of parental license. One social factor—neighborhood support and impacts from peers (OR = 1.625, 95% CI = 1.179, 2.240, $p<0.01$)—significantly increased the odds that parents allow children's unsupervised outdoor play.

Among housing and neighborhood physical environmental features, the presence of a friend's or relative's home (OR = 2.136, 95% CI = 1.352, 3.373, $p<0.01$) significantly increased the likelihood of parental license for unsupervised outdoor play, while stranger danger (OR = 0.568, 95% CI = 0.444, 0.727, $p<0.001$) played a significant negative role. Some other factors were found to be marginally significant in predicting the odds of parental license to unsupervised

outdoor play, including the quality of neighborhood as the reason for choosing the neighborhood (marginally negative), easy to walk around as the reason for choosing current neighborhood (marginally positive), and dog ownership (marginally negative). The school membership as Kiker Elementary (OR = 2.759, 95% CI = 1.085, 7.013, $p<0.05$) was positively associated with the outcome, while survey version and language as paper in English (OR = 0.202, 95% CI = 0.077, 0.527, $p<0.01$) showed negative impacts on predicting the outcome, compared to a paper survey in Spanish.

As a summary for the survey data analysis, all significant correlates of parental license for independent travel to non-school destinations and unsupervised outdoor play were summarized in Table 4-8. The presence of a friend's and relative's home was a significant correlate for both modes of CIM. It is not surprising as previous studies have also consistently reported a friend's or relative's home as the most popular neighborhood place where children would be allowed to independently travel to (Mackett et al., 2007; Villanueva et al., 2013) or have free play activities in (Veitch et al., 2008). Meanwhile, stranger danger was a negative predictor of both outcomes and is a factor variable extracted from NEWS items evaluating stranger danger in neighborhood. The specific items that were loaded on this factor variable include:1) "I am worried about letting my child *play or walk alone or with friends in my neighborhood and local streets* because I am afraid my child will be taken or hurt by a stranger;" 2) "I am worried about letting my child *play outside alone around my home (e.g., yard, driveway, apartment common area)* because I am afraid of them being taken or hurt by a stranger;" 3) "I am worried about letting my child *be alone or with friends in a local or nearby park* because I am afraid my child will be taken or hurt by a stranger;: 4) "I am worried about

letting my child *be outside with a friend around my home* because I am afraid my child will be taken or hurt by a stranger." Although three other items assess crime safety, only these four items related to stranger danger successfully loaded on this factor variable and played a significant role in affecting parental license for both modes of CIM at the $p<0.001$ level. This finding indicates that stranger danger is a major concern that prevents parents from allowing their children to have independent non-school travel or unsupervised outdoor play.

Table 4-8 Significant Predictors of Parental License for Independent Travel to Non-School Destinations and Unsupervised Outdoor Play Using Personal, Social, and Perceived Physical Environment Factors.

Significant predictors in the model	OR Model 1: parental license for independent travel to non-school destinations	OR Model 2: parental license for unsupervised outdoor play
Personal factors		
Child's grade level	1.380***	1.461***
Child's health conditions	0.652*	0.491**
Parent's occupation—employed	0.643 †	NS
Year(s) living in current residence	1.18**	
Reason for choosing current residence		
Quality of neighborhood	NS	0.565 †
Easy to walk around		1.653 †
Dog ownership		0.640 †
Parent's negative attitude toward independent travel	0.588***	N/A
Parent's negative attitude toward unsupervised outdoor play	N/A	0.356***
Social factors		
Neighborhood support and impacts from peers	NS	1.625**
Housing and neighborhood environmental factors		
Presence of… in neighborhood		
Walking/biking trails	0.629*	NS
Friend's/relative's house	2.676***	2.136**
Quality of surrounding neighborhood environment	1.304*	NS
Stranger danger	0.599***	0.568***
Paper survey in English (ref: paper survey in Spanish)		0.202**
School membership		
Mills Elementary	3.203*	N/A
Overton Elementary	0.312*	NS
Kiker Elementary	3.429*	2.759*

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$.

One positive correlate of parental license for children's independent travel—the quality of surrounding neighborhood environments—is also a factor variable extracted from NEWS items assessing neighborhood surroundings. It was loaded by parents' evaluation of the following items for their own neighborhoods: 1) "There are many *beautiful natural things* for my child to look at in my neighborhood (e.g., gardens, views);" 2) "There are many *interesting things* for my child to look at while walking in my neighborhood;" 3) "There are many *buildings/homes in my neighborhood that are nice to look at* for my child;" 4) "It is *well maintained and clean*; 5) there are *trees along the streets* in my neighborhood;" and 6) "It is *quiet (without much noise from cars, airplanes, factories, etc.)"* These specific environmental features indicate parents' expectations of child-friendly neighborhood environments which would enable them to allow their children's independent non-school travel.

In addition, some school membership showed significant predictive impacts on parental license for children's travel to non-school destinations and/or unsupervised outdoor play. Attending Kiker Elementary is a positive correlate for both modes of CIM. Attending Mills Elementary is a positive predictor of parental license for children's travel to non-school destinations, while the membership of Overton Elementary is a negative correlate of this CIM behavior. After further checking the geographic locations of the three schools (Figure 4-11), it was noticed that Kiker Elementary and Mills Elementary are in adjacent areas and located in the southwest portion of the City of Austin, which has the lowest percentage of population below the poverty level. However, Overton Elementary is located in the northeast portion of the City of Austin and falls into the area with the highest percentage of the population below the poverty level. The huge disparities in the socioeconomic status between the two areas and the relevant

environmental features may be the potential reasons that the membership of different schools showed opposite impacts on the parental license for CIM.

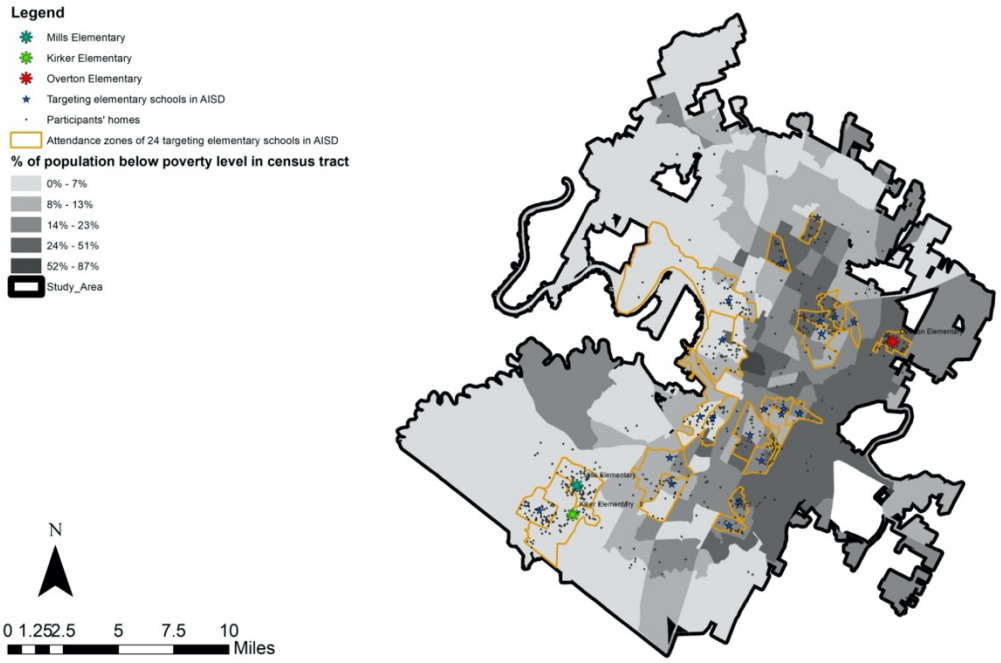

Figure 4-11 Geographic locations of Mills Elementary, Kiker Elementary, and Overton Elementary and the percentage of the population below the poverty level in each Census tract.

4.3.2. Predicting CIM Using Personal, Social, and Objective Environmental Factors

In order to better understand the impacts of specific physical environmental features on CIM, additional regression models were tested to predict two outcomes using personal and social factors from the survey, as well as the objective physical environment features from GSV audits and GIS analyses (N=758). This section summarizes the results from these analyses. Similar to the previous section, the results from the data reduction process, including factor analysis for

survey data and bivariate analysis testing each independent variable's correlation with each outcome variable, are illustrated first.

4.3.2.1. Factor and Bivariate Analysis

Five environment-related factor variables—the quality of surrounding environments in the neighborhood, stranger danger, crime danger and barriers for walking, sidewalk/buffer availability and lighting condition, and access to services—as well as one social factor variable—neighborhood support and impacts from peers—were extracted from NEWS-items and questions developed based on the researchers' literature review. The social factor variable was included in the multivariate logistic analysis because of its theoretical importance. Table C-1 in Appendix C shows the descriptive statistics and the results from the bivariate data analysis by testing the correlation between each personal/social variable and each outcome variable for this sub-group sample.

The bivariate analysis results for the relationship between each objectively-measured housing and neighboring variable and the two dependent variables are presented in Appendix C, Table C-2. The results of normalized GIS variables' bivariate correlations with the outcome variables were summarized in terms of half-mile aerial, quarter mile aerial, half-mile network, and quarter-mile network buffers (Appendix C, Table C-3 to Table C-6). In addition, Walk Score, Bike Score, and Transit Score's bivariate correlations with two outcome variables were also examined and summarized together in the half-mile aerial buffer table (Appendix C, Table C-3).

4.3.2.2. Multivariate Binary Logistic Regression Analysis of Survey Data and Objectively-Measured Environmental Data

Similar to analyzing survey data, a series of multivariate logistic regression models were applied in a sequential order to predict the odds of parental license for children's independent travel to non-school destinations and unsupervised outdoor play by using 1) personal and social factors, 2) personal, social, and home and neighboring environmental factors, and 3) personal, social, and all objective housing and neighborhood environmental factors. The results of the above analysis models 1) and 2) were summarized in Table D-1 and Table D-2 in Appendix D, respectively.

The Nagelkerke R^2 value was again applied as an estimate that represents the percentage of variance explained by models. For models predicting parental license for children's independent travel to non-school destinations, the first model with only personal and social variables explained 38.4% of the variance (Appendix D, Table D-1). After further adding home and neighboring environmental variables, the variance increased to 40.2% (Appendix D, Table D-2). With the further addition of neighborhood-level environmental variables, the percentages of explained variance reached 42.8% (quarter-mile aerial buffer), 43.3% (quarter-mile network buffer), 42.2% (half-mile aerial buffer), and 42.8% (half-mile network buffer) (Appendix D, Table D-3). For the quarter-mile network buffer model with the highest R^2 value, the researcher further added additional variables for survey version and language, recruitment channel, and school membership, which increased the percentage of explained variance in the model to 46.4% (Table 4-9).

Table 4-9 Binary Logistic Regressions Predicting Parental License for Independent Travel to Non-School Destinations Using Personal, Social, and Housing and Neighborhood Physical Environment Factors (Adjusted Final Model, Sub-Group Sample, N=758).

Predictors	OR (95% CI)	
	Predicting parental license for independent travel to non-school destinations (N = 634)	Predicting parental license for unsupervised outdoor play (N = 643)
	Quarter-mile network buffer	Half-mile network buffer
Child's gender (0 = female, 1 = male)	0.739 (0.487, 1.121)	0.901 (0.579, 1.402)
Child's grade level (0 = kindergarten, 1 = first grade …, 5 = fifth grade)	1.333 (1.170, 1.520)***	1.432 (1.244, 1.648)***
Child's ethnicity (0 = non-Hispanic, 1 = Hispanic)	1.368 (0.725, 2.583)	0.781 (0.403, 1.512)
Eligibility for free or reduced-price lunch (0 = no, 1 = yes)	0.655 (0.333, 1.289)	1.799 (0.841, 3.849)
Child's health conditions (The total number of health conditions a child has)	0.679 (0.448, 1.028) †	0.430 (0.264, 0.699)**
Parental and household factors		
Parent's occupation—employed (0 = no, 1 = yes)	0.541 (0.328, 0.893)*	1.012 (0.602, 1.701)
English as home language (0 = no, 1 = yes)	1.196 (0.592, 2.416)	2.527 (1.170, 5.459)*
Year(s) living in current residence (1 = < 2 years; 2 = 2-<4 years; 3 = 4-<6 years; 4 = 6-<8 years; 5 = 8-<10 years; 6 = 10 years or longer)	1.211 (1.068, 1.374)***	1.054 (0.923, 1.204)
Reason for choosing current residence (0 = no, 1 = yes)		
Quality of neighborhood	1.221 (0.702, 2.124)	0.806 (0.439, 1.481)
Easy to walk around	1.165 (0.708, 1.916)	1.351 (0.802, 2.277)
Household's car ownership (Number of motor vehicles in the household)	1.129 (0.807, 1.578)	0.897 (0.633, 1.272)
Dog ownership (0 = no, 1 = yes)	0.754 (0.484, 1.176)	0.782 (0.480, 1.273)
Parent's negative attitude toward independent travel (1 = strongly disagree …, 5 = Strongly agree)	0.556 (0.473, 0.654)***	N/A
Parents should NOT let children of this age travel to and from places without an adult's supervision.		
Parent's negative attitude toward unsupervised outdoor play (1 = strongly disagree …, 4 = Strongly agree)	N/A	0.280 (0.219, 0.360)***
Parents should NOT let children of this age play alone or with peers in the neighborhood without an adult's supervision.		
Social factors		
Social connection—"I feel connected to people in my neighborhood." (1 = strongly disagree …, 5 = strongly agree)	1.025 (0.821, 1.280)	1.051 (0.830, 1.330)
Neighborhood support and impacts from peers (Factor, range: -3.02869, 2.28349)	0.987 (0.751, 1.298)	1.515 (1.128, 2.035)**

Table 4-9 Continued.

Predictors	OR (95% CI)	
	Predicting parental license for independent travel to non-school destinations (N = 634) Quarter-mile network buffer	Predicting parental license for unsupervised outdoor play (N = 643) Half-mile network buffer
Home and neighboring environmental factors		
Housing type (ref: a non-single-family home and inside an apartment complex)		N/A
A non-single-family home and not inside an apartment complex	0.636 (0.214, 1.896)	
A single-family home	0.380 (0.123, 1.175) †	
Presence of … in own home outdoor spaces	N/A	
Front porch		1.177 (0.684, 2.025)
Own driveway		1.331 (0.595, 2.977)
Home in a gated community (0 = no, 1 = yes)	0.920 (0.359, 2.359)	N/A
Home parcel lot is (0 = no, 1 = yes)		
A middle lot of a regular street	1.311 (0.807, 2.130)	N/A
A corner lot of a dead-end street	N/A	5.154 (1.308, 20.313)*
Presence of residential land use along the frontage street (0 = no, 1 = yes)	N/A	
Mobile home		0.247 (0.036, 1.695)
Number of driveways & street intersections (ref: 0-3)		N/A
4-10	0.948 (0.464, 1.937)	
11+	1.004 (0.481, 2.094)	
Signs along frontage street (0 = no, 1 = yes)		
Community/cultural/religious/political message or event/historical marker	1.064 (0.651, 1.738)	N/A
Crime watch/surveillance warning/home security service (e.g., ADT)	1.481 (0.884, 2.480)	1.397 (0.825, 2.364)
Neighborhood environmental factors		
Traffic danger		
Crash density by buffer area (unit: per acre)	0.921 (0.832, 1.020)	N/A
Crash density by total street segment length in buffer (unit: per mile)	N/A	1.004 (0.991, 1.016)
Presence of level 2 roads: major arterials and county roads, minor arterial, city collectors (0 = no, 1 = yes)	0.928 (0.460, 1.872)	N/A
Proportion of level 2 roads: major arterials and county roads, minor arterial, city collectors	N/A	0.293 (0.067, 1.280)
Crime danger		
Violent crime (sex offenses excluded) density by buffer area (unit: per acre)	0.945 (0.772, 1.155)	1.261 (0.883, 1.801)
Presence of registered sex offenders (0 = no, 1 = yes)	0.547 (0.309, 0.967)*	0.549 (0.314, 0.960)*
Land use		
Land use mix (entropy index)	0.630 (0.141, 2.817)	2.744 (0.456, 16.507)

Table 4-9 Continued.

Predictors	OR (95% CI)	
	Predicting parental license for independent travel to non-school destinations (N = 634) Quarter-mile network buffer	**Predicting parental license for unsupervised outdoor play (N = 643) Half-mile network buffer**
Neighborhood destinations		
Density of playground in buffer	N/A	1.063 (0.976, 1.159)
Straight distance to nearest playground	0.981 (0.434, 2.218)	1.278 (0.558, 2.925)
Transit Score (ref: minimal transit)		
Some transit	1.429 (0.689, 2.965)	0.437 (0.238, 0.803)**
Good transit	1.705 (0.561, 5.177)	0.251 (0.085, 0.741)*
Sidewalk density		N/A
Sidewalk density by buffer area (unit: per square miles)	0.994 (0.979, 1.010)	
Sidewalk density by total street segment length in buffer (unit: per mile)	N/A	
Street connectivity		N/A
Cul-de-sac density by total street segment length in buffer (unit: per mile)	N/A	
Intersection (3 or more ways) density by total street segment length in buffer (unit: per mile)	0.927 (0.774, 1.111)	
Tree canopy density	N/A	0.683 (0.049, 9.537)
Survey version and language (ref: paper survey in Spanish)		
Paper survey in English	0.614 (0.267, 1.414)	0.190 (0.075, 0.478)*
Online survey (all in English)	1.213 (0.446, 3.297)	0.470 (0.164, 1.345)
Recruitment channel (0 = NextDoor message, 1 = school)	0.806 (0.281, 2.313)	N/A
School membership (0 = no, 1 = yes)		N/A
Mills Elementary	2.769 (1.164, 6.591)*	
Clayton Elementary	2.629 (0.819, 8.436)	
Overton Elementary	0.519 (0.173, 1.560)	
Kiker Elementary	3.437 (1.223, 9.661)*	
Casey Elementary	1.494 (0.495, 4.509)	
Harris Elementary	0.422 (0.125, 1.425)	
Wooten Elementary	0.518 (0.175, 1.533)	
Houston Elementary	0.306 (0.078, 1.202) †	
Sanchez Elementary	0.123 (0.013, 1.195) †	
	Cox & Snell R Square: 0.348; Nagelkerke R Square: 0.464	Cox & Snell R Square: 0.423; Nagelkerke R Square: 0.567

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; OR = odds ratio; CI = confidence interval.

Among models predicting parental license for children's unsupervised outdoor play, the model with only personal and social variables explained 48.8% of the variance (Appendix, Table

D-1). The model with additional home and immediate surrounding variables slightly increased that value to 50.4% (Appendix, Table D-2). With the further addition of neighborhood environmental factors, the percentages of explained variance from four different buff dimensions are 53.5% (quarter-mile aerial buffer), 52.9% (quarter-mile network buffer), 53.0% (half-mile aerial buffer), and 54.0% (half-mile network buffer), respectively (Appendix, Table D-4). In order to justify the potential bias, additional variables—survey version and language, recruitment channel, and school membership—were added to the half-mile network buffer model, which has the highest R^2 value among the four models; the percentage of explained variance in the final model increased to 56.7% (Table 4-9).

As shown in Table 4-9, for predicting parental license of children's independent travel to non-school destinations, higher grade levels (OR = 1.333, CI = 1.170, 1.520, $p<0.001$) and more years lived in the current residence (OR = 1.211, CI = 1.068, 1.374, $p<0.001$) were significantly associated with the increased odds of this outcome, which are consistent with results from the survey data analysis. In addition, a parent being employed (OR = 0.541, CI = 0.328, 0.893, $p<0.05$) and parents' negative attitude toward independent travel (OR = 0.556, CI = 0.473, 0.654, $p<0.001$) were negative correlates of this behavior. Neither of the social factors nor any variables from the home and home immediate surrounding level were significantly associated with the odds of parental license for independently travel at $p<0.05$ level. Only housing type as single-family home was found to be marginally significant in predicting the lower odds of parental license for independent travel to non-school destinations. For neighborhood environmental features, only one variable—the presence of registered sex offenders (OR = 0.547, CI = 0.309, 0.967, $p<0.05$)—was negatively associated with the odds of children being allowed to have non-

school independent travel. It makes sense as the presence of registered sex offenders would definitely increase parents' concerns about crime danger and thus limit their children's independent travel. The school membership of Mills Elementary (OR = 2.769, CI = 1.164, 6.591, $p<0.05$) and Kiker Elementary (OR = 3.437, CI = 1.223, 9.661, $p<0.05$) were associated with an increased likelihood of parental license for children's non-school independent travel, which was also consistent with the results of survey data. Meanwhile, school memberships of Houston Elementary and Sanchez Elementary were marginally negative correlates at the $0.05\leq p<0.1$ level.

