

Article

The Built Environment and Children's Active Commuting to School: A Case Study of San Pedro De Macoris, the Dominican Republic

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Abstract: While car-centric culture and children's mobility have been studied in industrialized countries, there are limited data on developing countries in Latin America and the Caribbean. This study analyzes children's active transportation to school in the Dominican Republic using audit observations of the built environment and surveys. The study assesses how parents' and children's environmental perceptions vary and how children's mode choice is influenced by physical features and perceived safety levels. Land use and built environment attributes were evaluated for each street segment within a 400-m radius of 20 schools using the audit method. The findings indicate that safety problems are the main obstacle preventing children from bicycling or walking to school. Particularly, industrial land use, abandoned buildings, and bars hampered children's active travels to school. Interestingly, public school students are nearly four times more likely to walk or bike to school than private school students. Furthermore, children who live in an area with fast-moving cars were more inclined to walk to school as captive walkers. The study's conclusions have implications for urban environments where children's independent mobility is constrained by car-oriented policies.



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Keywords: active commuting to school; mode choice; land use; built environment; safety; children; Dominican Republic

1. Introduction

According to the World Health Organization (WHO) [1], road accidents and injuries cost most countries worldwide 3% of their gross domestic product, and more than half of these accidents affect vulnerable users such as pedestrians and cyclists. Road traffic injuries are one of the leading causes of death for children. According to the Pan American Health Organization [2], each year 38% of children injured or killed on roads around the world are pedestrians. The death of children in the streets is considered a global epidemic that could grow in the coming decades considering the estimated increase in both the population and number of cars. Additionally, disparities in road traffic fatality rates are observed among nations and regions. In 2019, Latin America and the Caribbean had the highest rates at 21.1 per 100,000 people, which was twice as high as the rate in North America (11.7) [2]. As the leading cause of mortality for children aged 5–14 and the second leading cause of death for teenagers aged 15 and older in Latin America and the Caribbean, road traffic injuries impose a significant health burden on the region's adolescents [3].

The Dominican Republic has some of the world's most dangerous roadways, according to the WHO [4]. The Dominican Republic ranks second among the 182 United Nations member states in the number of fatal road accidents [5]. Additionally, at 65 per 100,000 people, the Dominican Republic has the highest road traffic injury death rate in Latin America and the Caribbean [6]. Accidents involving motorcycles were the most common in the country, as motorcycles made up 56% of the country's fleet, compared to

20% of automobiles [7]. Pedestrians account for 17% of all accident victims, followed by motorcycle riders (67%).

Over the last decade, the number of registered vehicles in the Dominican Republic increased by 88%, from 2,735,000 in 2010 to 5,152,000 in 2020 [7]. The Dominican Republic had a lower vehicle ownership rate than the United States (832 per 1000 people) or the European Union (631 per 1000 people) in 2020, but it is rapidly increasing. Since 2005, the Dominican Republic's vehicle ownership rate has more than quadrupled, rising from 111 per 1000 people in 2005 to 446 per 1000 people in 2020.

High investment in urban roadways, vehicle centralization, and segmented urban development have exacerbated urban sprawl and neighborhood imbalances in Latin America. Car-oriented culture has led to the concentration of people living in poverty in some areas [8–10]. Accessibility inequalities based on spatial and social segregation resulted from a car-oriented culture. Land value increases and displacement of low-income residents have occurred in Latin American cities due to the concentration of economic activities caused by transportation investments and past and present urban development trajectories. The lower income group in those cities does not generally own a private vehicle. They have to deal with long commutes and high transportation costs [9].

Lower-income neighborhoods are considered less safe. Poor communities in Brazil, for example, have fewer police officers per capita and poorer street connectivity, quality, and attractiveness [11]. Safety, accessibility, and comfort are all lacking on the streets where low-income Chileans dwell [12]. In Mexico, as with elsewhere in Latin America, deprived and marginalized neighborhoods have less open space, fewer service providers, narrower walkways, and fewer places for children to play [13].

Despite having one of the region's fastest-growing economies, the Dominican Republic consistently spends less on public services and programs than other Latin American and Caribbean countries, according to the World Bank [14]. Economic inequality has risen as a result. Poorer residents have built homes in marginalized areas on the outskirts of cities, traditionally the most impoverished regions, or hazardous areas near rivers within a floodplain. These vulnerable people have limited access to goods and services. Furthermore, governments prioritize funding for car-centric infrastructure while underfunding infrastructure for walking and bicycling, limiting children's active and independent mobility [10,15].

The majority of research on children's independent mobility in Latin American cities is lacking. It is crucial to explore how children are affected by car-oriented policies in rapidly expanding economies and the underfunding of active transportation infrastructure. Therefore, this study investigates the demographics, built environment, and perceptions influencing independent mobility among Dominican elementary school children. Furthermore, the study compares parental and child perceptions of the walking environment, as well as the relationship between safety perception and children's mode of transportation to school.

2. Literature Review

A growing body of literature recognizes the importance of the built environment of schools in determining children's mobility [16–18]. Pedestrian mobility is integral to sustainable urban development because it has a low environmental impact and generates no air or noise pollution. Transitioning from motorized to active travel can benefit both the environment and the economy [19–22].

According to recent research, walking not only has a low environmental impact, but it also promotes mental and physical health. School trips are also an excellent way for children to incorporate active travel into their daily routines [23–25]. Establishing active commuting at a young age is critical because this travel behavior can last a lifetime and enhances children's physical, mental, and social well-being. In addition, supporting active travel became a more pressing concern as children have spent less time outdoors than previous generations [26]. Physical inactivity among children causes several non-communicable

diseases (e.g., health diseases, stroke, cancers, diabetes), contributing to the global problem of child obesity and more children being overweight [27].

Children's walkability has recently been examined in the literature on social equality and spatial justice. The core tenet of the social-spatial justice concept is the function of space in producing justice and injustice. According to Soja [28], space is the interaction of socially generated material and ideological relations. In this vein, some studies investigate the effects of urban surroundings on children's health and well-being. For instance, German researchers examined how children's walking time was influenced by their socioeconomic status [29]. The differences in school travel between public and private school students were investigated in China [30]. Another study examined how societal structural variables contribute to inequity issues for children in Brazilian cities [31].

In general, environmental factors found to be influencing pedestrian mobility included density [32–35], street connectivity and configuration [36,37], and mixed land use [32,38,39]. These factors can potentially reduce commuting distances, encourage physical activity, and provide multiple route options [32,33,40–43]. Case studies have been established to present detailed analysis of children's mobility in environmental conditions such as distance to school, presence of sidewalks or bike lanes, and mixed land use, which all have an important impact on facilitating or reducing walking in children [44,45].

Some authors have mainly been interested in research questions concerning restrictions on children's independent mobility that primarily stem from parental concern about traffic road safety [46–50] and personal safety related to the possible social danger posed by strangers and crime [51–54]. Moreover, parents' work patterns, especially those of women, influence their children's school-going walking routines and mobility patterns [55]. These studies confirm the importance of both children's and parents' reports on children's mobility and their environmental exposure. Although previous studies have recognized that both physical and perceived school environments influence children's mobility, few have investigated both students' and parents' perceptions of the school neighborhood and analyzed how such perceptions influence children's mode choice. Furthermore, while various factors have been connected to children's independent mobility, most studies on the topic have been undertaken in the West. These countries' wide range of sociocultural and environmental traits may make it difficult for developing nations in Latin America to use data collected there.

This study aims to contribute additional evidence by exploring children's walkability in school areas in San Pedro de Macoris, the Dominican Republic. The study investigates the impact of physical components of the school environment on children's and parents' perceptions of walking and bicycling safety, as well as the factors that influence children's mode choice to school. The following section describes the research methodology, including the research framework and data collection methods. The main findings of logit models are then summarized. Finally, the paper closes with a discussion and the key conclusions, which include the study's limitations and directions for future research.