In the final adjusted models predicting parental license for children's unsupervised outdoor play, higher grade level (OR = 1.432, CI = 1.244, 1.648, $p<0.001$) and English as the home language (OR = 2.527, CI = 1.170, 5.459, $p<0.05$) were positive correlates, while the number of a child's health conditions (OR = 0.430, CI = 0.264, 0.699, $p<0.01$) and parents' negative attitude toward this CIM behavior (OR = 0.280, CI = 0.219, 0.360, $p<0.001$) were negative correlates. One social factor—neighborhood support and impacts from peers (OR = 1.515, CI = 1.128, 2.035, $p<0.01$) increased the odds of parental license for children's unsupervised outdoor play. A home's location on a corner lot of a dead-end street (OR = 5.154, CI = 1.308, 20.313, $p<0.05$) was also found to be a positive correlate. This is probably because of the lower traffic volume caused by less through traffic and better surveillance of a dead-end street as appearance of a stranger would be easily noticed. It is also common that many families with children would prefer to live in housing at a dead-end street or a cul-de-sac, so that children may be safer to play in the dead-end area. Previous studies also identified the presence of cul-de-sacs in a neighborhood as a positive predictor of children's outdoor active play (Brockman et al.,

2011) and proposed creating cul-de-sacs as a design strategy to help build safe street environments for children (Marcus & Sarkissian, 1988). Meanwhile, compared to parcel lots located in the middle of a street segment, corner lots typically have larger yard areas, which can accommodate children's unsupervised outdoor play more easily. Although the presence of own yards was not identified as a significant correlate of children's unsupervised outdoor play in this study, a yard near home was found to be a positive predictor of children's active outdoor play in a previous study (Marino et al., 2012). In addition, the presence of registered sex offenders (OR = 0.549, CI = 0.314, 0.960, $p<0.05$) were also negatively associated with the likelihood that children were allowed to play unsupervised by parents. Compared to minimal transit, a higher Transit Score level (some transit: OR = 0.437, CI = 0.238, 0.803, $p<0.01$; good transit: OR = 0.251, CI = 0.085, 0.741, $p<0.05$) was also found to play a negative role, probably due to the increased traffic volume and safety threats that are likely to come with transit, which may lower parents' willingness to let children play outdoors without supervision. Besides, compared to surveys taken in a Spanish paper version, respondents taking the English paper version showed a reduced likelihood for parental license for children's unsupervised outdoor play (OR = 0.190, CI = 0.075, 0.478, $p<0.05$). Neither school membership nor recruitment channel was found to be significant in the final model.

4.3.3. Correlations between Two Modes of CIM and Children's Physical Activity Level

After investigating the relationship between housing and neighborhood environmental features and two modes of CIM—home-based independent travel to non-school destinations and unsupervised outdoor play in the neighborhood—the correlations between two modes of CIM and children's physical activity level were further examined to identify the potential health

benefits of CIM. Children's physical activity level was measured by one question in the parent/guardian survey: “During a usual week, how many days does your child take part in physical activity for at least 60 minutes?” Sixty minutes or more of moderate-to-vigorous physical activity each day was the physical activity level for school-aged children and adolescents (ages 6 through 17 years) recommended by the Centers for Disease Control and Prevention (CDC) (Division of Nutrition Physical Activity and Obesity & National Center for Chronic Disease Prevention and Health Promotion, 2021).

A *T*-test was applied to detect if there is a significant difference in children’s physical activity levels (i.e., the days that the child has more than 60 minutes of physical activity in a usual week) between those who were “allowed” to have independent mobility by parents and those who were “never allowed,” for each of the two CIM modes. The results showed that children who were allowed to travel independently to non-school destinations had significantly more physically active days in a week (4.83 ± 1.95), compared to those who were never allowed (4.22 ± 2.03), with the group mean difference being significant at the $p<0.001$ level. A similar result was identified for parental license for children’s unsupervised outdoor play. Children who were allowed to have unsupervised outdoor play had significantly more physically active days per week (4.94 ± 1.89) than those who were never allowed to do so (4.17 ± 2.04) ($p<0.001$ for the group mean difference). The results indicate that parental license for children’s independent travel to non-school destinations or unserved outdoor play may help children accumulate more physical activity and benefit their health.

5. DISCUSSION AND CONCLUSION*

This dissertation study used data from parents'/guardians' survey responses, GSV audits, GIS analysis, and other public data sources (e.g., county appraisal districts, Walk Score website) to explore the association between housing and neighborhood environments and parental license for two modes of CIM— home-based independent travel to non-school destinations and unsupervised outdoor play, considering personal and social factors. This section discusses the knowledge gaps addressed in this study, implications of study findings for future environmental design and research, limitations of the study, planned additional studies/analyses, and, lastly, brief conclusions.

5.1. Contributions to the Literature

Bridged the identified knowledge gaps and provided a better understanding of current CIM status in a setting in the U.S. This study addressed two important knowledge gaps as reported in the introduction section. First, compared to other modes of CIM (e.g., independent/active school travel) that have been widely studied, children's independent travel to non-school destinations and unsupervised outdoor play, which can facilitate greater physical activity during non-school hours, are highly understudied (Schoeppe et al., 2013). Meanwhile, compared to other countries and areas, very few studies with a focus on CIM were conducted in the U.S. Based on a systematic literature review, among 52 identified empirical studies on CIM

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and active travel, only eight of them (15.4%) were from the U.S. and only one of them studied CIM (i.e., unsupervised outdoor play in parks) (Schoeppe et al., 2013). Thus, a better understanding of current CIM status among U.S. children is needed due to its importance to children's healthy development. This study filled these two major knowledge gaps by investigating parental license for children's home-based independent travel to non-school destinations and unsupervised outdoor play among elementary school children in the City of Austin, Texas.

In general, the current CIM status of our study sample is consistent with results from previous studies. However, most of the previous studies were conducted in other countries, and there are very few U.S. studies that investigated the exact same CIM modes. Based on this study, around half of the children were not allowed to travel independently to non-school destinations (49.2%) or play in outdoor areas without adult accompaniment or supervision (54.4%). For those who were allowed, most of the activities (27.7% allowed for independent non-school travel and 29.6% allowed for unsupervised outdoor play) were restricted to a very short distance within a five-minute's walk (around 0.25 miles) from the home. Overall, the CIM levels from this study are consistent with the results from several Australian studies reporting that the distances children travel independently tend to be short (Veitch et al., 2008; Villanueva et al., 2012), and parents restricted children's independent travel and outdoor play to the area just immediately around their homes (i.e., 60% allowed within around 500 m (around 0.31 miles) of the home) (Schoeppe, Duncan, et al., 2016). This study's survey results also showed that a friend's or relative's home in the neighborhood was the most frequently visited neighborhood destination to which children independent travel, and it is far more frequently used than the neighborhood

street, which was the second most popular neighborhood destination (41.4% vs. 16.2%). The finding also corresponds to previous studies that reported a friend's or relative's home in the neighborhood as the most popular neighborhood destination for children's non-school independent travel (Mackett et al., 2007; Villanueva et al., 2013). In addition, this study also found that a friend's or relative's home was the most popular neighborhood place, where children spent the most time playing without adult supervision both on a typical week day and a weekend day. Furthermore, participants' own home yards (backyard and front yard) were found to be the places directly near the home where children were most often allowed to play without adult supervision. The findings are similar to what were reported in earlier studies: the yard at home was the most frequently used space for unsupervised outdoor play (Schoeppe, Duncan, et al., 2016) and active free-play (Veitch et al., 2006).

Tested proposed hypotheses and identified significant correlates of CIM from multiple levels. In addition to providing a better understanding of current CIM status among elementary school children in Austin, Texas, this study tested the proposed hypotheses by examining the impacts of housing and neighborhood environments on parental license for two types of CIM: independent travel from home to non-school destinations and unsupervised outdoor play, considering personal and social factors. Significant correlates were identified at the personal, social, and physical environment factor levels (Table 5.1). Specifically, for physical environments, both perceived neighborhood environments (collected using surveys) and objectively-measured environmental features (collected using GSV audits and GIS) were tested for their relationships with two modes of CIM, respectively. For objectively-measured environments, the examined factors reflect three spatial scales (i.e., the home environment,

home's immediate surrounding environment, and neighborhood environment), aiming to discover how environments at different spatial scales might have different impacts on CIM. For neighborhood-level physical environments, the analyses were further conducted in four different spatial units (i.e., a half-mile aerial buffer, quarter-mile aerial buffer, half-mile street network buffer, and quarter mile street network buffer) to examine which spatial unit for the neighborhood-level variables would most significantly affect CIM. After comparing the pseudo R^2 values of different models, it turned out that these models with physical environments from four different spatial units did not have significant differences in explaining the variance of outcome variables.

Table 5-1 Significant Predictors of Parental License for Independent Travel to Non-School Destinations and Unsupervised Outdoor Play Using Perceived Physical Environment Factors and Objective Environment Factors.

Significant predictors in the models (Those variables not significant in any of the models were excluded from this table.)	**OR**			
	Models predicting parental license for independent travel to non-school destinations		**Models predicting parental license for unsupervised outdoor play**	
	Survey data	**Survey data and objective environmental data**	**Survey data**	**Survey data and objective environmental data**
Personal factors				
Child's grade level	1.380***	1.333***	1.461***	1.432***
Child's health conditions	0.652*	0.679 †	0.491**	0.430 **
Parent's occupation—employed	0.643 †	0.541*	NS	NS
Year(s) living in current residence	1.181**	1.211***	NS	NS
English as home language		NS	NS	2.527*
Reason for choosing current residence				
Quality of neighborhood		NS	0.565 †	NS
Easy to walk around			1.653 †	
Dog ownership			0.640 †	
Parent's negative attitude toward independent travel	0.588***	0.556***	N/A	
Parent's negative attitude toward unsupervised outdoor play		N/A	0.356***	0.280***
Social factors				
Neighborhood support and impacts from peers		NS	1.625**	1.515**

Table 5-1 Continued.

Significant predictors in the models (Those variables not significant in any of the models were excluded from this table.)	OR			
	Models predicting parental license for independent travel to non-school destinations		Models predicting parental license for unsupervised outdoor play	
	Survey data	Survey data and objective environmental data	Survey data	Survey data and objective environmental data
Housing and neighborhood environmental factors				
Single-family home (ref: a non-single-family home and inside an apartment complex)	NS		0.380 †	N/A
Home location as a corner lot of a dead-end street	N/A		N/A	5.154*
Presence of… in neighborhood				
Walking/biking trails	0.629*	N/A	NS	N/A
Friend's/relative's house	2.676***		2.136**	
Quality of surrounding neighborhood environment	1.304*		NS	
Stranger danger	0.599 ***		0.568 ***	
Presence of registered sex offenders	N/A	0.547*	N/A	0.549*
Transit Score (ref: minimal transit)				
Some transit	NS		NS	0.437**
Good transit				0.251**
Paper survey in English (ref: paper survey in Spanish)	NS		0.202**	0.190 *
School membership				
Mills Elementary	3.203*	2.769*	N/A	N/A
Overton Elementary	0.312*	NS	NS	
Kiker Elementary	3.429*	3.437*	2.759*	
Houston Elementary	NS	0.306 †	NS	
Sanchez Elementary	NS	0.123 †	N/A	

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; NS: not significant; N/A: not applicable.

For testing the first hypothesis that housing and neighborhood environments (including the home environment, home's immediate surrounding environment, and neighborhood environment) have significant impacts on parental license for children's home-based independent travel to non-school destinations and unsupervised outdoor play. Specific findings were discussed in terms of the two outcomes as follows:

For parental license for children's home-based independent travel to non-school destinations, no significant objective physical environmental predictors were identified from the home environment or home's immediate surrounding environment levels. One objective neighborhood environmental factor—the presence of sex offenders in a neighborhood—played a significant negative role. In the model examining the perception of neighborhood environments, the presence of walking/biking trails and stranger danger were identified as negative predictors of this CIM outcome. The potential reason for the presence of walking/biking trails' negative impacts on parental license for children's independent non-school travel might be related to the fact that some existing trails are not as safe as necessary (e.g., close to forest/wilderness area, no surveillance). The perception of stranger danger has been consistently identified as a major barrier that has prevented parents from allowing children to travel independently to non-school destinations in both this study and previous studies (Foster et al., 2014; Lopes et al., 2014). This perceived stranger danger also corresponds to the identified objective environmental factor—the presence of sex offenders in this study. The other two positive variables for perceived environments are the presence of a friend's or relative's home and the quality of neighborhood environments. The quality of neighborhood environments is a factor variable loaded by items related to specific features, including 1) beautiful natural things, 2) interesting things, 3) nice buildings, 4) well maintained and clean, 5) trees along the street, and 6) quietness. It depicts an ideal neighborhood scenario with important characteristics that would enable parents to permit their children's non-school independent travel.

For parental license for children's unsupervised outdoor play, none of the home environment factors was found to be significant. One variable—the home's location on a corner

lot of a dead-end street—from the home's immediate surrounding environment level was found to be a positive predictor of this CIM outcome. Compared to a middle lot, a corner lot would typically have spacious yards that can accommodate children's outdoor play activities, which require larger areas. In this case, children can play while remaining fairly close to home, reducing parents' safety concerns. It also corresponds to one of the findings of this study that children actually spent the most time playing in their own home yard. Meanwhile, a dead-end-street typically has less thru-traffic and better surveillance from neighbors so that parents also have a greater sense of traffic and crime safety, and thus are more likely to allow children to have unsupervised outdoor play in the neighboring spaces. One negative environmental factor at the neighborhood level is the higher Transit Score. Although a higher Transit Score means the location has better accessibility to public transportation, it may also involve increased traffic volume, which may lower parents' allowance of children's unsupervised outdoor play. For the model using perceived neighborhood environments, the presence of a friend's or relative's home in the neighborhood is also a positive correlate, while stranger danger is a negative correlate. The overall findings testified that some of the housing and neighborhood environments at certain levels have significant impacts on parental license for children's home-based independent travel to non-school destinations and unsupervised outdoor play.

For testing the second hypothesis—personal and social factors also play a significant role in parents' decision making of their children's home-based independent travel to non-school destinations and unsupervised outdoor play. Significant correlates from the two levels were identified through the analyses. Parents' negative attitude toward the CIM behavior was a negative predictor of both CIM modes and was significant at the $p<0.001$ level. It is also

consistent with findings from previous studies that parents' decision-making in CIM is crucial (De Meester et al., 2014; Marzi & Reimers, 2018). In addition, a child's higher grade level was identified as a positive predictor of both CIM modes, which is also consistent with previous studies (Bringolf-Isler et al., 2010; Ghekiere et al., 2017; Lopes et al., 2014; O'brien et al., 2000; Pacilli et al., 2013; Prezza et al., 2001).

Furthermore, for parental license of independent travel to non-school destinations, more years lived in the current residence was found to be a positive correlate. The child's health condition was found to be a negative predictor when analyzing survey data only, and a parent being employed acted as a negative predictor in the analysis using objective environmental data. Employment may prevent parents from being able to accompany their child, increasing the odds that the child travels independently. No social factor was significant in predicting parental license of independent travel to non-school destinations. For predicting parental license for unsupervised outdoor play, the number of a child's health conditions was still a negative predictor. In addition, English as the home language was found to be a positive correlate of this CIM outcome. Similarly, a previous study from Switzerland also reported that children who spoke French had less outdoor play when compared to those who spoke German (Bringolf-Isler et al., 2010). This finding is interesting and deserves further exploration, especially for a diverse community/society as language is often related to cultural factors, which may have significant impacts on people's behavioral choices.

5.2. Perceptions of Physical Environmental and Objective Environmental Features

Previous studies have confirmed that both parents' perceived environments and objective environments were significantly associated with their license for CIM (Marzi, Demetriou, &

Reimers, 2018; Smith et al., 2019). This dissertation also examined the impacts of housing and neighborhood environments on parental license for children's independent travel to non-school destinations and unsupervised outdoor play by using 1) perceived environmental data and 2) objective environment data, and identified significant correlates of CIM from both perceived environments and objective environments.

It was noticed in this study that the models using perceived environmental data showed higher R^2 values than those using objective environmental data (Table 4-7 and Table 4-9), which indicates that parents' perception of neighborhood environments may play a more significant role in their decision making than the objective environments. A previous systematic literature review reported significant variables related to parents' perception of physical environments that are correlated with CIM license, including a fear of strangers, neighborhood friendliness, and neighborhood safety (Marzi et al., 2018). Smith et al. (2019) further emphasized that perceptions related to safety, especially traffic safety and stranger danger are important indicators for CIM licenses. The same study also examined and confirmed that parents' perceived environments were consistent with objectively-measured neighborhood environments (Smith et al., 2019). However, after adjusting for other factors, this study identified differences in parents' perceptions toward environments by their socio-demographic characteristics, such as the child's grade level, ethnicity, and level of deprivation in the area (Smith et al., 2019). For example, compared to older children, parents of younger children reported higher perceived needs for neighborhood traffic safety. These findings indicated a relationship between parents' perceptions of the environments and their socio-demographic factors and may explain why parents'

perceptions of environments play a more important role in predicting CIM license (Smith et al., 2019).

5.3. Implications for Environmental Design

This study identified significant housing and neighborhood environmental correlates of CIM by examining 1) survey data from the full sample, and 2) survey data and objectively-measured environmental data from the sub-sample. Some consistent findings from both perceived environmental data and objectively-measured environments have important implications for environmental design at both the housing and neighborhood levels.

5.3.1. Implications for Child-friendly Housing

Firstly, crime safety has been identified as a major barrier which prevents parents from allowing greater independent mobility for their children. Based on survey data, the factor variable of stranger danger was found to be a significant negative predictor of both independent travel and unsupervised outdoor play. In addition, among objectively-measured environmental variables, the presence of registered sex offenders in a neighborhood was identified as a negative predictor for both CIM modes as well. Actions should be taken to address these issues and promote neighborhood safety through environmental design. One applicable concept is Crime Prevention through Environmental Design (CPTED), which emphasizes creating safer neighborhoods through built environments and design strategies of territoriality, surveillance, access control, and maintenance (Jeffery, 1977). Applicable design strategies are discussed as follows:

Create defensible space. Defensible space operates by dividing neighborhood public spaces into small ones and assigning them for individual and small groups to use (Newman,

1972, 1976, 1996). This concept is especially applicable to duplexes and fourplexes. Compared to units in a large apartment complex, which is typically maintained by a professional management team, duplexes and fourplexes are more likely to have public spaces, such as parking lots, a yard/lawn, and driveways that are overlooked and require necessary maintenance. Dividing these shared spaces and assigning them to each family to "own" a portion of them would help make sure those spaces are better cared for. For example, as shown in Figures 5-1 and 5-2, based on the researcher's observation during the GSV audits, a duplex in which each unit has its own driveway and front yard (Figure 5-1) would have better maintenance of those spaces than a duplex in which both units share those common spaces (Figure 5-2). The design strategies built upon the Defensible Space concept could help enhance the users' sense of ownership and control of the assigned space, and thus help prevent and reduce safety issues related to crime danger and stranger danger.

Figure 5-1 A duplex with two separate driveways and front yards increases the sense of ownership of public space.

Figure 5-2 A duplex with a shared driveway and front yard reduces the sense of ownership of public space.

Housing design with features providing natural surveillance. In order to promote the perception of neighborhood safety, more natural surveillance could be provided along neighborhood streets and other open spaces by designing housing with more windows directly facing those areas (Figure 5-3 and Figure 5-4). Parents would feel safer about letting their children travel independently along streets or play unsupervised at places where they could be easily seen by them or other neighbors. Some previous studies also suggested other strategies to increase surveillance, such as incorporating improved lighting and designing buildings with 'soft edges' that encourage residents and proprietors to use and monitor the streets and neighborhood common spaces (Foster et al., 2010, 2011; Jacobs, 1961).

Figure 5-3 Housing with little surveillance of the frontage street reduces the perception of neighborhood safety.

Figure 5-4 Housing with good surveillance of the frontage street increases the perception of neighborhood safety.

Create outdoor play spaces in the design of housing. As indicated by the findings form this study, among spaces directly adjacent to the home (i.e., a frontage street, front yard,

backyard, driveway), children spent the most time playing without adult supervision in their own yards (i.e., backyard and front yard) both on a weekday and weekend day. Meanwhile, the presence of a home located on a corner lot of a dead-end street was found to increase the odds of parental license for children's unsupervised outdoor play. A dead-end street means fewer thru traffic and better surveillance, which are important to children's safety. In addition, compared to other types of parcel lots, a corner lot typically has a larger yard that also has benefits for children's play. For example, a larger yard accommodates more equipment or amenities that children can play with, such as a swing, tree house, or trampoline. Although it is a bit disappointing that today's children have fewer opportunities to play unsupervised and to explore a larger range of the neighborhood compared to the previous generations, the findings about having yards as an important child-friendly environmental feature should be considered in future housing design. Additional considerations should be paid to the design of duplexes, fourplexes, and apartment units, as very few of them have a yard or patio that could accommodate children's unsupervised play. Providing a yard or balcony to accommodate different play needs for medium-density family housing also aligns with one of the site design guidelines proposed by Marcus and Sarkissian (1988).

5.3.2. Implications for Child-friendly Neighborhoods

Design for traffic safety. Among objectively-measured environmental features, a higher Transit Score was found to have a negative association with the likelihood of children's unsupervised outdoor play being allowed by parents. This may be due to parents' concerns about greater traffic volume and increased traffic danger accompanied by better transit accessibility. To address this, having child-friendly amenities in the neighborhood, such as buffers between

sidewalks and roadways as well as protected bike lanes, would promote children's traffic safety and encourage their independent travel and play along the streets. In addition, posting child-friendly signs and having more traffic calming devices should also be considered when developing child-friendly neighborhoods so as to promote traffic safety.

Provide child-friendly neighborhood places with real affordances. The survey used in this study asked parents/guardian to choose from a list of diverse locations or destinations for children's unsupervised play or independent travel. The provided options include items such as a park, playground, and sports field, which should be attractive to children. However, a friend's or relative's home was still the most popular place for children to play unsupervised and travel independently. One possible reason may be that those other neighborhood destinations/places are not safe or lack relevant amenities. As proposed by Chatterjee (2005, 2006), a child-friendly place should have the certain qualities or affordances: (1) providing opportunities for children to develop an attitude of care for places that children love and respect; (2) promoting meaningful exchange between child and place through affordance actualization in places; (3) offering opportunities for environmental learning and developing environmental competence through direct experience in places; (4) allowing children to create and control territories and protect these territories from harm; (5) providing privacy experiences and nurturing childhood secrets; and (6) allowing children to express themselves freely in place. Neighborhood destinations designed with a consideration of children's unique characteristics and diverse needs for activities, privacy, and socializing (e.g., comfortable dimensions and scales, purpose-built play areas for children in different age group) should be considered.

Provide plenty of green space for plants and small animals. Based on survey data, the factor variable of "quality of neighborhood surrounding environments" was identified as a significant predictor for both modes of CIM. One of the most important variables loaded on this factor is the presence of beautiful natural things for child to look at. Having plenty of green space for plants and small animals would encourage children to engage in outdoor activities, while also facilitating their learning from interactions with nature. This strategy was also recommended in the UNICEF's framework for defining and guiding the development of a "Child-Friendly City" (UNICEF, 2004) and proposed by other studies with a focus on creating child-friendly environments (Chawla, 2002; Haikkola et al., 2007; Nordström, 2010).

5.4. Implications for Future Study

This dissertation research is one of the few studies that investigate parental license for children's independent travel to non-school destinations and unsupervised outdoor play in the U.S. Significant correlates of both CIM modes were identified from personal, social, and environmental levels. The study findings also have important implications for future research.

First, it was observed from this study that parents' perception of the neighborhood environments played a more significant role in their decision making than the objective environment. Meanwhile, one earlier study reported that parents' perceived neighborhood environments were overall consistent with the objective environments, but could be influenced by their sociodemographic characteristics (Smith et al., 2019). This dissertation also showed that a significant percentage of variance in the CIM outcomes was explained by personal factors. Thus, future studies should further explore the correlation between objective environments and

perceived environments, and should also take sociodemographic characteristics into consideration.

In addition, this study used parental license to measure CIM and collected data from a relatively small sample. Future studies should develop a more rigorous study design (e.g., interventional study design with a larger sample size and objective measures for CIM by recording real trips and play activities), and further investigate the relationship between parental CIM and real CIM. More studies are also needed to understand diverse environmental settings. This study also suggested that most CIM were restricted to a very short distance from the home or at a place directly adjacent to the home. Thus, it will be helpful to conduct more in-depth studies on the home environment and its immediate surrounding environment.

Lastly, this study investigated multi-level factors' associations with parental license for CIM using a quantitative method and identified significant correlations. However, some ethnic and economically disadvantage groups (i.e., Hispanic children and those who were eligible for free or reduced-price lunch) were underrepresented, and those groups showed relatively lower rates of parental license for CIM, compared to their counterparts. The real barriers of their children's independent non-school travel and unsupervised outdoor play may not be fully discovered. Qualitative studies with these population groups would also be highly valuable.

5.5. Limitations of the Study and Additional Analyses for Next Steps

This study has several limitations. First, although this cross-sectional study identified significant personal, social, and physical environmental correlates for two modes of CIM, the causality cannot be assessed. Parental license for CIM was used as outcome variables in the analyses, which may not fully match children's actual independent mobility. Also, compared to

the study population, the study sample has a relatively smaller portion of students who are Hispanic or eligible for free or reduced-price lunch. This sampling bias may affect the internal validity of the analysis and might have led to the inaccurate estimation of relationships between variables (Acharya, Prakash, Saxena, & Nigam, 2013). It may also limit the findings of the study in terms of its generalizability to a broader group due to the lack of external validity (Acharya et al., 2013). Some other limitations were caused by defects in the collected data and the nature of the data collection methods. For example, in the survey data, 125 out of 883 participants did not provide a valid home address, and as a result, their actual home locations cannot be geocoded. Some of the home and neighborhood environment variables captured using GSV may have limited accuracy or miss some details (e.g., posted signs, unattractive items along the street), due to the low resolutions of the GSV images and limited angles of the views provided. Besides, some social factors such as social norms (Page et al., 2010) and parenting style (Pacilli et al., 2013) on CIM may also have significant impacts, but were not measured in this study. In addition, the physical environments that were examined in this study have relatively limited variations, with highly child-friendly environments being underrepresented due to the actual conditions of housing and neighborhood development in Austin. From the perspective of statistical analysis, the lack of variance in the independent variable lowers the power of the analysis. Meanwhile, some important environmental features that are highly supportive for CIM are missing and not examined due to the lack of variance.

In response to some of these limitations, this research has planned for additional analyses in the near future. First, in order to fully address the proposed conceptual framework, the mediating effect of perceived environments will be further examined using structural equation

models, and relevant findings can inform future interventions. In addition, the reliability and validity of the survey instrument and GSV audit instrument applied in the study need to be further assessed. A qualitative study on CIM targeting the underrepresented group or those who live in communities with less satisfying environments (e.g., mobile home communities) should also be considered to better understand their actual challenges and provide tailored strategies. Some other unexplored questions related to CIM also warrant further investigation, including: 1) how CIM benefits child development, 2) how parental license of CIM is correlated with children's actual fulfillment of CIM, and 3) how objectively-measured physical environments are correlated with perceptions.

5.6. Conclusion

In summary, this dissertation study examined the current status of parental license for two types of CIM—home-based independent travel to non-school destinations and unsupervised outdoor play for public elementary school children in Austin, Texas. It also explored the correlation between participants' housing and neighborhood physical environments and the two CIM behaviors, while accounting for personal and social factors. Regression analysis using only survey data showed that children were less likely to be allowed to travel to non-school neighborhood destinations independently if they are in a lower grade level, have more health conditions, have lived in their current residence for fewer years, or have parents/guardians with a negative attitude toward independent travel behavior. Meanwhile, the likelihood of independent travel is higher given the presence of a friend's or relative's home and less stranger danger in the neighborhood. Furthermore, children were more likely to be allowed to play outdoors unsupervised if they are older or have fewer health conditions. Having a friend's or relative's

home in their neighborhoods, parents' positive attitude toward unsupervised outdoor play, reduced strange danger, and neighborhood support and positive peer influences also played positive roles.

Regression models using personal and social factors and objective environmental measures also reported significant personal factors and environment features from neighborhood levels. In addition to a child's higher grade level, longer duration of living in the residence and parents' positive attitude are significant positive correlates of parental license for children's independent travel to non-school destinations. In contrast, a parent being employed was a negative predictor of this behavior. The presence of registered sex offenders in the neighborhood reduced the odds of parental license for children's non-school independent travel. For parental license for children's unsupervised outdoor play, the child's grade level, fewer health conditions, home language as English, parents' positive attitude, neighborhood support and impacts from peers, and home's location on a corner lot of a dead-end street were identified as positive correlates of this behavior, while having registered sex offenders in the neighborhood and higher Transit Score were negative predictors.

The study findings indicated the potential of applying targeted environmental interventions to encourage children's independent travel and unsupervised outdoor play, and thereby promote children's development, improve children's physical activity, and help combat the obesity epidemic. Furthermore, the identified environmental variables can be used to inform design strategies at both housing and neighborhood levels. The empirical evidence can also contribute to current conceptual frameworks and guidelines for developing child-friendly environments.

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APPENDIX A

BILINGUAL PARENT/GUARDIAN SURVEY

Part of the items/questions in the survey instrument are from two previously validated survey instruments —the Safe Routes to School Survey (Zhu & Lee, 2008) and the Neighborhood Environment Walkability Scale (NEWS)-Youth Survey (Rosenberg et al., 2009).

(Versión en Español al Reverso)

November 26, 2018

Dear Parent:

As many of you may know the City of Austin passed a $720 million mobility bond in 2016, of which Safe Routes to School received $27.5 million. To measure the impact of this funding, we are working with researchers from Texas A&M University to study children's school travel and mobility, and the role of environments. This is also a follow-up study for 2 similar surveys in 2007 and 2010, which received tremendous support from the parents and schools.

The survey will take about 20 minutes. It asks about your child's school travel and mobility, your thoughts about these topics, and any other factors that may have an impact. Your participation is completely voluntary, and will not expose you to any more risk than what you would come across in everyday life. Responses to the survey, including those with confidential information, will be kept private and only accessible to the research team. No identifiers linking you to this study will be included in any sort of report that might be published. You may decide to not begin or to stop participating at any time. If you choose not to be in this study or stop being in the study, there will be no effect on your or your child's relationship with the school or other involved institutions.

To participate, please complete this paper survey and return it with the cover page to your child's teacher, OR you can complete it online at 1.austinsrts.org

Upon receipt of your completed survey, your child will have a chance to win a $50 gift card. The Elementary School with the most participants and the Middle School with the most participants will each receive a $250 gift card.

If you have any questions, concerns, or complaints about the research, please call Amir Emamian with the City of Austin's Safe Routes to School Program at 512-974-9319, or contact Dr. Xuemei Zhu (Principal Investigator at Texas A&M University) at xuemeizhu@tamu.edu or 979-845-3780. This research has been reviewed and approved by the Texas A&M Institutional Review Board (IRB). If you have any other concerns, you may talk to them at 1-979-458-4067, toll free at 1-855-795-8636, or by email at irb@tamu.edu.

Thank you for your time and help! Working together we can have a healthier Austin!

To be entered into the drawing, please provide your information below:

School: _____

Your Email: _____

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SAFE ROUTES TO SCHOOL SURVEY

Thanks for your help! Everything you tell us will be kept strictly confidential (secret). If you have more than one child, please answer the following questions in terms of the child who took this survey home.

Section 1: Children's Daily Travel

1. On a typical day, when the weather is nice, how does your child travel…	
1) From home to school	**2) From school to home**
○ Walk *alone*	○ Walk *alone*
○ Walk *with friends*	○ Walk *with friends*
○ Walk *with a parent / adult*	○ Walk *with a parent / adult*
○ Bicycle	○ Bicycle
○ School bus	○ School bus
○ Public bus or light rail	○ Public bus or light rail
○ Private car, including carpool	○ Private car, including carpool

2. How long does it take to get to school, using this typical travel mode *from home to school*? _____ minutes

3. Is this travel distance close enough for your child to walk to school? ○ Yes ○ No

4. Does the school provide bus service for your child? ○ Yes ○ No ○ Not sure

5. At what grade would / did you allow your child to walk or bicycle without an adult to / from school?

Grade (K-12): _____ **OR** ○ I would not feel comfortable at any grade.

Now we would like to ask some questions about your child's way *to and from school*.

6. Which of the following are located along your child's way to school? (Check ALL that apply.)

☐ Industrial site / junk yard ☐ Community / youth center ☐ Playground ☐ Convenience store
☐ Bakery / café / restaurant ☐ Small retail / business ☐ Bus stop ☐ Park
☐ Large parking lot / garage ☐ Large office building ☐ Gas station ☐ Walking path / trail
☐ Large apartment complex ☐ Church ☐ Vacant lot / abandoned building
☐ Others: _____ ☐ None of the above

7. Which of the following would your child have to cross if he / she walks to school? (Check ALL that apply.)

☐ Highway or freeway ☐ Road with busy traffic ☐ Intersection without street signals or stop signs
☐ Intersection without a painted crosswalk ☐ Railway / light rail ☐ None of the above

8. Are there sidewalks along your child's way to school?

○ No → *Skip to **Question 10 on next page.***
○ Yes, on all streets ○ Yes, on most streets ○ Yes, on some streets ○ Yes, on very few streets

9. What do you think about the sidewalks along your child's way to and from school? Please tell us how much you agree or disagree with each statement by checking your answers.	**Strongly disagree**	**Somewhat disagree**	**Neither disagree nor agree**	**Somewhat agree**	**Strongly agree**
1) Sidewalks are well maintained and clean.	○	○	○	○	○
2) Sidewalks are wide enough for two persons walking together.	○	○	○	○	○
3) Sidewalks are separated from traffic by grass or trees.	○	○	○	○	○
4) Sidewalks are free of obstructions (trash cans, power poles, parked cars, etc.).	○	○	○	○	○

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10. How about safety concerns for walking to / from school?	Strongly disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Strongly agree
1) My child may get lost.	O	O	O	O	O
2) My child may get bullied, teased, or harassed.	O	O	O	O	O
3) My child may be taken or hurt by a stranger.	O	O	O	O	O
4) My child may be attacked by stray dogs.	O	O	O	O	O
5) My child may be hit by a car.	O	O	O	O	O
6) Exhaust fumes may harm my child's health.	O	O	O	O	O
7) No one will be able to see and help my child in case of danger.	O	O	O	O	O
8) My child may get injured by falling (due to a drainage ditch, uneven walking surface, etc.).	O	O	O	O	O

11. How do you feel about having your child walk to / from school?	Strongly disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Strongly agree
1) It is convenient to walk to / from school.	O	O	O	O	O
2) The school zones are well enforced.	O	O	O	O	O
3) Walking to school involves too much planning ahead.	O	O	O	O	O
4) It is easier / faster for me to drive my child to / from school.	O	O	O	O	O
5) My child has too much to carry.	O	O	O	O	O
6) My child gets too hot and sweaty.	O	O	O	O	O
7) My child thinks walking to school is "cool".	O	O	O	O	O
8) I (would) enjoy walking with my child to / from school.	O	O	O	O	O
9) My family and friends like the idea of walking to / from school.	O	O	O	O	O
10) Other kids walk to / from school in my neighborhood.	O	O	O	O	O

Following questions are about your child's independent travel from *home to non-school destinations*. By *independent travel*, we mean traveling without an adult's company (alone or with other child(ren)). By *neighborhood*, we mean the area within a *10-15 minute walk from your home*.

12. How far away from home is your child allowed to go without an adult's company (alone or with other child(ren))?

O ≤5 min walk O 6–10 min walk O 11–15 min walk O 16–20 min walk O ≥21 min walk
O Never allowed

13. What neighborhood destinations other than school does your child actually go to without an adult's company (alone or with other child(ren))? (Check ALL that apply.)

☐ Friend's / relative's house ☐ Park ☐ Sporting field
☐ Recreation center ☐ Playground ☐ Neighborhood center
☐ Local shop / restaurant ☐ Apartment common area ☐ Other open space
☐ Walking / biking trails ☐ Neighborhood streets
☐ Other places, please specify: _____ ☐ None above

14. How do you feel about walking in your neighborhood?	Strongly disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Strongly agree
1) My child walks quite often in his / her daily routine.	O	O	O	O	O
2) Walking is a good way to exercise.	O	O	O	O	O
3) Walking is a good way to interact with other people.	O	O	O	O	O
4) I walk quite often in my daily routine.	O	O	O	O	O
5) Other kids and parents walk quite often in their daily routines.	O	O	O	O	O
6) I feel connected to people in my neighborhood.	O	O	O	O	O
7) Parents should NOT let children of this age travel to and from places without adult's supervision.	O	O	O	O	O

Section 2: Children's Outdoor Play without Adult Company

This section asks about children's outdoor play activities, alone or with other child(ren) without an adult's company. Please answer the questions in terms of a typical week when the weather is nice.

15. In a typical week, when the weather is nice, how many minutes per day does your child play outdoors without an adult's company? (Do NOT count outdoor play during school hours.)

For a typical **weekday**: _____ minutes per day

For a typical **weekend day**: _____ minutes per day

16. How far away from home is your child allowed to play in outdoor areas without an adult's company?

O ≤5 min walk O 6–10 min walk O 11–15 min walk O 16–20 min walk O ≥21 min walk

O Never allowed

17. At what grade would / did you allow your child to play outside without an adult's company?

Grade (K-12): _____ **OR** O I would not feel comfortable at any grade.

18. Do you have any of the following located in your neighborhood?	IF YES →	How many minutes per day does your child play there without an adult's company?
1) School	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
2) Park	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
3) Playground	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
4) Sporting field	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
5) Walking / biking trails	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
6) Neighborhood / recreation center	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
7) Friend's / relative's house that your child visit at least once per week	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
8) Apartment common area	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
9) Other open space	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
10) Any other places in your neighborhood where your child plays at least once per week?	O No O Yes →	**Please specify:** Place 1: _____ _____ min / weekday **AND** _____ min / weekend day Place 2: _____ _____ min / weekday **AND** _____ min / weekend day

19. Do you have any of the following around your home?	IF YES →	How many minutes per day does your child play there without an adult's company?
1) Your own front yard	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
2) Your own back yard	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
3) Your own driveway	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
4) Frontage street (street directly in front of your home)	O No O Yes →	_____ min / weekday **AND** _____ min / weekend day
5) Any other place directly around your home where your child plays at least once per week?	O No O Yes →	**Please specify:** _____ _____ min / weekday **AND** _____ min / weekend day

20. Please tell us how much you agree or disagree with each statement by checking your answer.	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
1) The quality of parks / playgrounds in my neighborhood is satisfactory.	O	O	O	O
2) Adult(s) in my family can find time to transport my child to activities.	O	O	O	O
3) My child has many friends in my neighborhood.	O	O	O	O
4) My child enjoys playing outside without an adult's company.	O	O	O	O
5) Lots of children play or hang out on my street.	O	O	O	O
6) My family goes to the park together at least once per week.	O	O	O	O
7) People in the neighborhood are willing to help each other.	O	O	O	O
8) The neighborhood is a tight community.	O	O	O	O
9) The people in the neighborhood can be trusted.	O	O	O	O
10) In general, the people in the neighborhood get along well.	O	O	O	O
11) People in the neighborhood share the same norms and values.	O	O	O	O
12) Parents should NOT let children of this age play alone or with peers in the neighborhood without adult's supervision.	O	O	O	O

Section 3: Overall Neighborhood Environment

Please check the answer that best applies to the neighborhood where your family lives. Both "*local*" and "*within walking distance*" in these questions mean within a 10-15 minute walk from your home.