3. Materials and Methods

3.1. Study Area

The Dominican Republic, a Latin American republic in the Caribbean, is the second-largest island in the Greater Antilles chain in the Caribbean Sea. It shares the eastern two-thirds of the island of Hispaniola with the country of Haiti. The city of San Pedro de Macoris was chosen as the study area because, according to the National Institute of Transportation [56], it is one of the cities in the nation with the highest number of traffic accidents.

San Pedro de Macoris is the Dominican Republic's seventh-most populous and tenth-largest province. The city covers 58.81 square miles and is one of the largest in the eastern part of the country. The city has a large number of residences and a low rural population, according to a cartographic survey [57]. Lack of control in the rise of urban sprawl, the increase in density in some parts of the territory, and the spontaneous generation of new

neighborhoods has demolished the road and pedestrian network at both the urban and periphery levels. Only the main streets of the province have sidewalks and pavement, while the inner streets of the urban center and periphery are in poor condition. A dearth of city signage makes it difficult for residents and visitors to find buildings and important locations. This condition is exacerbated by the lack of a population-appropriate urban mobility system, and the challenges that communities face are not just related to natural and disaster risk, but also to access to educational opportunities and transit options.

A total of 20 schools in San Pedro de Macoris that indicated their interest to participate in the survey were chosen as the target study site. Ten of these are private schools, while the remaining ten are public schools (Figure 1). Figure 2 includes photos of the public and private schools in the study area.