21. Access to services	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
1) Stores are within easy walking distance of our home.	O	O	O	O
2) Parking is difficult in local shopping areas.	O	O	O	O
3) There are many places for my child to go (alone or with someone) within easy walking distance of our home.	O	O	O	O
4) From our home, it is easy for my child to walk (alone or with someone) to a transit stop (bus, subway, train).	O	O	O	O
5) The streets in my neighborhood are hilly, making our neighborhood difficult for my child to walk in.	O	O	O	O
6) There are major barriers to walking in our local area that make it hard for my child to get from place to place (for example, freeways, railway lines, rivers).	O	O	O	O

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22. Neighborhood surroundings	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
1) There are sidewalks on most of the streets in our neighborhood.	O	O	O	O
2) Sidewalks are separated from the road / traffic in our neighborhood by parked cars.	O	O	O	O
3) There is grass / dirt between the streets and the sidewalks in our neighborhood.	O	O	O	O
4) There are trees along the streets in my neighborhood.	O	O	O	O
5) There are many interesting things for my child to look at while walking in my neighborhood.	O	O	O	O
6) There are many beautiful natural things for my child to look at in my neighborhood (e.g., gardens, views).	O	O	O	O
7) There are many buildings / homes in my neighborhood that are nice to look at for my child.	O	O	O	O
8) It is well maintained and clean.	O	O	O	O
9) It is quiet (without much noise from cars, airplanes, factories, etc.).	O	O	O	O

23. Neighborhood safety	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
1) There is so much traffic along nearby streets that it makes it difficult or unpleasant for my child to walk (alone or with someone) in our neighborhood.	O	O	O	O
2) The speed of traffic on most nearby streets is usually slow (30 mph or less).	O	O	O	O
3) Most drivers go faster than the posted speed limits in our neighborhood.	O	O	O	O
4) Our neighborhood streets have good lighting at night.	O	O	O	O
5) Walkers and bikers on the streets in our neighborhood can be easily seen by people in their homes.	O	O	O	O
6) There are crosswalks and signals to help walkers cross busy streets in our neighborhood.	O	O	O	O
7) When walking in our neighborhood there are a lot of exhaust fumes.	O	O	O	O

24. Crime safety	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
1) There is a high crime rate in our neighborhood.	O	O	O	O
2) The crime rate in our neighborhood makes it unsafe for my child to go on walks (alone or with someone) at night.	O	O	O	O
3) The gang criminal activity in our neighborhood makes it unsafe for my child to play or travel alone or with other child(ren) in my neighborhood.	O	O	O	O
4) I am worried about letting my child play outside alone around my home (e.g., yard, driveway, apartment common area) because I am afraid of them being taken or hurt by a stranger.	O	O	O	O
5) I am worried about letting my child be outside with a friend around my home because I am afraid my child will be taken or hurt by a stranger.	O	O	O	O
6) I am worried about letting my child play or walk alone or with friends in my neighborhood and local streets because I am afraid my child will be taken or hurt by a stranger.	O	O	O	O
7) I am worried about letting my child be alone or with friends in a local or nearby park because I am afraid my child will be taken or hurt by a stranger.	O	O	O	O

Section 4: Questions about You and Your Family

25. About the Child Who Brought the Survey Home

1) The child is: ○ Female ○ Male

2) Child's grade: _____

3) Child's weight: _____ pounds **OR** _____ kg (kilograms)

4) Child's height: _____ feet and _____ inches **OR** _____ meters

5) Is your child: ○ Hispanic ○ White, Non-Hispanic ○ African American ○ Other: _____

6) Does your child have any of the following health conditions? (Check **ALL** that apply.)

☐ Diabetes ☐ Obesity ☐ Hypertension ☐ Heart condition ☐ Asthma

☐ Depression ☐ ADHD ☐ Autism ☐ None of the above ☐ Others: _____

7) During a usual WEEK, how many days does your child take part in physical activity for at least 60 minutes?

_____ days / WEEK

8) In a typical week, when the weather is nice, how many minutes per day does your child play outdoors with or without an adult's company? _____ minutes / WEEKDAY **AND** _____ minutes / WEEKEND DAY

9) How many minutes does your child typically spend watching television, using a computer, reading, or playing video games, when not working / studying? ____ min / WEEKDAY **AND** ____ min / WEEKEND DAY

10) Does your child qualify for special school lunch programs?

○ Yes, free lunch ○ Yes, reduced price lunch ○ No

26. About Family Members

1) What is your relationship to the child you are completing this survey for?

○ Mother ○ Father ○ Grandmother ○ Grandfather ○ Other: _____

2) Are you: ○ Hispanic ○ White, Non-Hispanic ○ African American ○ Other: _____

3) Were you born in the US? ○ Yes ○ No → How long have you been living in the U.S.? _____ year(s)

4) Which adults (relationship to the child) live in your household? (Check **ALL** that apply including yourself.)

☐ Mother ☐ Father ☐ Grandmother ☐ Grandfather ☐ Other: _____

5) Are any of those adults available to supervise your child's travel and play? ○ Yes ○ No

6) What is the highest level of education completed among all adults (including yourself) in your household?

○ Elementary or less ○ Some college / Associate degree

○ Middle school ○ College graduate / Bachelor's degree

○ High school or GED ○ Graduate / professional degree

7) Are you currently (Check **ALL** that apply.)

☐ Employed for wages ☐ A student ☐ Out of work for 1 year or more ☐ A homemaker

☐ Self-employed ☐ Retired ☐ Out of work for less than 1 year ☐ Unable to work

8) What are the ages of ALL children in your household? _____;_____;_____;_____;_____;_____;_____

9) What language do you use most often at home? ○ English ○ Spanish ○ _____

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27. About Your Household

1) Your home address: _____, TX, ZIP _____

2) How long have you lived in your current residence? _____ year(s)

3) Do you own or rent the current house / apartment? ○ Own ○ Rent

4) What is the type of your current housing?

○ A one-family house detached from any other house
○ A building with 5 or more apartments or units
○ A one-family house attached to one or more houses (e.g., townhouse)
○ A mobile home or trailer
○ A building with 2 to 4 apartments or units
○ Other, please specify: _____

5) What's your main reason to choose this neighborhood? (Check **ALL** that apply.)

☐ Housing price ☐ Close to work ☐ Close to my child's school ☐ Quality of school
☐ Quality of neighborhood ☐ Easy to walk around ☐ Others: _____ ☐ None of the above

6) Does your family have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?

○ Yes. Everyone. ○ Yes. Only the adult(s). ○ Yes. Only my child(ren). ○ No. No one has coverage.

7) Was there a time in the past 12 months when your child needed to see a doctor but could not because of the cost? ○ Yes ○ No

8) How many cars are there in your household? _____ cars

9) How many people in your household have a driver's license? _____ people

10) Do you have any pets in your household? ○ None ○ Dog(s) ○ Cat(s) ○ Others:_____

11) Is your annual household income from all sources:

○ Less than $5,000
○ $5,000 - $9,999
○ $10,000 - $19,999
○ $20,000 - $39,999
○ $40,000 - $59,999
○ $60,000 - $79,999
○ $80,000 - $99,999
○ $100,000 - $200,000
○ $200,000 or more
○ Don't know / not sure
○ Don't want to answer

28. Is there anything else that is important to your child's independent travel or outdoor free play?

Please specify:

Thanks for your help!

You will also be entered in the drawing to win one of the ten $50 gift cards!

Our efforts are devoted to creating safe and healthy environments for children and families.

Would you be interested in helping us by letting us contact you for similar studies in the future?

○ Yes ○ No

(English Version on the Other Side)

November 26, 2018

Estimados Padres:

Como muchos de ustedes sabrán, la Ciudad de Austin aprobó en el 2016 un bono de movilidad de $720 millones, de los cuales Rutas Seguras a la Escuela recibió $27.5 millones. Para medir el impacto de este financiamiento, estamos trabajando en colaboración con investigadores de la Universidad de Texas A&M para estudiar sobre rutas de los niños a la escuela y su movilidad, y el papel que juegan los ambientes. Este es un estudio de seguimiento a 2 encuestas previas similares llevadas a cabo en los años 2007 y 2010, las cuales recibieron un gran apoyo por parte de padres y escuelas.

La encuesta adjunta tomará aproximadamente 20 minutos y cuestiona respecto al recorrido y movilidad escolar de su hijo, su actitud respecto a estos temas, y cualquier otro problema que puedan tener un impacto. Su participación es completamente voluntaria, y no lo expondrá a ningún riesgo adicional del que podría encontrarse en su vida cotidiana. Las respuestas de la encuesta, incluyendo aquellas con información confidencial, se mantendrán privadas y solamente accesibles por el equipo de investigación. No habrá identificadores que lo enlacen a usted con este estudio incluidos en ningún tipo de reporte que pueda ser publicado. Usted podría decidir no comenzar o dejar de participar en cualquier momento. Si usted elige no formar parte de este estudio, no tendrá ningún efecto en la relación de usted o de su hijo con la escuela o alguna otra institución involucrada.

Para participar, por favor complete esta encuesta en papel y regrésela con la página de portada al maestro de su hijo(a). O usted puede completarla en línea en la página 1.austinsrts.org

Al ser recibida su encuesta completa, su hijo(a) tendrá la oportunidad de ganar una tarjeta de regalo de $50. La Escuela Primaria y la Escuela Secundaria con más participantes recibirán cada una, una tarjeta de regalo de $250.

Si tiene alguna pregunta, comentario o queja sobre la investigación, por favor llame a Amir Emamian del Programa de Rutas Seguras a la Escuela de la Ciudad de Austin al 512-974-9319 o contacte a la Dra. Xuemei Zhu (Investigadora Principal de la Universidad de Texas A&M) al correo electrónico xuemeizhu@tamu.edu o al 979-845-3780. Esta investigación ha sido revisada y aprobada por la Junta de Revisión Institucional de Texas A&M. Si tiene alguna otra preocupación, puede contactarlos al 1-979-458-4067, línea gratuita al 1-855-795-8636, o por correo electrónico al irb@tamu.edu.

¡Gracias por su tiempo y por completar la encuesta! ¡Trabajando juntos podemos tener un Austin más saludable!

Para entrar el sorteo, favor de proporcionar su información:

Escuela: _____

Su correo electrónico: _____

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ENCUESTA DE LAS RUTAS SEGURAS HACIA LA ESCUELA

Gracias por su ayuda! Todo lo que usted nos diga será estrictamente confidencial (secreto). Si usted tiene más de un niño favor de responder las siguientes preguntas en base a el niño(a) que llevo la encuesta a casa.

Sección 1: Recorrido diario del niño(a) a la escuela

1. En un día normal, cuando el clima es agradable, como va su hijo(a)……	
1) De la Casa a la escuela	**2) De la escuela a la casa**
○ Camina *solo(a)*	○ Camina *solo(a)*
○ Camina *con amigos(as)*	○ Camina *con amigos(as)*
○ Camina *con padre / madre / adulto*	○ Camina *con padre / madre / adulto*
○ Bicicleta	○ Bicicleta
○ Autobús escolar	○ Autobús escolar
○ Autobús publico o Tren Ligero	○ Autobús publico Tren Ligero
○ Auto privado, incluye "carpool"	○ Auto privado, incluye "carpool"

2. ¿Cuánto tiempo le toma llegar a la escuela, usando el modo de transportación que normalmente usa de la casa a la escuela? _____ minutos

3. ¿Es la distancia lo suficientemente corta para que su hijo(a) caminé hacia la escuela? ○ Si ○ No

4. ¿Provee la escuela servicio de autobús para su hijo(a)? ○ Si ○ No ○ No estoy segura(o)

5. ¿En qué grado permitió o permitirá que su hijo(a) vaya / regrese a pie o en bicicleta a la / de la escuela sin supervisión de un adulto? Grado (K-12): _____ **O** ○ No me sentiría bien en ningún grado.

Tenemos algunas preguntas acerca de la ruta que sigue su hijo(a) para ir y regresar de la escuela.

6. ¿Por cuales de los siguientes lugares pasa su hijo(a) camino a la escuela? (Marque TODOS los que apliquen.)

- ☐ Áreas industriales / depósitos de basura
- ☐ Centros comunitarios y / o para jóvenes
- ☐ Jardín de juegos
- ☐ Tienda de conveniencia
- ☐ Panadería / cafés / restaurante
- ☐ Comercios pequeños
- ☐ Parada de autobús
- ☐ Parque
- ☐ Estacionamiento grande / garaje
- ☐ Edificio grande de oficinas
- ☐ Gasolinera
- ☐ Senderos
- ☐ Complejo de apartamento grande
- ☐ Iglesia
- ☐ Terreno baldío / edificio abandonado
- ☐ Otros: _____
- ☐ Ninguno de los anteriores

7. En caso de que su hijo(a) camine a la escuela ¿Cuál de los siguientes lugares tendría que cruzar? (Marque TODOS los que apliquen.)

- ☐ Carreteras o autopistas
- ☐ Calles / carreteras con mucho tráfico
- ☐ Intersección sin semáforos o señales de alto
- ☐ Intersección sin cruceros marcados
- ☐ Vías de tren / tren ligero
- ☐ Ninguna de las anteriores

8. ¿Hay aceras (banquetas) en el camino hacia la escuela de su hijo(a)?

○ No → *Pase a **la pregunta 10 en la página siguiente**.*

○ Si, en todas las calles ○ Si, en la mayoría de las calles ○ Si, en algunas calles ○ Si, en muy pocas calles

9. ¿Qué piensa usted de las aceras que hay en la ruta que toma su hijo(a) para ir y regresar de la escuela? Por favor díganos qué tan de acuerdo o desacuerdo está usted con las siguientes oraciones.	**Totalmente en desacuerdo**	**Un poco en desacuerdo**	**Ni de acuerdo ni desacuerdo**	**Un poco de acuerdo**	**Totalmente de acuerdo**
1) Las aceras están limpias y bien cuidadas.	○	○	○	○	○
2) Las aceras son lo suficiente anchas para que dos personas caminen juntas.	○	○	○	○	○
3) Las aceras están separadas del tráfico por pasto o árboles.	○	○	○	○	○
4) Las aceras están libres de obstáculos (botes de basura, postes de electricidad o carros estacionados, etc.).	○	○	○	○	○

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10. ¿Qué le preocupa acerca de la seguridad para caminar hacia / de la escuela?	Totalmente en desacuerdo	Un poco en desacuerdo	Ni de acuerdo ni desacuerdo	Un poco de acuerdo	Totalmente de acuerdo
1) Mi hijo se podría perder.	O	O	O	O	O
2) Mi hijo puede ser acosado, humillado o intimidado.	O	O	O	O	O
3) Mi hijo se lo podría llevar o lastimar un extraño.	O	O	O	O	O
4) Mi hijo puede ser atacado por perros.	O	O	O	O	O
5) Mi hijo puede ser atropellado por un carro.	O	O	O	O	O
6) El humo de los vehículos puede dañar la salud de mi niño.	O	O	O	O	O
7) Nadie en el vecindario será capaz de ver y ayudar a mi hijo en caso de peligro.	O	O	O	O	O
8) Mi hijo se puede caer y lastimarse (debido a coladeras, o aceras en mal estado, etc.)	O	O	O	O	O

11. ¿Cómo se siente acerca de que su hijo(a) vaya venga de la escuela caminando?	Totalmente en desacuerdo	Un poco en desacuerdo	Ni de acuerdo ni desacuerdo	Un poco de acuerdo	Totalmente de acuerdo
1) Es conveniente caminar a de la escuela.	O	O	O	O	O
2) La zona escolar esta bien vigilada.	O	O	O	O	O
3) El caminar a la escuela involucra mucha planeación.	O	O	O	O	O
4) Es más fácil / rápido llevar o traer a mi hijo a la escuela en carro	O	O	O	O	O
5) Mi hijo tiene muchas cosas que cargar.	O	O	O	O	O
6) A mi hijo le da mucho calor y suda.	O	O	O	O	O
7) Mi hijo piensa que caminar a la escuela es “divertido”.	O	O	O	O	O
8) Me (gustaría) gusta caminar con mi hijo hacía y de regreso de la escuela.	O	O	O	O	O
9) Mi familia y amigos les gusta la idea de caminar hacia / de regreso a la escuela.	O	O	O	O	O
10) Otros niños de mi vecindario caminan hacia / de regreso a la escuela.	O	O	O	O	O

Las siguientes preguntas son acerca del recorrido independiente de su hijo(a) de la casa a destinos no escolares. Nosotros definimos recorrido independiente como a viajar sin el acompañamiento de un adulto (solo(a) o con otros(as) niños(as)). Nosotros definimos el vecindario como una área la cual se encuentra de 10 a 15 minutos caminando desde su casa.

12. ¿Que tan lejos de su casa usted le permite a su hijo(a) salir sin la compañía de un adulto (solo(a) o con otros(as) niños(as))?

O ≤5 min caminando O 6–10 min caminando O 11–15 min caminando
O 16–20 min caminando O ≥21 min caminando O No está permitido

13. ¿Que otros destinos en el vecindario aparte de la escuela su hijo(a) realmente va sin el acompañamiento de un adulto (solo(a) o con otros(as) niños(as))?(Marque TODOS los que apliquen.)

☐ Casa de Familiares / amigos ☐ Parques ☐ Campo deportivo
☐ Centros de recreación ☐ Jardín de juegos ☐ Centros del vecindario
☐ Tienda / restaurante local ☐ Área común de los apartamentos ☐ Algún otro espacio abierto
☐ Senderos / senderos para bicicleta ☐ Calles del vecindario
☐ Otros lugares, por favor especifique: _____ ☐ Ninguno

14. ¿Cómo se siente al caminar en su vecindario?	Totalmente en desacuerdo	Un poco en desacuerdo	Ni de acuerdo ni desacuerdo	Un poco de acuerdo	Totalmente de acuerdo
1) Mi hijo camina frecuentemente como parte de su rutina.	O	O	O	O	O
2) Caminar es una buena forma de hacer ejercicio.	O	O	O	O	O
3) Caminar es una buena forma de interactuar con otras personas.	O	O	O	O	O
4) Yo camino con frecuencia en mi rutina diaria.	O	O	O	O	O
5) Otros niños y padres de mi vecindario caminan frecuentemente como parte de sus rutinas diarias.	O	O	O	O	O
6) Me siento conectado con mis vecinos.	O	O	O	O	O
7) Los padres NO deberían permitir que niños(as) de esta edad vayan y vengan de lugares sin la supervisión de un adulto.	O	O	O	O	O

Sección 2: Niños(as) Jugando al Aire Libre sin Compañía de un Adulto

Esta sección es sobre las actividades del niño jugando al aire libre, solo o con otros niños, sin la compañía de un adulto. Por favor responda las siguientes preguntas en base a un clima agradable.

15. En una semana típica, cuando el clima es agradable ¿cuántos minutos por día su hijo juega afuera sin la compañía de un adulto? (NO cuente jugar afuera durante horas de la escuela.)

Por un **día de entre semana** típico: _____ minutos

Por un **día de fin de semana** típico: _____ minutos

16. ¿Que tan lejos de su casa usted le permite a su hijo(a) jugar en áreas al aire libre sin la compañía de un adulto?

O ≤5 min caminando O 6–10 min caminando O 11–15 min caminando

O 16–20 min caminando O ≥21 min caminando O No está permitido

17. ¿En qué grado permitió o permitirá que su hijo(a) juegue en áreas al aire libre sin la compañía de un adulto (solo(a) o con otros(as) niños(as)) ?

Grado (K-12): _____ **O** O No me sentiría bien en ningún grado.

18. Usted tiene alguno de los siguientes ubicados en su colonia?→	Si es Sí →	¿Cuántos minutos por día su hijo juega ahí sin la compañía de un adulto?
1) Escuela	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
2) Parque	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
3) Patio de recreo	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
4) Campo de deportes	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
5) Senderos para caminar o andar en bicicleta	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
6) Colonia / centro de Recreación	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
7) Casa de amigo / familiar que su hijo visite por lo menos una vez por semana	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
8) Área común de apartamentos	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
9) Algún otro espacio abierto	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
10) ¿Cualquier otro lugar en el que su hijo juegue por lo menos una vez a la semana?	O No O Sí →	**Por favor especifique** Lugar 1:_____ ___ min / día de entre semana **Y** ___ min / día de fin de semana Lugar 2: _____ ___ min / día de entre semana **Y** ___ min / día de fin de semana

19. ¿Tiene alguno de los siguientes alrededores de su hogar?→	Si es Sí →	¿Cuántos minutos por día su hijo juega ahí sin la compañía de un adulto?
1) Su propio jardín frontal	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
2) Su propio jardín trasero	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
3) Su propia entrada propia para carro	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
4) Calle de fachada (directamente enfrente de su hogar)	O No O Sí →	___ min / día de entre semana **Y** ___ min / día de fin de semana
5) ¿Cualquier otro lugar directamente alrededor de su hogar donde su niño juega por lo menos una vez a la semana?	O No O Sí →	**Por favor especifique** Lugar: _____ ___ min / día de entre semana **Y** ___ min / día de fin de semana

20. Por favor díganos qué tan de acuerdo o en desacuerdo está usted con los siguientes escenarios marcando su respuesta.	Totalmente en desacuerdo	Un poco en desacuerdo	Un poco de acuerdo	Totalmente de acuerdo
1) La calidad de los parques / jardín de juegos en mi vecindario es satisfactorio.	O	O	O	O
2) Adultos en mi familia encuentran tiempo para llevar a mi hijo(a) a actividades.	O	O	O	O
3) Mi hijo(a) tiene muchos amigos en el vecindario.	O	O	O	O
4) Mi hijo(a) disfruta jugar afuera sin la compañía de un adulto.	O	O	O	O
5) Muchos niños(as) juegan o pasan tiempo en mi calle.	O	O	O	O
6) Mi familia va al parque juntos al menos una vez a la semana.	O	O	O	O
7) Las personas en el vecindario están dispuestas a ayudarse mutuamente.	O	O	O	O
8) El vecindario es una comunidad unida.	O	O	O	O
9) Las personas en el vecindario son confiables.	O	O	O	O
10) En general, In general, las personas en el vecindario se llevan bien.	O	O	O	O
11) Las personas en el vecindario comparten las mismas normas y valores.	O	O	O	O
12) Los padres NO deberían de permitir a niños(as) de esta edad a jugar solos o con compañeros(as) en el vecindario sin la supervisión de un adulto.	O	O	O	O

Sección 3: Entorno general del vecindario

Por favor marque la respuesta que es más aplicable a el vecindario donde su familia vive. Ambas "locales" y "dentro de una distancia cómoda para caminar" estas preguntas se refieren a una distancia que puede recorrer dentro de 10 a 15 minutos caminando desde su hogar.

21. Acceso a servicios	Totalmente en desacuerdo	Un poco en desacuerdo	Un poco de acuerdo	Totalmente de acuerdo
1) Las tiendas están a una distancia cómoda caminando de nuestro hogar.	O	O	O	O
2) Es difícil estacionarse en las áreas comerciales locales.	O	O	O	O
3) Hay muchos lugares a distancia cómoda caminando de nuestro hogar a los que mi hijo(a) vaya (solo(a) o con alguien).	O	O	O	O
4) Es fácil par mi hijo(a) caminar (solo(a) o con alguien) desde nuestro hogar a una parada de tránsito (autobús, metro, tren).	O	O	O	O
5) Las calles de mi vecindario tienen colinas lo cual le dificulta a mi hijo caminar por el vecindario.	O	O	O	O
6) Hay grandes obstáculos en nuestra área local, los cuales le dificultan a mi hijo(a) caminar de un lugar a otro (ejemplos: Carretera o autopista, vías de tren o tren ligero, ríos)	O	O	O	O

22. Los alrededores del vecindario	Totalmente en desacuerdo	Un poco en desacuerdo	Un poco de acuerdo	Totalmente de acuerdo
1) Hay aceras (banquetas) en la mayoría de las calles en nuestro vecindario.	O	O	O	O
2) Las aceras (banquetas) en nuestro vecindario están separadas de la calle / tráfico por autos estacionados.	O	O	O	O
3) En nuestro vecindario hay franjas de pasto / tierra que dividen la calle de las aceras (banquetas).	O	O	O	O
4) Hay árboles a lo largo de las calles en mi vecindario.	O	O	O	O
5) Hay muchas cosas interesantes para que mi hijo(a) observe mientras camina en nuestro vecindario.	O	O	O	O
6) Hay muchas cosas hermosas naturales para que mi hijo(a) observe en mi vecindario (ex. jardines, vistas).	O	O	O	O
7) Hay muchos edificios / casas en mi vecindario que son agradables de observar para mi hijo(a).	O	O	O	O
8) Está bien mantenido y limpio.	O	O	O	O
9) Es tranquilo (sin mucho ruido de autos, aviones, fábricas, etc.).	O	O	O	O

23. La seguridad del vecindario	Totalmente en desacuerdo	Un poco en desacuerdo	Un poco de acuerdo	Totalmente de acuerdo
1) Hay mucho tráfico en las calles cercanas a mi vecindario lo cual es difícil o desagradable para que mi hijo(a) caminé (solo(a) o con alguien).	O	O	O	O
2) La velocidad del tráfico en la mayoría de las calles cercanas suele ser lento (30 mph o menos).	O	O	O	O
3) La mayoría de los conductores van más rápido que los límites de velocidad señalados en nuestro vecindario.	O	O	O	O
4) Las calles en nuestro vecindario están bien iluminadas durante la noche.	O	O	O	O
5) Los peatones y ciclistas en nuestro vecindario pueden ser fácilmente vistos por personas que están en sus casas.	O	O	O	O
6) En nuestro vecindario hay cruces peatonales y señales para ayudar a peatones a cruzar calles concurridas.	O	O	O	O
7) Al caminar por mi vecindario, hay mucho humo de vehículos.	O	O	O	O

24. Seguridad ante el crimen	Totalmente en desacuerdo	Un poco en desacuerdo	Un poco de acuerdo	Totalmente de acuerdo
1) Hay una alta tasa de criminalidad en nuestro vecindario	O	O	O	O
2) La tasa de criminalidad en nuestro vecindario hace que sea inseguro para mi hijo(a) salga a caminar (solo(a) o con alguien) por la noche.	O	O	O	O
3) La actividad criminal de pandillas en nuestro vecindario hace que sea inseguro para mi hijo(a) juegue o salga solo o con otros(as) niños(as) en mi vecindario.	O	O	O	O
4) Me preocupa dejar a mi hijo(a) jugar afuera solo(a) alrededor de mi casa (ej. jardín, entrada para carro, área común de los apartamentos) porque temo que un extraño se lo lleve o lastime.	O	O	O	O
5) Me preocupa dejar a mi hijo(a) jugar afuera con un(a) amigo(a) alrededor de mi casa porque temo que un extraño se lo lleve o lastime.	O	O	O	O
6) Me preocupa dejar a mi hijo(a) jugar afuera o caminar solo(a) o con amigos(as) en mi vecindario y calles locales porque temo que un extraño se lo lleve o lastime.	O	O	O	O
7) Me preocupa dejar a mi hijo(a) solo(a) o con amigos en un parque local o cercano porque temo que un extraño se lo lleve o lastime.	O	O	O	O

Sección 4: Preguntas sobre usted y su familia

25. Sobre el Niño que Trajo la Encuesta a Casa

1) El niño(a) es: ○ Mujer ○ Hombre

2) Grado escolar: _____

3) Peso del niño(a): _____ libras **O** _____ kg (kilogramos)

4) Estatura del niño(a): _____ pies y _____ pulgadas **O** _____ metros

5) Su niño(a) es: ○ Hispano ○ Blanco, No hispano ○ Afroamericano ○ Otro: _____

6) ¿Su niño presenta alguno de los siguientes problemas de salud? (Marque **TODOS** los que apliquen.)

☐ Diabetes ☐ Obesidad ☐ Hipertensión ☐ Condiciones cardiacas ☐ Asma
☐ Depresión ☐ ADHD ☐ Autismo ☐ Ninguna de las anteriores ☐ Otras: _____

7) Durante una SEMANA habitual, ¿Cuantos días su niño tiene actividad física por lo menos 60 minutos?

_____ días / SEMANA

8) En una semana típica, cuando el clima es agradable, ¿cuántos minutos por día su hijo juega afuera con o sin la compañía de un adulto? _____ minutos / DÍA DE ENTRE SEMANA **Y** _____ minutos / DÍA DE FIN DE SEMANA

9) ¿Cuántos minutos su hijo(a) pasa viendo televisión, usando una computadora, leyendo o jugando videojuegos, cuando no trabaja / estudia?

_____ minutos / DÍA DE ENTRE SEMANA **Y** _____ minutos / DÍA DE FIN DE SEMANA

10) ¿Su hijo califica para los programas especiales de comida?

○ Si, comida gratis ○ Si, comida a precio reducido ○ No

26. Acerca de los Miembros de la Familia

1) ¿Cuál es su relación con el niño por el cual está llenando esta encuesta?

○ Madre ○ Padre ○ Abuela ○ Abuelo ○ Otro: _____

2) Usted es: ○ Hispano ○ Blanco, no Hispano ○ Afroamericano ○ Otro: _____

3) ¿Nació usted en los Estados Unidos?

○ Si ○ No → ¿Cuanto tiempo lleva viviendo en los Estados Unidos? _____ año(s)

4) ¿Cuáles adultos (emparentados con el niño(a)) viven en su hogar? (Marque **TODOS** los que apliquen incluyéndose a usted.)

☐ Madre ☐ Padre ☐ Abuela ☐ Abuelo ☐ Otro: _____

5) ¿Alguno de estos adultos está dispuesto a supervisar el recorrido o cuando juega su hijo(a)? ○ Si ○ No

6) ¿Cuál es el nivel más alto de educación alcanzado entre los adultos (incluyéndose usted) en su hogar?

○ Primaria o menos ○ Licenciatura incompleta o Licenciatura Técnica
○ Secundaria ○ Universidad o Licenciatura
○ Preparatoria o GED ○ Maestría o posgrado

7) Está usted actualmente (Marque **TODOS** los que apliquen.)

☐ Asalariado ☐ Estudiante ☐ Sin trabajo por 1 un año o más
☐ Trabajador por cuenta propia ☐ Jubilado ☐ Sin trabajo por menos de 1 año
☐ Ama de casa ☐ Imposibilitado para trabajar

8) ¿Qué edad tienen TODOS los niños(as) en su hogar? _____;_____;_____;_____;_____;_____;_____

9) ¿Usualmente que idioma hablan en su hogar? ○ Inglés ○ Español ○

27. Acerca de Su Hogar

1) Dirección de domicilio: _____, TX, ZIP _____

2) ¿Cuánto tiempo ha vivido en su dirección actual? _____ año(s)

3) ¿Usted es propietario o renta su actual casa / apartamento? O Propietario O Rento

4) ¿En qué tipo de vivienda usted vive actualmente?

- O Una casa unifamiliar separada de cualquier otra casa
- O Una casa unifamiliar unida a una o más casas (ej. "townhouse")
- O Un edificio con 2 a 4 apartamentos o unidades
- O Un edificio con 5 o mas apartamentos o unidades
- O Una casa móvil o un remolque
- O Otro, por favor especifique: _____

5) ¿Cuáles fueron las razones primordiales al escoger este vecindario? (Marque **TODAS** las que apliquen.)

☐ Precio de la casa ☐ Cerca del trabajo ☐ Cerca a la escuela de mis hijos(as) ☐ Calidad de la escuela
☐ Calidad del vecindario ☐ Fácil para caminar ☐ Otros: _____ ☐ Ninguna de las anteriores

6) ¿Su familia tiene algún tipo de cobertura médica, incluyendo seguro médico, planes pre-pagados como los HMO o planes del gobierno tales como Medicare?

O Si. Todos. O Si. Solo los adultos. O Si. Solo los niños. O No. Nadie tiene cobertura.

7) En los últimos 12 meses ¿Se ha presentado una situación en la cual su hijo ha necesitado atención medica la cual no se pudo atender dado al costo de la visita? O Si O No

8) ¿Cuántos automóviles hay en su hogar? _____ automóviles

9) ¿Cuántas personas en su domicilio tienen licencia para conducir? _____ persona(s)

10) ¿Tiene usted mascotas en su hogar? O No O Perro(s) O Gato(s) O Otros:_____

11) Su ingreso familiar anual es:

- O Menos de $5,000
- O $5,000 - $9,999
- O $10,000 - $19,999
- O $20,000 - $39,999
- O $40,000 - $59,999
- O $60,000 - $79,999
- O $80,000 - $99,999
- O $100,000 - $200,000
- O $200,000 o más
- O No sé / no estoy seguro
- O Prefiero no responder

28. Hay algo más que sea importante para el recorrido independiente de su hijo(a) o para jugar al aire libre?

Por favor especifique:

¡Gracias por su ayuda!

¡Usted también será ingresado en el sorteo para ganar una de las diez tarjetas de regalo de $ 50!

Nuestros esfuerzos están dedicados a crear ambientes seguros y saludables para niños y familias.

¿Estaría interesado en ayudarnos al dejarnos contactarlo para estudios similares en el futuro?

O Si O No

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APPENDIX B

GOOGLE STREET VIEW AUDIT INSTRUMENT

Part of the audit instrument is from a validated tool TCOPPE (Texas Childhood Obesity Prevention Policy Evaluation) School Environmental Audit Tool, which is designed to reliably provide effective evaluations of streets at/around schools and school site environments for safety and walkability related to children's school travel (Lee et al., 2013).

Default Question Block

GSV Audit Instrument for Home Surrounding Environments

Response ID in Survey

Google Street View Link

Housing environments

1. The home is

- ○ A single family home
- ○ A non-single family home and inside an apartment complex
- ○ A non-single family home and NOT inside an apartment complex (e.g. a duplex or fourplex with individual parcel land)

2. Is the home in a gated community?

Yes	No	Not identifiable from Google Street View
○	○	○

3. The parcel lot for the participant's home is ...

- ☐ A middle lot of a regular street
- ☐ A middle lot of a dead-end street
- ☐ A corner lot of a regular street
- ☐ A corner lot of a dead-end street
- ☐ An end lot at a cul-de-sac (i.e., driveway directly touching a cul-de-sac/dead end)
- ☐ None of the above
- ☐ Not identifiable from Google Street View

4. Which of the following outdoor spaces is available at participant's own home? Check all that apply.

- ☐ Open front / side yard
- ☐ Enclosed front / side yard
- ☐ Backyard
- ☐ Front porch
- ☐ Own driveway
- ☐ Own frontage street
- ☐ Others:
- ☐ None of the above
- ☐ Not identifiable from Google Street View

5. Which of the following outdoor spaces is available at the participant's neighboring homes? Check all that apply.

- ☐ Single-family's open front / side yard
- ☐ Single-family's enclosed front / side yard
- ☐ Single-family's backyard
- ☐ Single-family's front porch
- ☐ Single-family's own driveway
- ☐ Single-family's frontage street
- ☐ Non-single-family's open front / side yard
- ☐ Non-single-family's enclosed front / side yard
- ☐ Non-single-family's backyard
- ☐ Non-single-family's front porch
- ☐ Non-single-family's own driveway
- ☐ Non-single-family's (i.e. duplex & fourplex) frontage street
- ☐ Multi-family housing shared common area: parking lot
- ☐ Multi-family housing shared common area in : yard / lawn
- ☐ Multi-family housing shared common area: driveway
- ☐ Multi-family housing (i.e. apartment complex) shared common area: frontage street
- ☐ Others:
- ☐ None of the above
- ☐ Not identifiable from Google Street View

Amenities of the apartment complex where the participant's home is located (Check all that apply).

- ☐ Swimming pool
- ☐ Playground
- ☐ Park
- ☐ Sporting field
- ☐ Barbecue / grill / picnic area
- ☐ Other:
- ☐ None of the above
- ☐ Not identifiable from Google Street View

Adjacent buildings along both sides of the frontage street segment

6. Average number of stories of buildings immediately along both sides of the frontage street segment is:

Number of windows and porches/balconies (both sides of the frontage street segment)

	0	1-3	4-10	11+	Not identifiable from Google Street View
7. Number of windows overlooking the street (both sides of the frontage street segment) is:	○	○	○	○	○
8. Number of porches/balconies (both sides of the frontage street segment, with a view to the street) is:	○	○	○	○	○

Land use along both sides of the frontage street segment

9. Immediate land use along both sides of the frontage street segment (Check all that apply).

☐ Residential: Single family home	☐ Commercial: Convenience store with gas station	☐ Educational, Office & Service: Church / other religious institution	☐ Other: Factory / power plant / junk yard
☐ Residential: Multifamily housing(e.g., apartment, condominium, duplex, 4-plex)	☐ Commercial: Convenience store without gas station	☐ Educational, Office & Service: Institutional excluding education and religious (e.g., city hall, court, hospital)	☐ Other: Warehouse / storage building / self-storage
☐ Residential: Mobile home	☐ Commercial: Gas station with no convenience store	☐ Educational, Office & Service: Office (e.g., clinic, dental clinic, law office, insurance office)	☐ Other: Parking lot / garage (stand alone)
☐ Commercial: Fast food restaurant	☐ Commercial: Drug store / pharmacy (e.g., CVS)	☐ Recreational: Gym / fitness center / indoor playground	☐ Other: Vacant / abandoned / undeveloped land (without buildings)
☐ Commercial: Buffet restaurant	☐ Commercial: Mall / strip mall / big box retail (e.g., Wal-mart, Home Depot, IKEA, Toys “R” Us): double-code all individual land uses	☐ Recreational: Lake / river / stream / creek	☐ Other: Vacant / abandoned building
☐ Commercial: Regular sit-	☐ Educational, Office &	☐ Recreational: Forest /	☐ Other: Other 1

down restaurant/taqueria	Service: Boys & girls club / YMCA	wooded area	
☐ Commercial: Café / bakery / snack (e.g., coffee, tea, juice, ice cream)	☐ Educational, Office & Service: School / kindergarten / daycare center	☐ Recreational: Public plaza / public square	☐ Other: Other 2
☐ Commercial: Pub / bar	☐ Educational, Office & Service: Police station	☐ Recreational: Playground	☐ None of the above
☐ Commercial: Small retail / service (e.g., clothing store, barber shop, boutique)	☐ Educational, Office & Service: Bank / post office	☐ Recreational: Trail / paths / greenway	☐ Not identifiable from Google Street View
☐ Commercial: Supermarket/grocery store	☐ Educational, Office & Service: Library	☐ Recreational: Park (not part of the school)	

The Park (not part of a school) is with (check all that apply):

- ☐ Playground equipment
- ☐ Trail / path / jogging track
- ☐ Basketball / tennis / volleyball court
- ☐ Baseball / football / soccer field
- ☐ Outdoor swimming pool
- ☐ Open field with no facility / equipment
- ☐ None of the above
- ☐ Not identifiable from Google Street View

Characteristics of the frontage street segment

10. Check ALL that apply for the frontage street segment of the participant's home.

- ☐ A cul-de-sac / dead end
- ☐ A one-way street
- ☐ School zone designated for part of segment
- ☐ School zone designated for entire of segment
- ☐ None of the above
- ☐ Not identifiable from Google Street View

11. Speed posted on the frontage street segment? (Check all that apply)

- ☐ Yes, general speed limit (mph):
- ☐ Yes, school zone speed limit (mph):
- ☐ No
- ☐ Not identifiable from Google Street View

School zone speed limit posted (check all that apply):

- ☐ When flashing
- ☐ During designated hours / days
- ☐ When children are present
- ☐ At all times
- ☐ Not identifiable from Google Street View

12. Street parking along the frontage street segment?

Yes, on one side	Yes, on both sides	No	Not identifiable from Google Street View
○	○	○	○

13. Number of lanes along the frontage street segment (both directions, If no marked lanes, estimate based on roadway width or driving behaviors):

14. Number of driveways & street intersections (both sides along the frontage street segment):

- ○ 0
- ○ 1-3
- ○ 4-10
- ○ 11+
- ○ Not identifiable from Google Street View

15. Number of street lights (not traffic lights, both sides of the frontage street segment & sidewalk):

16. Traffic calming devices that apply along the both sides of the frontage street segment (check all apply).

- ☐ Reduced speed sign (excluding school zone speed
- ☐ Pavement change / pavement marking (e.g., brick-

sign)

- [ ] Speed bump or hump
- [ ] Median island
- [ ] Roundabout
- [ ] Curb extension / bulb-out

paved roadways)

- [ ] Other:
- [ ] None of the above
- [ ] Not identifiable from Google Street View

17. Number of marked crosswalks within the frontage street segment:

- ○ 0
- ○ 1
- ○ 2
- ○ 3+
- ○ Not identifiable from Google Street View

18. Marked crosswalk connectivity of the frontage street segment?

Yes, on one end	Yes, on both ends	No	Not identifiable from Google Street View
○	○	○	○

19. Drainage problems on street, sidewalk, or buffer of the frontage street segment? (check all that apply)

- [ ] Yes, standing water
- [ ] Yes, traces of standing water (e.g., collected debris / leaves / soil, water stain on surfaces)
- [ ] No drainage problem
- [ ] Not identifiable from Google Street View

Characteristics of sidewalk on Side A of the frontage street segment (Side A: the side of the frontage street where the participant's home locates)

20A. Presence of sidewalk on side A

Yes	No	Not identifiable from Google Street View
○	○	○

The sidewalk A is along

○ Part of segment ○ Entire segment

21A. Material of Sidewalk A along the frontage street segment (check all that apply).

☐ Asphalt
☐ Concrete
☐ Paving block / brick
☐ Gravel or other stones
☐ Dirt or sand
☐ Other:
☐ None of the above
☐ Not identifiable from Google Street View

22A. Obstructions along the Sidewalk A of the frontage street segment (check all that apply).

☐ Poles or signs
☐ Mail boxes
☐ Parked cars
☐ Trees/shrubs/other vegetation
☐ Trash cans
☐ Other:
☐ None of the above
☐ Not identifiable from Google Street View

23A. Sidewalk A complete?

Yes	No	Not identifiable from Google Street View
○	○	○

24A. Sidewalk A connected?

Yes, on one end	Yes, on both ends	No	Not identifiable from Google Street View
○	○	○	○

Sidewalk A shade and protection from rain

	Poor	Fair	Good	Very Good	Excellent	Not identifiable from Google Street View

	Poor	Fair	Good	Very Good	Excellent	Not identifiable from Google Street View
25A. Sidewalk A shade (from trees, bldgs., etc.)	○	○	○	○	○	○
26A. Sidewalk A protection from rain	○	○	○	○	○	○

27A. Sidewalk A surface condition

	None/Very little	A little/some	A lot	Not identifiable from Google Street View
Holes & cracks	○	○	○	○
Bumps & uneven surfaces	○	○	○	○
Weeds	○	○	○	○
Litter	○	○	○	○

28A. Sidewalk A has buffer?

Yes	No	Not identifiable from Google Street View
○	○	○

If having buffer, it is along

Part of segment	Entire segment
○	○

Buffer material (check all that apply)

- ☐ Tall/shade trees
- ☐ Shrubs/small trees
- ☐ Grass or other ground cover vegetation
- ☐ Concrete or other hard paving
- ☐ Other:
- ☐ None of the above
- ☐ Not identifiable from Google Street View

29A. Drainage ditch along street/sidewalk A or in buffer?

Yes	No	Not identifiable from Google Street View

○ ○ ○

Characteristics of sidewalk on Side B of the frontage street segment (Side B: the side of the frontage street where participant's home does not locate)

20B. Presence of sidewalk on side B

Yes	No	Not identifiable from Google Street View
○	○	○

The sidewalk B is along

○ Part of segment ○ Entire segment

21B. Material of Sidewalk B along the frontage street segment (check all that apply).

☐ Asphalt
☐ Concrete
☐ Paving block / brick
☐ Gravel or other stones
☐ Dirt or sand
☐ Other:
☐ None of the above
☐ Not identifiable from Google Street View

22B. Obstructions along the Sidewalk B of the frontage street segment (check all that apply).

☐ Poles or signs
☐ Mail boxes
☐ Parked cars
☐ Trees/shrubs/other vegetation
☐ Trash cans
☐ Other:
☐ None of the above
☐ Not identifiable from Google Street View

23B. Sidewalk B complete?

Yes	No	Not identifiable from Google Street View
○	○	

○

24B. Sidewalk B connected?

Yes, on one end	Yes, on both ends	No	Not identifiable from Google Street View
○	○	○	○

Sidewalk B shade and protection from rain

	Poor	Fair	Good	Very Good	Excellent	Not identifiable from Google Street View
25B. Sidewalk B shade (from trees, bldgs., etc.)	○	○	○	○	○	○
26B. Sidewalk B protection from rain	○	○	○	○	○	○

27B. Sidewalk B surface condition

	None/Very little	A little/some	A lot	Not identifiable from Google Street View
Holes & cracks	○	○	○	○
Bumps & uneven surfaces	○	○	○	○
Weeds	○	○	○	○
Litter	○	○	○	○

28B. Sidewalk B has buffer?

Yes	No	Not identifiable from Google Street View
○	○	○

If having buffer, it is along

Part of segment	Entire segment
○	○

Buffer material (check all that apply)

- ☐ Tall/shade trees
- ☐ Shrubs/small trees
- ☐ Grass or other ground cover vegetation
- ☐ Concrete or other hard paving
- ☐ Other:
- ☐ None of the above
- ☐ Not identifiable from Google Street View

29B. Drainage ditch along street/sidewalk B or in buffer**?**

Yes	No	Not identifiable from Google Street View
○	○	○

Walking & Biking Conditions

30. Check all presented signs that apply along both sides of the frontage street segment

- ☐ No thru trucks
- ☐ No parking / towing enforced
- ☐ Child safety / pedestrian crossing sign
- ☐ Bike Route / bicyclist friendly sign
- ☐ Community / cultural / religious / political message or event / historical marker
- ☐ Crime watch / surveillance warning / home security service (e.g., ADT)
- ☐ Beware of dog sign
- ☐ No trespassing
- ☐ Stop sign
- ☐ Other:
- ☐ None of the above
- ☐ Not identifiable from Google Street View

31. Check all amenities that apply along both sides of the frontage street segment

- ☐ Bench / seating
- ☐ Trash can
- ☐ Other (e.g., public art, public telephone or call box):
- ☐ None of the above
- ☐ Not identifiable from Google Street View

32. Bus stop along both sides of the frontage street segment (check all that apply)

- [ ] Bus stop with shelter
- [ ] Bus stop with trash can
- [ ] Bus stop with bench
- [ ] Bus stop with sign only
- [ ] No bus stop
- [ ] Not identifiable from Google Street View

33. Street trees along both sides of the frontage street segment? (Check all apply).

- [ ] Tall deciduous trees, in PUBLIC right-of- way
- [ ] Tall evergreen trees, in PUBLIC right-of- way
- [ ] Shrubs, in PUBLIC right-of- way
- [ ] Other, in PUBLIC right-of- way:
- [ ] Tall deciduous trees, in PRIVATE property / yard
- [ ] Tall evergreen trees, in PRIVATE property / yard
- [ ] None of the above
- [ ] Not identifiable from Google Street View

34. Check all unattractive items that apply along both sides of the frontage street segment.

- [ ] Graffiti
- [ ] Whole or broken bottles / cans
- [ ] Cigarette / cigar butts or packages
- [ ] Abandoned cars
- [ ] Buildings with broken / boarded windows or other vandalism
- [ ] Condoms, needles, syringes, or drug-related paraphernalia
- [ ] Excessive power lines
- [ ] Stray dogs along streets / public areas
- [ ] Unattended dogs in private property / yard
- [ ] Other trash
- [ ] Other:
- [ ] None of the above
- [ ] Not identifiable from Google Street View

35. Check all bicycle facilities that apply along both sides of the frontage street segment.

- [ ] Striped & designated bicycle lane
- [ ] Bike rack
- [ ] Other
- [ ] None of the above
- [ ] Not identifiable from Google Street View

Perceptions of the frontage street segment

	Side A of the frontage street						Side B of the frontage street					
	Poor	Fair	Good	Very Good	Excellent	Not identifiable	Poor	Fair	Good	Very Good	Excellent	Not identifiable
36. Surveillance (easily observed from the windows, porches, or yards nearby)	O	O	O	O	O	O	O	O	O	O	O	O
37. Street/sidewalk maintenance (free of cracks, holes, overgrown grass/weeds, etc.)	O	O	O	O	O	O	O	O	O	O	O	O
38. Street/sidewalk cleanliness (free of litter, rubbish, broken glass, discarded items, etc.)	O	O	O	O	O	O	O	O	O	O	O	O
39. Cleanliness and maintenance of buildings and gardens (clean, well-kept, free of litter, discarded items, etc.)	O	O	O	O	O	O	O	O	O	O	O	O
40. Visual quality of street (everything visible from the street)	O	O	O	O	O	O	O	O	O	O	O	O
41. Visual quality of buildings	O	O	O	O	O	O	O	O	O	O	O	O
42. Visual quality of trees/vegetation	O	O	O	O	O	O	O	O	O	O	O	O
43. Condition/health of trees/vegetation	O	O	O	O	O	O	O	O	O	O	O	O
44. Attractiveness in walking	O	O	O	O	O	O	O	O	O	O	O	O
45. Attractiveness in bicycling	O	O	O	O	O	O	O	O	O	O	O	O
46. Comfort in walking	O	O	O	O	O	O	O	O	O	O	O	O
47. Comfort in bicycling	O	O	O	O	O	O	O	O	O	O	O	O
48. Safety in walking (for upper-year elementary school children)	O	O	O	O	O	O	O	O	O	O	O	O
49. Safety in bicycling (for upper-year elementary school children)	O	O	O	O	O	O	O	O	O	O	O	O

Please leave your initial.

APPENDIX C

DESCRIPTIVE STATISTICS OF PREDICTORS AND THE BIVARIATE RELATIONSHIP BETWEEN EACH PREDICTOR AND EACH OUTCOME VARIABLE (UNADJUSTED)

Table C-1 Descriptive Statistics of Personal/Social Predictors and the Bivariate Relationship between Each Predictor and Each Outcome Variable (Unadjusted, Sub-Group Sample, N=758)

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Child's personal factors				
Child's gender (Male: %)	0 = female, 1 = male	50.0	1.074	1.063
Child's grade level	0 = kindergarten, 1 = first grade …, 5 = fifth grade	2.13	1.439***	1.504***
Child's ethnicity (Hispanic: %)	0 = non-Hispanic, 1 = Hispanic	46.1	0.352***	0.333***
Eligibility for free or reduced-price lunch (Yes: %)	0 = no, 1 = yes	42.5	0.241***	0.320***
Child's health conditions	The total number of health conditions a child has	0.23 (0.605)	0.900	0.691*
Parental and household factors				
Parent's highest education	1 = elementary or less …, 6 = graduate or professional degree	4.38 (1.571)	1.494***	1.387***
Parent's occupation—employed (Yes: %)	0 = no, 1 = yes	64.8	1.428*	1.628**
English as home language (Yes: %)	0 = no, 1 = yes	67.8	2.657***	2.537***
Year(s) living in current residence	1 = < 2 years; 2 = 2-<4 years; 3 = 4-<6 years; 4 = 6-<8 years; 5 = 8-<10 years; 6 = 10 years or longer	3.36 (1.844)	1.234***	1.170***
Home ownership (Own: %)	0 = rent, 1 = own	56.5	3.474***	3.480***
Reason for choosing current residence (Yes: %)	0 = no, 1 = yes			
Quality of neighborhood		53.0	3.028***	2.798***
Easy to walk around		26.1	1.953***	1.838***
Household's car ownership	Number of motor vehicles in the household	1.816 (0.754)	1.530***	1.419**
Dog ownership	0 = no, 1 = yes	44.4	1.361*	1.524**
Parent's negative attitude toward independent travel	1 = strongly disagree …, 5 = Strongly agree	3.585 (1.452)	0.487***	N/A
Parent's negative attitude toward unsupervised outdoor play		2.758 (1.150)	N/A	0.310***
Social factors				
Social connection—"I feel connected to people in my neighborhood."	1 = strongly disagree …, 5 = strongly agree	3.586 (1.228)	1.401***	1.526***

Table C-1 Continued.

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Neighborhood support and impacts from peers	Factor (range: -3.02869, 2.28349)	0.000 (0.999)	1.543***	1.886***

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; SD = standard deviation; OR = odds ratio.

Table C-2 Descriptive Statistics of Housing and Neighborhood Environmental Predictors and the Bivariate Relationship between Each Predictor and Each Outcome Variable (Unadjusted, Sub-Group Sample, N=758)

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Home and neighboring environment factors				
Housing type (ref: a non-single-family home and inside an apartment complex)	0 = a non-single-family home and inside an apartment complex; 1 = a non-single-family home and not inside an apartment complex; 2 = a single-family home	24.0		
A non-single-family home and not inside an apartment complex		11.3	1.015	1.170
A single-family home		64.6	3.293***	3.203***
Housing type (ref: a single-family home)		64.6		
A non-single-family home and not inside an apartment complex		11.3	0.308***	0.365***
A non-single-family home and inside an apartment complex		24.0	0.304***	0.312***
Home in a gated community (Yes: %)	0 = no, 1 = yes	10.8	0.440***	0.352***
The parcel lot vs street (Yes: %)	0 = no, 1 = yes			
A middle lot of a regular street		55.9	1.907***	1.648**
A middle lot of a dead-end street		7.0	1.502	1.352
A corner lot of a regular street		12.8	0.890	0.882
A corner lot of a dead-end street		3.4	1.151	2.800*
An end lot at a cul-de-sac		5.6	0.618	1.105
Presence of … in own home outdoor spaces (Yes: %)	0 = no, 1 = yes	63.5	--	2.703***
Open front/side yard				
Enclosed yard (front/side yard or backyard)		70.9	--	2.722***
Front porch		28.4	--	1.951***
Own driveway		63.4	--	3.316***
Own frontage street		70.4	--	2.693***
Front porch		28.4	--	1.951***
Own driveway		63.4	--	3.316***
Own frontage street		70.4	--	2.693***
Presence of … in home neighboring spaces (Yes: %)	0 = no, 1 = yes		--	
Single-family's open front/side yard		65.0	--	2.862***
Single-family's enclosed yard (front/side yard or backyard)		65.0		
Single-family's front porch		39.9	--	2.037***
Single-family's own driveway		64.6	--	2.866***
Single-family's frontage street		66.1	--	2.963***
Non-single-family's open front/side yard		6.7	--	0.487*

Table C-2 Continued.

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Non-single-family's enclosed front/side yard		7.4	--	0.464*
Non-single-family's backyard		9.2	--	0.870
Non-single-family's front porch		4.2	--	0.428*
Non-single-family's own driveway		3.7	--	1.190
Non-single-family's (i.e., duplex & fourplex) frontage street		11.9	--	0.555*
Multi-family housing shared common area: parking lot		30.1	--	0.399***
Multi-family housing shared common area yard/lawn		30.7	--	0.356***
Multi-family housing shared common area: driveway		33.5	--	0.379***
Multi-family housing (i.e., apartment complex) shared common area: frontage street		26.9	--	0.379***
Apartment amenities (Yes: %)	0 = no, 1 = yes		--	
Swimming pool		18.3	--	0.334***
Playground		13.1	--	0.305***
Sports filed		5.7	--	0.238***
Barbecue/grill/picnic area		10.7	--	0.299***
Presence of any apartment amenities (e.g., swimming pool, playground, sports filed, BBQ area, pet park, courtyard)		22.7	--	0.361***
Height of buildings along the frontage street segment	Average number of stories of buildings immediately along both sides of the frontage street segment	1.53 (1.00)	0.906	0.828
Number of windows overlooking the street	0 = 0; 1 = 1-3;	2.89 (0.413)	1.370	0.928
Number of porches/balconies along both sides of the frontage street segment	2 = 4-10; 3 = 11+;	1.73 (0.965)	0.962	0.865
Land use along both sides of the frontage street (Yes: %)	0 = no, 1 = yes			
Residential land use				
Single-family housing		67.3	3.021***	3.047***
Multifamily housing		40.6	0.352***	0.340***
Mobile home		2.3	0.473	0.164*
Commercial land use		2.7	1.059	0.737

Table C-2 Continued.

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Educational, office, and service land use		5.5	0.949	0.596
Recreational land use		3.1	0.968	1.173
Characteristics of frontage street				
Street type (Yes: %)	0 = no, 1 = yes			
A cul-de-sac/dead end		17.1	0.862	1.081
Speed limit posted (Yes: %)	0 = no, 1 = yes			
General speed limit posted		27.2	0.993	1.165
General speed limit or school zone speed limit posted		28.1	0.956	1.097
Street parking (ref: no)	0 = no;	11.8		
On one side	1 = yes, on one side;	16.1	1.036	0.917
On both sides	2 = yes, on both sides	72.1	0.922	0.862
Number of lanes along the frontage street segment	The total number of lanes along the frontage street segment (both directions)	2.03 (0.25)	0.792	0.863
Number of driveways & street intersections (ref: 0-3)	0 = 0-3; 1 = 4-10;	22.0		
4-10	2 = 11+	28.0	1.597*	1.482†
11+		50.0	2.151***	2.069***
Number of street lights	The total number of street lights along the frontage street segment (both directions)	2.36 (1.93)	1.002	0.982
Presence of traffic calming device(s) along the frontage street (Yes: %)	0 = no, 1 = yes	21.2	0.570**	0.524**
Presence of marked crosswalk connectivity of the frontage street segment (Yes: %)	0 = no, 1 = yes	11.7	0.837	0.662†
Have drainage problems (Yes: %)	0 = no, 1 = yes	10.6	0.916	0.859
Characteristics of sidewalk[a]				
Presence of sidewalks along the frontage street (ref: no)	0 = no; 1 = one on side;	28.5		
On one side	2 = on both sides	35.8	1.330	1.128
On both sides		35.8	1.043	0.806
Presence of sidewalks along the frontage street (ref: on both sides)		35.8		
On one side		35.8	0.959	1.400†
No sidewalk		35.8	1.276	1.241

Table C-2 Continued.

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Presence of sidewalks (Yes: %)	0 = no, 1 = yes			
On side A		56.7	1.062	0.818
On side B		50.8	0.974	0.902
Presence of obstruction (Yes: %)	0 = no, 1 = yes			
On side A		26.5	1.018	0.680
On side B		20.8	0.705	0.712
Sidewalk shade (from trees, bldgs., etc.) (Fair to excellent: %)	0 = poor, 1 = fair to excellent			
On side A		50.4	1.712**	1.532*
On side B		55.3	1.813**	1.449†
Sidewalk A surface condition	0 = none/very litter;			
Holes & cracks	1 = a little/some;	1.84 (1.242)	0.705†	0.602*
Bumps & uneven surfaces	2 = a lot	2.01 (1.215)	0.927	0.870
Weeds		2.03 (1.195)	0.895	0.753†
Litter		1.77 (1.228)	0.576*	0.733
Sidewalk B surface condition	0 = none/very litter;			
Holes & cracks	1 = a little/some;	1.24 (0.557)	0.565*	0.602*
Bumps & uneven surfaces	2 = a lot	1.41 (0.631)	0.765	0.893
Weeds		1.47 (0.680)	0.700*	0.746†
Litter		1.19 (0.492)	0.495**	0.678
Presence of buffer (Yes: %)	0 = no, 1 = yes			
On side A		60.7	1.646*	1.771***
On side B		69.8	1.548†	2.221**
Drainage ditch along street/sidewalk or in buffer (Yes: %)	0 = no, 1 = yes			
On side A		4.4	1.324	1.396
On side B		4.1	1.167	1.626
Walking & Biking Conditions				
Signs along frontage street (Yes: %)	0 = no, 1 = yes			
Community/cultural/religious/political message or event/historical marker		31.4	1.920**	1.768***
Crime watch/surveillance warning / home security service (e.g., ADT)		53.0	2.491***	2.230***
Stop sign		54.6	1.017	1.093
No parking/towing enforced		23.0	0.597**	0.587**
Presence of unattractive items	0 = no, 1 = yes	31.4	0.859	0.913

Table C-2 Continued.

Predictors	Coding scheme or range of factors	% of "1" or mean (SD)	OR	
			Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Perceptions of the frontage street segment[b]				
Surveillance (easily observed from the windows, porches, or yards nearby)	1 = poor 2 = fair 3 = good 4 = very good 5 = excellent	3.285 (0.954)	1.193*	1.113
Street/sidewalk maintenance (free of cracks, holes, overgrown grass/weeds, etc.)		3.593 (0.935)	1.1345***	1.369***
Street/sidewalk cleanliness (free of litter, rubbish, broken glass, discarded items, etc.)		3.647 (0.933)	1.330**	1.261**
Cleanliness and maintenance of buildings and gardens (clean, well-kept, free of litter, discarded items, etc.)		3.617 (0.920)	1.429***	1.408***
Visual quality of street (everything visible from the street)		3.148 (0.935)	1.685***	1.703***
Visual quality of buildings		3.360 (0.876)	1.781***	1.646***
Visual quality of trees/vegetation		3.037 (0.972)	1.691***	1.612***
Condition/health of trees/vegetation		3.091 (0.962)	1.617***	1.575***
Attractiveness in walking		2.532 (0.962)	1.405***	1.430***
Attractiveness in bicycling		2.383 (1.004)	1.409***	1.421***
Comfort in walking		2.184 (0.989)	1.268**	1.290**
Comfort in bicycling		1.938 (0.982)	1.380***	1.399***
Safety in walking (for upper-year elementary school children)		2.206 (1.079)	1.171*	1.142†
Safety in bicycling (for upper-year elementary school children)		1.861 (0.989)	1.314***	1.297**

[a] The percentage-related variables about sidewalks' characteristics were calculated based on the total number of segments having sidewalk(s).

[b] The variables related to perceptions of the frontage street were calculated as the mean of the scores of side A and side B.

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; SD = standard deviation; OR = odds ratio.

Table C-3 Descriptive Statistics of Half-mile Aerial Buffer-Level Neighborhood Environmental Predictors and the Bivariate Relationship between Each Predictor and Each Outcome Variable (Unadjusted, Sub-Group Sample, N=758)

Predictors	% of "1" or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Traffic danger			
Crash density			
Crash density by buffer area (unit: per acre)	0.971 (0.980)	0.600***	0.714***
Crash density by total street segment length in a buffer (unit: per mile)	30.18 (28.53)	0.980***	0.985***
Road classification			
Proportion of different classifications of roads by total street segment length in a buffer			
Proportion of level 1 roads: highways, interstate, etc.	0.07 (0.10)	0.274	1.923
Proportion of level 2 roads: major arterials and county roads, minor arterial, city collectors	0.34 (0.15)	0.198**	0.095***
Proportion of level 3 roads: local city/county street	0.56 (0.13)	11.856***	9.615***
Proportion of level 4 roads: driveway, private road	0.03 (0.06)	2.461	1.243
Presence of different classifications of roads (0 = no, 1 = yes)			
Presence of level 1 roads: highways, interstate, etc.	48.2	0.931	1.270
Presence of level 2 roads: major arterials and county roads, minor arterial, city collectors	97.1	0.478	0.537
Presence of level 3 roads: local city/county street	100.0	--	--
Presence of level 4 roads: driveway, private road	36.9	1.297†	1.210
Crime danger			
Violent crime (sex offenses excluded) density by buffer area (unit: per acre)	0.974 (1.124)	0.621***	0.697***
Sexual crime			
Density of registered sex offenders (unit: per square miles)	7.21 (8.01)	0.925***	0.933***
Presence of registered sex offenders (0 = no, 1 = yes)	74.9	0.366***	0.323***
Land use			
Land use mix (entropy index)	0.61 (0.11)	0.207*	0.364
Proportion of residential land use by buffer area	0.46 (0.14)	3.286*	1.276
Neighborhood destinations			
Park			
Percentage of park area in a buffer	7.00 (8.77)	1.029**	1.028**
Distance to nearest park entrance point[a]			
Network distance to nearest park entrance point	0.56 (0.41)	0.790	0.854
Straight distance to nearest park entrance point	0.35 (0.23)	0.622	0.874
Presence of park (0 = no, 1 = yes)	83.5	0.898	0.769

Table C-3 Continued.

Predictors	% of "1" or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Playground			
Playground density by buffer area (unit: per square miles)	1.15 (1.60)	1.150**	1.118*
Distance to nearest playground[a]			
Network distance to nearest playground	0.90 (0.58)	0.754*	0.891
Straight distance to nearest playground	0.58 (0.36)	0.476***	0.631*
Presence of playground (0 = no, 1 = yes)	83.5	1.498*	1.396*
Public transportation			
Transit stop density by buffer area (unit: per square miles)	13.26 (11.74)	0.959***	0.966***
Distance to nearest transit stop[a]			
Network distance to nearest transit stop	0.55 (8.17)	2.059***	2.056***
Straight distance to nearest transit stop	0.34 (3.94)	2.789***	2.643***
Presence of transit stop (0 = no, 1 = yes)	81.5	0.486***	0.525**
Sidewalk density			
Sidewalk density by buffer area (unit: per square miles)	27.84 (7.79)	1.020*	1.013
Sidewalk density by total street segment length in a buffer (unit: per mile)	1.47 (0.27)	3.312***	1.933*
Street connectivity			
Cul-de-sac density			
Cul-de-sac density by buffer area (unit: per square miles)	22.31 (11.86)	1.013*	1.007
Cul-de-sac density by total street segment length in a buffer (unit: per mile)	1.27 (0.74)	1.288*	1.217*
Intersection (3 or more ways) density			
Intersection density by buffer area (unit: per square miles)	91.14 (36.41)	1.001	1.001
Intersection density by total street segment length in a buffer (unit: per mile)	4.64 (1.04)	1.140	1.056
Tree Canopy			
Proportion of tree canopy area in a buffer	0.31 (0.15)	48.828***	19.682***
Water Features			
Percentage of water features in a buffer	0.64 (2.06)	1.041	1.025
Presence of water features in a buffer (0 = no, 1 = yes)	62.1	1.117	1.032

Table C-3 Continued.

Predictors	% of "1" or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Walk Score, Bike Score, Transit Score[a]			
Walk Score (ref: almost all errands car-dependent)	37.1		
Most errands car-dependent	23.7	0.962	0.833
Walkable	39.2	0.485***	0.500***
Walk Score (ref: walkable)	39.2		
Most errands car-dependent	23.7	1.982***	1.667***
Almost all errands car-dependent	37.1	2.061***	2.001***
Bike Score (ref: somewhat bikeable)	46.6		
Bikeable	33.1	0.847	0.957
Very bikeable	20.3	0.979	0.827
Bike Score (ref: very bikeable)	20.3		
Bikeable	33.1	0.865	1.157
Somewhat bikeable	46.6	1.021	1.210
Transit Score (ref: minimal transit)	28.5		
Some transit	61.6	0.419***	0.445***
Good transit	9.9	0.276***	0.297***
Transit Score (ref: good transit)	9.9		
Some transit	61.6	1.520	1.501
Minimal transit	28.5	3.626***	3.372***

[a] The variables which measure the distances to the nearest park entrance point, playground, and transit stop, as well as Walk Score, Bike Score, and Transit Score are not normalized in terms of buffer dimensions.

[†] $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; SD = standard deviation; OR = odds ratio.

Table C-4 Descriptive Statistics of Quarter-mile Aerial Buffer-Level Neighborhood Environmental Predictors and the Bivariate Relationship between Each Predictor and Each Outcome Variable (Unadjusted, Sub-Group Sample, N=758)

Predictors	% of yes or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Traffic danger			
Crash density			
Crash density by buffer area (unit: per acre)	0.905 (1.243)	0.670***	0.698***
Crash density by total street segment length in a buffer (unit: per mile)	23.03 (29.67)	0.981***	0.982***
Road classification			
Proportion of different classifications of roads by total street segment length in a buffer			
Proportion of level 1 roads: highways, interstate, etc.	0.06 (0.12)	0.409	1.165
Proportion of level 2 roads: major arterials and county roads, minor arterial, city collectors	0.34 (0.19)	0.218***	0.126***
Proportion of level 3 roads: local city/county street	0.58 (0.20)	4.133***	5.884***
Proportion of level 4 roads: driveway, private road	0.02 (0.08)	4.726	0.994
Presence of different classifications of roads (0 = no, 1 = yes)			
Presence of level 1 roads: highways, interstate, etc.	23.4	0.731	0.934
Presence of level 2 roads: major arterials and county roads, minor arterial, city collectors	91.6	0.508*	0.411**
Presence of level 3 roads: local city/county street	99.7	0.976	0.790
Presence of level 4 roads: driveway, private road	15.0	1.383	1.118
Crime danger			
Violent crime (sex offenses excluded) density by buffer area (unit: per acre)	1.083 (1.462)	0.695***	0.756***
Sex offense			
Density of registered sex offenders (unit: per square miles)	9.01 (14.26)	0.955***	0.966***
Presence of registered sex offenders (0 = no, 1 = yes)	53.4	0.307***	0.341***
Land use			
Land use mix (entropy index)	0.51 (0.15)	0.281**	0.495
Proportion of residential land use by buffer area	0.52 (0.15)	2.902*	5.699
Neighborhood destinations			
Park			
Percentage of park area in a buffer	5.41 (9.50)	1.016*	1.022**
Distance to nearest park entrance point[a]			
Network distance to nearest park entrance point	0.56 (0.41)	0.790	0.854
Straight distance to nearest park entrance point	0.35 (0.23)	0.622	0.874
Presence of park (0 = no, 1 = yes)	51.8	1.223	1.148

Table C-4 Continued.

Predictors	% of yes or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Playground			
Playground density by buffer area (unit: per square miles)	1.16 (2.79)	1.014	1.007
Distance to nearest playground[a]			
Network distance to nearest playground	0.90 (0.58)	0.754*	0.891
Straight distance to nearest playground	0.58 (0.36)	0.476***	0.631*
Presence of playground (0 = no, 1 = yes)	18.1	1.107	1.035
Public transportation			
Transit stop density by buffer area (unit: per square miles)	13.37 (15.41)	0.970***	0.971***
Distance to nearest transit stop[a]			
Network distance to nearest transit stop	0.55 (8.17)	2.059***	2.056***
Straight distance to nearest transit stop	0.34 (3.94)	2.789***	2.643***
Presence of transit stop (0 = no, 1 = yes)	55.5	0.432***	0.432***
Sidewalk density			
Sidewalk density by buffer area (unit: per square miles)	32.49 (9.64)	1.023**	1.017*
Sidewalk density by total street segment length in a buffer (unit: per mile)	1.46 (0.37)	2.355***	2.417***
Street connectivity			
Cul-de-sac density			
Cul-de-sac density by buffer area (unit: per square miles)	25.39 (19.39)	1.007	1.006
Cul-de-sac density by total street segment length in a buffer (unit: per mile)	1.22 (1.01)	1.173*	1.198*
Intersection (3 or more ways) density			
Intersection density by buffer area (unit: per square miles)	97.66 (41.71)	1.002	1.001
Intersection density by total street segment length in a buffer (unit: per mile)	4.12 (1.36)	1.172**	1.157**
Tree Canopy			
Proportion of tree canopy area in a buffer	0.31 (0.17)	43.477***	19.872***
Water Features			
Percentage of water features in a buffer	0.40 (1.84)	1.031	1.022
Presence of water features in a buffer (0 = no, 1 = yes)	25.9	0.887	1.026

[a] The variables which measure the distances to the nearest park entrance point, playground, and transit stop, as well as Walk Score, Bike Score, and Transit Score are not normalized in terms of buffer dimensions.

[†] $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; SD = standard deviation; OR = odds ratio.

Table C-5 Descriptive Statistics of Half-mile Network Buffer-Level Neighborhood Environmental Predictors and the Bivariate Relationship between Each Predictor and Each Outcome Variable (Unadjusted, Sub-group Sample, N=758)

Predictors	% of yes or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Traffic danger			
Crash density			
Crash density by buffer area (unit: per acre)	1.319 (1.919)	0.739***	0.859**
Crash density by total street segment length in a buffer (unit: per mile)	27.27 (32.34)	0.981***	0.982***
Road classification			
Proportion of different classifications of roads by total street segment length in a buffer			
Proportion of level 1 roads: highways, interstate, etc.	0.05 (0.12)	0.241*	1.166
Proportion of level 2 roads: major arterials and county roads, minor arterial, city collectors	0.37 (0.19)	0.206***	0.090***
Proportion of level 3 roads: local city/county street	0.56 (0.20)	4.925***	9.265***
Proportion of level 4 roads: driveway, private road	0.02 (0.09)	9.211*	1.147
Presence of different classifications of roads (0 = no, 1 = yes)			
Presence of level 1 roads: highways, interstate, etc.	29.2	0.727*	1.119
Presence of level 2 roads: major arterials and county roads, minor arterial, city collectors	92.6	0.651	0.568*
Presence of level 3 roads: local city/county street	99.5	0.324	0.789
Presence of level 4 roads: driveway, private road	18.1	1.432†	0.983
Crime danger			
Violent crime (sex offenses excluded) density by buffer area (unit: per acre)	1.085 (1.287)	0.660***	0.700***
Sex offense			
Density of registered sex offenders (unit: per square miles)	10.17 (15.21)	0.962***	0.969***
Presence of registered sex offenders (0 = no, 1 = yes)	58.6	0.350***	0.361***
Land use			
Land use mix (entropy index)	0.48 (0.16)	0.118***	0.152***
Proportion of residential land use by buffer area	0.55 (0.15)	8.518***	0.584
Neighborhood destinations			
Park			
Percentage of park area in buffer	2.72 (4.91)	1.014	1.018
Distance to nearest park entrance point[a]			
Network distance to nearest park entrance point	0.56 (0.41)	0.790	0.854
Straight distance to nearest park entrance point	0.35 (0.23)	0.622	0.874
Presence of park (0 = no, 1 = yes)	54.2	0.957	0.830

Table C-5 Continued.

Predictors	% of yes or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Playground			
Playground density by buffer area (unit: per square miles)	1.33 (2.82)	1.056*	1.081**
Distance to nearest playground[a]			
Network distance to nearest playground	0.90 (0.58)	0.754*	0.891
Straight distance to nearest playground	0.58 (0.36)	0.476***	0.631*
Presence of playground (0 = no, 1 = yes)	23.9	1.288	1.364 †
Public transportation			
Transit stop density by buffer area (unit: per square miles)	18.07 (18.06)	0.967***	0.973***
Distance to nearest transit stop[a]			
Network distance to nearest transit stop	0.55 (8.17)	2.059***	2.056***
Straight distance to nearest transit stop	0.34 (3.94)	2.789***	2.643***
Presence of transit stop (0 = no, 1 = yes)	65.8	0.439***	0.458***
Sidewalk density			
Sidewalk density by buffer area (unit: per square miles)	39.71 (9.42)	1.034***	1.039***
Sidewalk density by total street segment length in a buffer (unit: per mile)	1.39 (0.35)	2.061**	1.680*
Street connectivity			
Cul-de-sac density			
Cul-de-sac density by buffer area (unit: per square miles)	28.43 (24.28)	1.011**	1.009**
Cul-de-sac density by total street segment length in a buffer (unit: per mile)	1.00 (0.83)	1.390***	1.321**
Intersection (3 or more ways) density			
Intersection density by buffer area (unit: per square miles)	133.81 (61.24)	1.003*	1.004**
Intersection density by total street segment length in a buffer (unit: per mile)	4.47 (1.35)	1.210**	1.172**
Tree Canopy			
Proportion of tree canopy area in a buffer	0.28 (0.15)	68.656***	25.538***
Water Features			
Percentage of water features in a buffer	0.18 (0.86)	0.919	0.923
Presence of water features in a buffer (0 = no, 1 = yes)	25.1	0.909	0.959

[a] The variables which measure the distances to the nearest park entrance point, playground, and transit stop are not normalized in terms of buffer dimensions.

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; SD = standard deviation; OR = odds ratio.

Table C-6 Descriptive Statistics of Quarter-mile Network Buffer-Level Neighborhood Environmental Predictors and the Bivariate Relationship between Each Predictor and Each Outcome Variable (Unadjusted, Sub-group Sample, N=758)

Predictors	% of yes or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Traffic danger			
Crash density			
Crash density by buffer area (unit: per acre)	1.558 (4.236)	0.875***	0.909**
Crash density by total street segment length in a buffer (unit: per mile)	17.85 (27.91)	0.979***	0.981***
Road classification			
Proportion of different classifications of roads by total street segment length in buffer			
Proportion of level 1 roads: highways, interstate, etc.	0.02 (0.08)	0.366	0.315
Proportion of level 2 roads: major arterials and county roads, minor arterial, city collectors	0.38 (0.26)	0.232***	0.182***
Proportion of level 3 roads: local city/county street	0.58 (0.27)	3.352***	5.173***
Proportion of level 4 roads: driveway, private road	0.02 (0.13)	3.664	1.538
Presence of different classifications of roads (0 = no, 1 = yes)			
Presence of level 1 roads: highways, interstate, etc.	10.7	0.775	1.129
Presence of level 2 roads: major arterials and county roads, minor arterial, city collectors	84.2	0.503**	0.411***
Presence of level 3 roads: local city/county street	98.0	0.728	2.205
Presence of level 4 roads: driveway, private road	6.2	1.492	0.850
Crime danger			
Violent crime (sex offenses excluded) density by buffer area (unit: per acre)	1.119 (1.594)	0.655***	0.755***
Sex offense			
Density of registered sex offenders (unit: per square miles)	12.332 (31.13)	0.985***	0.991**
Presence of registered sex offenders (0 = no, 1 = yes)	29.9	0.363***	0.436***
Land use			
Land use mix (entropy index)	0.33 (0.16)	0.122***	0.247**
Proportion of residential land use by buffer area	0.60 (0.19)	5.533***	38.830
Neighborhood destinations			
Park			
Percentage of park area in buffer	1.36 (4.86)	0.984	0.990
Distance to nearest park entrance point[a]			
Network distance to nearest park entrance point	0.56 (0.41)	0.790	0.854
Straight distance to nearest park entrance point	0.35 (0.23)	0.622	0.874
Presence of park (0 = no, 1 = yes)	22.3	1.081	0.951

Table C-6 Continued.

Predictors	% of yes or mean (SD)	OR	
		Outcome 1: parental license for independent non-school travel	Outcome 2: parental license for unsupervised outdoor play
Playground			
Playground density by buffer area (unit: per square miles)	1.61 (8.64)	1.002	1.004
Distance to nearest playground[a]			
Network distance to nearest playground	0.90 (0.58)	0.754*	0.891
Straight distance to nearest playground	0.58 (0.36)	0.476***	0.631*
Presence of playground (0 = no, 1 = yes)	6.3	1.074	1.075
Public transportation			
Transit stop density by buffer area (unit: per square miles)	24.16 (52.13)	0.986***	0.991***
Distance to nearest transit stop[a]			
Network distance to nearest transit stop	0.55 (8.17)	2.059***	2.056***
Straight distance to nearest transit stop	0.34 (3.94)	2.789***	2.643***
Presence of transit stop (0 = no, 1 = yes)	40.6	0.390***	0.456***
Sidewalk density			
Sidewalk density by buffer area (unit: per square miles)	53.07 (17.64)	1.011*	1.011*
Sidewalk density by total street segment length in a buffer (unit: per mile)	1.27 (0.42)	1.993***	1.856**
Street connectivity			
Cul-de-sac density			
Cul-de-sac density by buffer area (unit: per square miles)	23.09 (30.54)	1.006*	1.007**
Cul-de-sac density by total street segment length in a buffer (unit: per mile)	0.59 (0.78)	1.224*	1.272*
Intersection (3 or more ways) density			
Intersection density by buffer area (unit: per square miles)	191.35 (143.26)	0.999	1.000
Intersection density by total street segment length in a buffer (unit: per mile)	4.22 (1.51)	1.175**	1.188**
Tree Canopy			
Proportion of tree canopy area in a buffer	0.27 (0.16)	49.611***	21.767***
Water Features			
Percentage of water features in a buffer	0.09 (0.42)	1.225	1.109
Presence of water features in a buffer (0 = no, 1 = yes)	8.2	0.831	0.974

[a] The variables which measure the distances to the nearest park entrance point, playground, and transit stop are not normalized in terms of buffer dimensions.

[†] $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; SD = standard deviation; OR = odds ratio.

APPENDIX D

BINARY LOGISTIC REGRESSIONS PREDICTING PARENTAL LICENSE FOR INDEPENDENT TRAVEL TO NON-SCHOOL DESTINATIONS AND UNSUPERVISED OUTDOOR PLAY (PARTIALLY ADJUSTED MODELS)

Table D-1 Binary Logistic Regressions Predicting Parental License for Independent Travel to Non-school Destinations and Unsupervised Outdoor Play Using Personal and Social Factors (Adjusted Model, Sub-group Sample, N=758)

Predictors	Coding scheme or range of factors	OR (95% CI)	
		Model 1: predicting parental license for independent travel to non-school destinations (N = 637)	Model 2:predicting parental license for unsupervised outdoor play (N = 644)
Child's personal factors			
Child's gender	0 = female, 1 = male	0.800	0.878
Child's grade level	0 = kindergarten, 1 = first grade …, 5 = fifth grade	1.353***	1.405***
Child's ethnicity	0 = non-Hispanic, 1 = Hispanic	0.969	0.863
Eligibility for free or reduced-price lunch	0 = no, 1 = yes	0.471**	1.000
Child's health conditions	The total number of health conditions a child has	0.703†	0.496**
Parental and household factors			
Parent's occupation—employed	0 = no, 1 = yes	0.685†	1.027
English as home language	0 = no, 1 = yes	1.085	1.096
Year(s) living in current residence	1 = < 2 years; 2 = 2-<4 years; 3 = 4-<6 years; 4 = 6-<8 years; 5 = 8-<10 years; 6 = 10 years or longer	1.088	1.032
Reason for choosing current residence	0 = no, 1 = yes		
Quality of neighborhood		1.508†	0.982
Easy to walk around		1.062	1.534†
Household's car ownership	Number of motor vehicles in the household	1.160	0.946
Dog ownership	0 = no, 1 = yes	0.754	0.809
Parent's negative attitude toward independent travel	1 = strongly disagree …, 5 = Strongly agree	0.561***	N/A
Parent's negative attitude toward unsupervised outdoor play	1 = strongly disagree …, 4 = strongly agree	N/A	0.324***
Social factors			
Social connection—"I feel connected to people in my neighborhood."	1 = strongly disagree …, 5 = strongly agree	1.042	1.035
Neighborhood support and impacts from peers	Factor (range: -3.02869, 2.28349)	1.052	1.448**
		Cox & Snell R Square: 0.288; Nagelkerke R Square: 0.384	Cox & Snell R Square: 0.364; Nagelkerke R Square: 0.488

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; OR = odds ratio; CI = confidence interval.

Table D-2 Binary Logistic Regressions Predicting Parental License for Independent Travel to Non-School Destinations and Unsupervised Outdoor Play Using Personal, Social, and Home and Neighboring Physical Environment Factors (Adjusted Model, Sub-Group Sample, N=758)

Predictors	Coding scheme or range of factors	OR (95% CI)	
		Model 1: predicting parental license for independent travel to non-school destinations (N = 637)	Model 2:predicting parental license for unsupervised outdoor play (N = 644)
Child's personal factors			
Child's gender	0 = female, 1 = male	0.770 (0.523, 1.135)	0.834 (0.550, 1.267)
Child's grade level	0 = kindergarten, 1 = first grade …, 5 = fifth grade	1.366 (1.209, 1.543)***	1.426 (1.251, 1.625)***
Child's ethnicity	0 = non-Hispanic, 1 = Hispanic	0.923 (0.536, 1.590)	0.807 (0.445, 1.463)
Eligibility for free or reduced-price lunch	0 = no, 1 = yes	0.439 (0.240, 0.802)**	1.379 (0.708, 2.685)
Child's health conditions	The total number of health conditions a child has	0.655 (0.443, 0.967)*	0.488 (0.314, 0.758)**
Parental and household factors			
Parent's occupation—employed	0 = no, 1 = yes	0.613 (0.388, 0.970)*	0.938 (0.578, 1.522)
English as home language	0 = no, 1 = yes	1.091 (0.619, 1.922)	1.130 (0.610, 2.093)
Year(s) living in current residence	1 = < 2 years; 2 = 2-<4 years; 3 = 4-<6 years; 4 = 6-<8 years; 5 = 8-<10 years; 6 = 10 years or longer	1.116 (0.994, 1.252)†	1.006 (0.890, 1.138)
Reason for choosing current residence	0 = no, 1 = yes		
Quality of neighborhood		1.495 (0.898, 2.491)	0.937 (0.524, 1.621)
Easy to walk around		1.057 (0.663, 1.686)	1.453 (0.888, 2.3770
Household's car ownership	Number of motor vehicles in the household	1.200 (0.875, 1.646)	0.905 (0.660, 1.241)
Dog ownership	0 = no, 1 = yes	0.748 (0.492, 1.137)	0.731 (0.461, 1.158)
Parent's negative attitude toward independent travel	1 = strongly disagree …, 5 = Strongly agree	0.564 (0.485, 0.657)***	N/A
Parent's negative attitude toward unsupervised outdoor play	1 = strongly disagree …, 4 = strongly agree	N/A	0.323 (0.258, 0.404)***
Social factors			
Social connection—"I feel connected to people in my neighborhood."	1 = strongly disagree …, 5 = strongly agree	1.061 (0.860, 1.310)	1.049 (0.841, 1.309)
Neighborhood support and impacts from peers	Factor (range: -3.02869, 2.28349)	1.037 (0.803, 1.340)	1.485 (1.125, 1.959)**

Table D-2 Continued.

Predictors	Coding scheme or range of factors	OR (95% CI) Model 1: predicting parental license for independent travel to non-school destinations (N = 637)	OR (95% CI) Model 2:predicting parental license for unsupervised outdoor play (N = 644)
Home and neighboring environmental factors			
Housing type (ref: a non-single-family home and inside an apartment complex)	0 = a non-single-family home and inside an apartment complex; 1 = a non-single-family home and NOT inside an apartment complex; 2 = a single-family home		N/A
A non-single-family home and NOT inside an apartment complex		0.678 (0.267, 1.722)	
A single-family home		0.535 (0.212, 1.351)	
Presence of … in own home outdoor spaces (Yes: %)	0 = no, 1 = yes	N/A	
Front porch			1.017 (0.619, 1.673)
Own driveway			1.225 (0.616, 2.434)
Home in a gated community	0 = no, 1 = yes	1.033 (0.459, 2.325)	N/A
Home parcel lot is	0 = no, 1 = yes		
A middle lot of a regular street		1.221 (0.779, 1.914)	N/A
A corner lot at a cul-de-sac		N/A	2.834 (0.859, 9.354) †
Presence of mobile home land use along the frontage street	0 = no, 1 = yes	N/A	0.237 (0.040, 1.402)
Number of driveways & street intersections (ref: 0-3)	0 = 0-3; 1 = 4-10; 2 = 11+		N/A
4-10		0.790 (0.417, 1.498)	
11+		0.891 (0.454, 1.750)	
Signs along frontage street	0 = no, 1 = yes		
Community/cultural/ religious/political message or event/ historical marker		1.023 (0.654, 1.600)	N/A
Crime watch/surveillance warning/home security service (e.g., ADT)		1.667 (1.037, 2.681)*	1.498 (0.878, 2.557)
		Cox & Snell R Square: 0.301; Nagelkerke R Square: 0.402	Cox & Snell R Square: 0.376; Nagelkerke R Square: 0.504

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; OR = odds ratio; CI = confidence interval.

Table D-3 Binary Logistic Regressions Predicting Parental License for Independent Travel to Non-School Destinations Using Personal, Social, and Housing and Neighborhood Physical Environment Factors (Adjusted Final Model, Sub-Group Sample, N=758)

Predictors	OR (95% CI)			
	Quarter-mile aerial buffer	Quarter-mile network buffer	Half-mile aerial buffer	Half-mile network buffer
Child's personal factors				
Child's gender (0 = female, 1 = male)	0.765 (0.515, 1.136)	0.741 (0.497, 1.106)	0.792 (0.533, 1.177)	0.780 (0.524, 1.159)
Child's grade level (0 = kindergarten, 1 = first grade …, 5 = fifth grade)	1.390 (1.226, 1.576)***	1.380 (1.217, 1.564)***	1.404 (1.238, 1.593)***	1.376 (1.213, 1.561)***
Child's ethnicity (0 = non-Hispanic, 1 = Hispanic)	1.080 (0.611, 1.910)	1.018 (0.571, 1.814)	1.038 (0.588, 1.833)	1.080 (0.609, 1.915)
Eligibility for free or reduced-price lunch (0 = no, 1 = yes)	0.510 (0.273, 0.952)*	0.540 (0.287, 1.014) †	0.527 (0.277, 1.005) †	0.476 (0.255, 0.889)*
Child's health conditions (The total number of health conditions a child has)	0.672 (0.451, 1.002) †	0.643 (0.434, 0.952)*	0.701 (0.471, 1.043) †	0.661 (0.445, 0.981)*
Parental and household factors				
Parent's occupation—employed (0 = no, 1 = yes)	0.614 (0.383, 0.984)*	0.561 (0.347, 0.907)*	0.602 (0.376, 0.965)*	0.602 (0.375, 0.965)*
English as home language (0 = no, 1 = yes)	1.050 (0.578, 1.908)	1.146 (0.631, 2.083)	1.034 (0.570, 1.877)	1.022 (0.560, 1.865)
Year(s) living in current residence (1 = < 2 years; 2 = 2-<4 years; 3 = 4-<6 years; 4 = 6-<8 years; 5 = 8-<10 years; 6 = 10 years or longer)	1.134 (1.008, 1.276)*	1.169 (1.035, 1.319)*	1.141 (1.013, 1.285)*	1.158 (1.027, 1.304)*
Reason for choosing current residence (0 = no, 1 = yes)				
Quality of neighborhood	1.356 (0.793, 2.316)	1.276 (0.748, 2.177)	1.352 (0.790, 2.314)	1.311 (0.767, 2.241)
Easy to walk around	1.123 (0.694, 1.817)	1.148 (0.710, 1.857)	1.118 (0.692, 1.807)	1.111 (0.688, 1.796)
Household's car ownership (Number of motor vehicles in the household)	1.185 (0.862, 1.627)	1.186 (0.859, 1.636)	1.176 (0.856, 1.614)	1.188 (0.864, 1.634)
Dog ownership (0 = no, 1 = yes)	0.777 (0.507, 1.919)	0.781 (0.509, 1.199)	0.789 (0.515, 1.209)	0.768 (0.501, 1.177)
Parent's negative attitude toward independent travel (1 = strongly disagree …, 5 = Strongly agree)	0.571 (0.489, 0.666)***	0.564 (0.483, 0.659)***	0.561 (0.481, 0.654)***	0.562 (0.481, 0.657)***
Social factors				
Social connection—"I feel connected to people in my neighborhood." (1 = strongly disagree …, 5 = strongly agree)	1.059 (0.852, 1.316)	1.027 (0.827, 1.276)	1.047 (0.844, 1.299)	1.032 (0.830, 1.283)

Table D-3 Continued.

Predictors	OR (95% CI)			
	Quarter-mile aerial buffer	Quarter-mile network buffer	Half-mile aerial buffer	Half-mile network buffer
Neighborhood support and impacts from peers (Factor, range: -3.02869, 2.28349)	0.965 (0.741, 1.257)	1.011 (0.779, 1.314)	0.974 (0.748, 1.269)	0.989 (0.760, 1.287)
Home and neighboring environmental factors				
Housing type (ref: a non-single-family home and inside an apartment complex)				
A non-single-family home and not inside an apartment complex	0.659 (0.242, 1.794)	0.662 (0.234, 1.869)	0.630 (0.238, 1.666)	0.589 (0.218, 1.595)
A single-family home	0.484 (0.177, 1.325)	0.380 (0.132, 1.099) †	0.450 (0.169, 1.202)	0.404 (0.146, 1.121)†
Home in a gated community (0 = no, 1 = yes)	0.990 (0.420, 2.334)	0.936 (0.388, 2.262)	1.048 (0.446, 2.466)	1.041 (0.440, 2.463)
Home parcel lot is a middle lot of a regular street (0 = no, 1 = yes)	1.177 (0.737, 1.879)	1.279 (0.797, 2.052)	1.229 (0.772, 1.954)	1.240 (0.774, 1.987)
Number of driveways & street intersections (ref: 0-3)				
4-10	0.853 (0.439, 1.659)	0.921 (0.466, 1.819)	0.916 (0.474, 1.769)	0.908 (0.469, 1.758)
11+	0.990 (0.420, 2.334)	1.001 (0.493, 2.033)	0.968 (0.484, 1.936)	0.973 (0.483, 1.961)
Signs along frontage street (0 = no, 1 = yes)				
Community/cultural/religious/political message or event/historical marker	1.134 (0.715, 1.799)	1.117 (0.696, 1.793)	1.102 (0.693, 1.755)	1.158 (0.725, 1.849)
Crime watch/surveillance warning/home security service (e.g., ADT)	1.476 (0.901, 2.416)	1.534 (0.938, 2.510) †	1.480 (0.908, 2.414)	1.456 (0.889, 2.386)
Neighborhood environmental factors				
Traffic danger				
Crash density by buffer area (unit: per acre)	N/A	0.901 (0.815, 0.997)*	N/A	N/A
Crash density by total street segment length in a buffer (unit: per mile)	0.988 (0.977, 0.999)*	N/A	0.985 (0.970, 0.999)*	0.988 (0.977, 0.999)*
Presence of level 2 roads: major arterials and county roads, minor arterial, city collectors (0 = no, 1 = yes)	N/A	0.849 (0.464, 1. 553)	N/A	N/A
Crime danger				
Violent crime (sex offenses excluded) density by buffer area (unit: per acre)	1.140 (0.913, 1.422)	0.965 (0.797, 1.168)	1.221 (0.825, 1.807)	1.281 (0.939, 1.749)

Table D-3 Continued.

Predictors	OR (95% CI)			
	Quarter-mile aerial buffer	Quarter-mile network buffer	Half-mile aerial buffer	Half-mile network buffer
Density of registered sex offender (unit: per square miles)	N/A	N/A	0.971 (0.938, 1.004) †	N/A
Presence of registered sex offenders (0 = no, 1 = yes)	0.541 (0.327, 0.897)*	0.536 (0.311, 0.925)*	N/A	0.578 (0.345,0.968)*
Land use				N/A
Land use mix (entropy index)	1.140 (0.913, 1.422)	0.965 (0.797, 1.168)	5.165 (0.326, 81.943)	
Proportion of residential land use by buffer area	N/A	N/A	4.367 (0.324, 59.942)	
Neighborhood destinations	N/A		N/A	
Straight distance to nearest playground		0.806 (0.406, 1.597)		0.842 (0.433, 1.638)
Public transportation				
Transit Score (ref: minimal transit)				
Some transit	0.803 (0.467, 1.383)	0.785 (0.461, 1.339)	0.851 (0.484, 1.495)	0.888 (0.503, 1.567)
Good transit	0.709 (0.277, 1.817)	0.844 (0.328, 2.172)	0.816 (0.307, 2.168)	0.808 (0.294, 2.222)
Sidewalk density	N/A			
Sidewalk density by buffer area (unit: per square miles)		0.995 (0.981, 1.009)	0.987 (0.952, 1.023)	N/A
Sidewalk density by total street segment length in a buffer (unit: per mile)		N/A	N/A	1.389 (0.681, 2.832)
Street connectivity	N/A		N/A	
Cul-de-sac density by total street segment length in a buffer (unit: per mile)		N/A		1.152 (0.849, 1.564)
Intersection (3 or more ways) density by total street segment length in a buffer (unit: per mile)		0.896 (0.759, 1.058)		N/A
	Cox & Snell R Square: 0.321; Nagelkerke R Square: 0.428	Cox & Snell R Square: 0.324; Nagelkerke R Square: 0.433	Cox & Snell R Square: 0.316; Nagelkerke R Square: 0.422	Cox & Snell R Square: 0.321; Nagelkerke R Square: 0.428

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; OR = odds ratio; CI = confidence interval.

Table D-4 Binary Logistic Regressions Predicting Parental License for Unsupervised Outdoor Play Using Personal, Social, and Housing and Neighborhood Physical Environment Factors (Adjusted Final Model, Sub-Group Sample N=758)

Predictors	OR (95% CI)			
	Quarter-mile aerial buffer	Quarter-mile network buffer	Half-mile aerial buffer	Half-mile network buffer
Child's personal factors				
Child's gender (0 = female, 1 = male)	0.867 (0.563)	0.907 (0.589, 1.397)	0.930 (0.606, 1.428)	0.946 (0.613, 1.458)
Child's grade level (0 = kindergarten, 1 = first grade …, 5 = fifth grade)	1.457 (1.271, 1.669)***	1.443 (1.261, 1.651)***	1.439 (1.256, 1.648)***	1.437 (1.254, 1.647)***
Child's ethnicity (0 = non-Hispanic, 1 = Hispanic)	0.869 (0.470, 1.609)	0.867 (0.467, 1.608)	0.864 (0.466, 1.604)	0.908 (0.485, 1.698)
Eligibility for free or reduced-price lunch (0 = no, 1 = yes)	1.481 (0.715, 3.068)	1.452 (0.711, 2.966)	1.557 (0.747, 3.245)	1.604 (0.765, 3.362)
Child's health conditions (The total number of health conditions a child has)	0.415 (0.258, 0.668)***	0.421 (0.262, 0.675)***	0.430 (0.271, 0.682)***	0.423 (0.263, 0.682)***
Parental and household factors				
Parent's occupation—employed (0 = no, 1 = yes)	0.882 (0.536, 1.452)	0.903 (0.546, 1.493)	0.892 (0.539, 1.476)	0.874 (0.528, 1.447)
English as home language (0 = no, 1 = yes)	1.294 (0.674, 2.483)	1.243 (0.653, 2.369)	1.356 (0.707, 2.602)	1.347 (0.699, 2.595)
Year(s) living in current residence (1 = < 2 years: 2 = 2-<4 years; 3 = 4-<6 years; 4 = 6-<8 years; 5 = 8-<10 years; 6 = 10 years or longer)	1.012 (0.889, 1.151)	1.033 (0.909, 1.174)	1.007 (0.886, 1.145)	1.047 (0.919, 1.191)
Reason for choosing current residence (0 = no, 1 = yes)				
Quality of neighborhood	0.904 (0.502, 1.630)	0.928 (0.516, 1.668)	0.859 (0.479, 1.542)	0.863 (0.477, 1562)
Easy to walk around	1.487 (0.894, 1.151)	1.550 (0.931, 2.581)†	1.525 (0.917, 2.534)	1.459 (0.876, 2.430)
Household's car ownership (Number of motor vehicles in the household)	0.889 (0.641, 1.232)	0.882 (0.636, 1.224)	0.884 (0.639, 1.223)	0.860 (0.617, 1.201)
Dog ownership (0 = no, 1 = yes)	0.780 (0.485, 1.254)	0.774 (0.483, 1.241)	0.784 (0.489, 1.257)	0.829 (0.516, 1.332)
Parent's negative attitude toward unsupervised outdoor play (1 = strongly disagree …, 5 = Strongly agree)	0.298 (0.234, 0.380)***	0.300 (0.236, 0.380)***	0.303 (0.239, 0.383)***	0.294 (0.232, 0.374)***
Social factors				
Social connection—"I feel connected to people in my neighborhood." (1 = strongly disagree …, 5 = strongly agree)	1.117 (0.886, 1.407)	1.080 (0.862, 1.352)	1.091 (0.869, 1.370)	1.076 (0.856, 1.352)

Table D-4 Continued.

Predictors	OR (95% CI)			
	Quarter-mile aerial buffer	Quarter-mile network buffer	Half-mile aerial buffer	Half-mile network buffer
Neighborhood support and impacts from peers (Factor, range: -3.02869, 2.28349)	1.411 (1.059, 1.879)*	1.475 (1.109, 1.962)**	1.434 (1.074, 1.915)*	1.429 (1.072, 1.905)*
Home and neighboring environmental factors				
Presence of … in own home outdoor spaces (0 = no, 1 = yes)				
Front porch	1.069 (0.633, 1.805)	1.105 (0.652, 1.873)	1.102 (0.652, 1.862)	1.122 (0.662, 1.901)
Own driveway	1.228 (0.574, 2.627)	1.479 (0.682, 3.207)	1.265 (0.604, 2.651)	1.293 (0.600, 2.786)
Home parcel lot is a corner lot of a dead-end street (0 = no, 1 = yes)	4.021 (1.143, 14.145)*	3.818 (1.105, 13.194)*	3.759 (1.080, 13.082)*	3.767 (1.068, 13.288)*
Presence of mobile home land use along the frontage street (0 = no, 1 = yes)	0.324 (0.054, 1.932)	0.233 (0.038, 1.413)	0.253 (0.040, 1.585)	0.293 (0.045, 1.897)
Crime watch/surveillance warning/home security service (e.g., ADT) signs along frontage street (0 = no, 1 = yes)	1.367 (0.824, 2.268)	1.476 (0.888, 2.454)	1.452 (0.876, 2.407)	1.393 (0.833, 2.327)
Neighborhood environmental factors				
Traffic danger				
Crash density by total street segment length in a buffer (unit: per mile)	0.995 (0.984, 1.006)	1.002 (0.990, 1.014)	1.005 (0.990, 1.021)	1.002 (0.990, 1.014)
Proportion of level 2 roads: major arterials and county roads, minor arterial, city collectors	N/A	N/A	0.236 (0.038, 1.482)	0.279 (0.066, 1.169) †
Proportion of level 3 roads: local city/county street	N/A	0.985 (0.261, 3.712)	N/A	N/A
Presence of level 2 roads: major arterials and county roads, minor arterial, city collectors (0 = no, 1 = yes)	0.655 (0.274, 1.568)	0.659 (0.283, 1.534)	N/A	N/A
Crime danger				
Violent crime (sex offenses excluded) density by buffer area (unit: per acre)	1.351 (1.079, 1.692)**	1.141 (0.944, 1.379)	1.195 (0.794, 1.800)	1.283 (0.910, 1.809)
Presence of registered sex offenders (0 = no, 1 = yes)	0.654 (0.369, 1.161)	0.781 (0.444, 1.374)	0.698 (0.383, 1.273)	0.572 (0.332, 0.986)*
Land use	N/A		N/A	

Table D-4 Continued.

Predictors	OR (95% CI)			
	Quarter-mile aerial buffer	Quarter-mile network buffer	Half-mile aerial buffer	Half-mile network buffer
Land use mix (entropy index)		2.169 (0.411, 11.435)		1.750 (0.308, 9.932)
Neighborhood destinations	N/A			
Percentage of park area in a buffer		N/A	1.012 (0.984, 1.040)	N/A
Playground density by buffer area (unit: per square miles)		N/A	N/A	1.062 (0.976, 1.155)
Straight distance to nearest playground		1.165 (0.564, 2.406)	N/A	1.335 (0.602, 2.957)
Presence of playground (0 = no, 1 = yes)		N/A	1.075 (0.677, 1.707)	N/A
Public transportation				
Transit Score (ref: minimal transit)				
Some transit	0.421 (0.224, 0.794)**	0.498 (0.272, 0.910)*	0.389 (0.214, 0.707)**	0.476 (0.262, 0.867)*
Good transit	0.259 (0.091, 0.735)*	0.318 (0.115, 0.877)*	0.257 (0.088, 0.745)*	0.282 (0.095, 0.837)*
Sidewalk density			N/A	N/A
Sidewalk density by buffer area (unit: per square miles)	N/A	0.995 (0.981, 1.009)		
Sidewalk density by total street segment length in a buffer (unit: per mile)	1.736 (0.820, 3.676)	N/A		
Street connectivity		N/A	N/A	N/A
Cul-de-sac density by total street segment length in a buffer (unit: per mile)	0.947 (0.726, 1.235)			
Intersection (3 or more ways) density by total street segment length in a buffer (unit: per mile)	N/A			
Tree canopy density	0.119 (0.012, 1.161) †	0.271 (0.031, 2.359)	0.150 (0.011, 2.000)	0.266 (0.021, 3.404)
	Cox & Snell R Square: 0.399; Nagelkerke R Square: 0.535	Cox & Snell R Square: 0.395; Nagelkerke R Square: 0.529	Cox & Snell R Square: 0.395; Nagelkerke R Square: 0.530	Cox & Snell R Square: 0.403; Nagelkerke R Square: 0.540

† $0.05 \leq p < 0.1$; * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$; OR = odds ratio; CI = confidence interval.