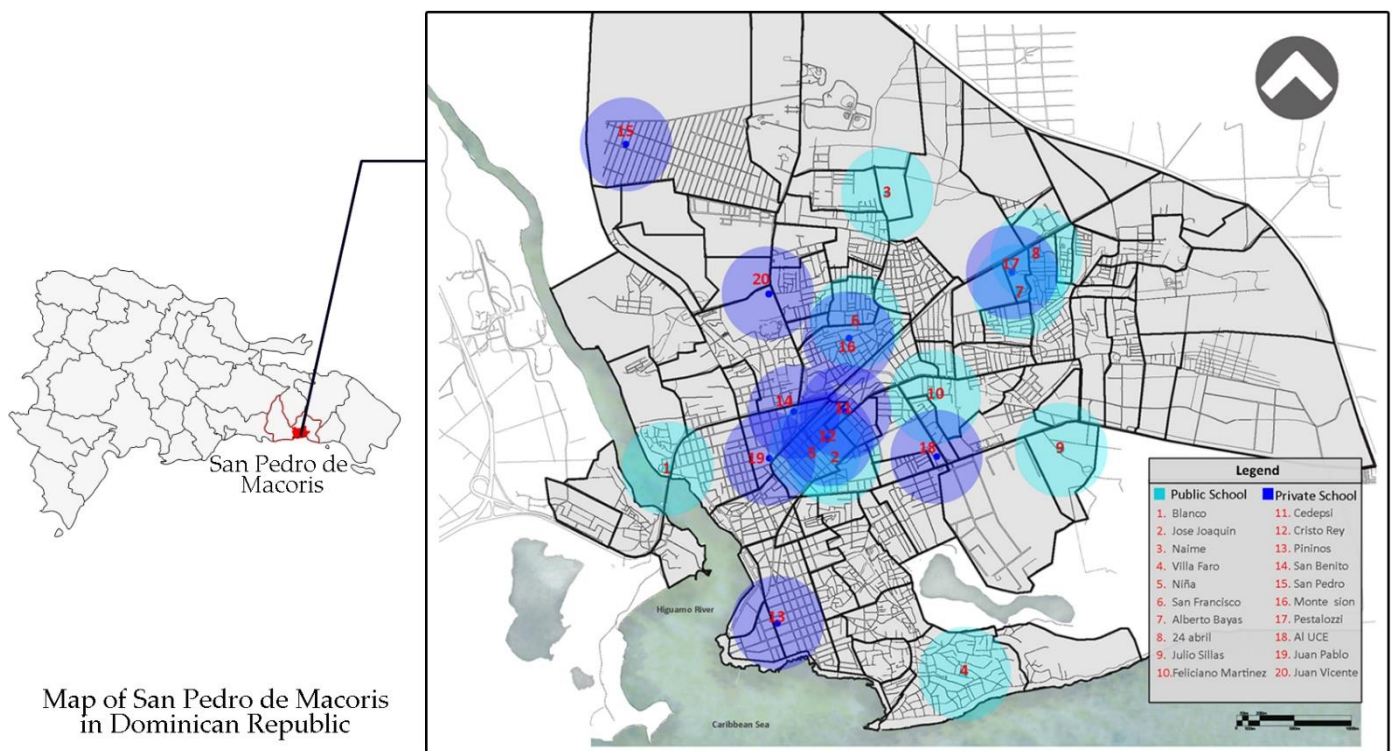


Figure 1. Study area (source: authors' original).

3.2. Methodology

The conceptual model used for mode choice modeling is displayed in Figure 3. Children's walking and biking behaviors to and from school were investigated using the framework created by Zhu et al. (2008) [58]. This methodology was chosen because it provides an organized collection of analytical frameworks that integrate aspects from the individual, the social environment, and the physical environment. In order to better understand how socio-demographic aspects of parents' and children's perspectives affect a child's mode choice, we updated the framework by integrating both parental and child elements as personal characteristics. The tendency of children to walk or familiarity with the neighborhood setting may change a child's travel behavior. Peer and school-related characteristics play a significant role in determining mode choice [59–62]. A range of environmental aspects, such as land use, street safety, and parking, are included in the neighborhood features near schools. These personal and societal elements, as well as neighborhood characteristics, have a direct influence on children's mode of transportation to school.



Figure 2. Photo of schools in the study area (source: google earth, street view).

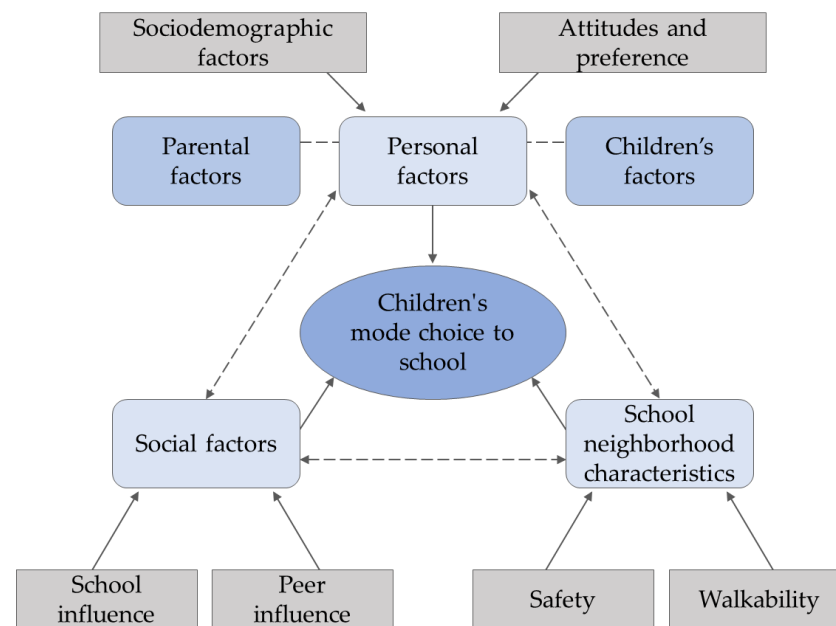


Figure 3. Conceptual framework of the study: factors influencing mode choice. (Source: modified by the authors based on the framework created by [58].)

3.3. Data Collection

Two datasets were compiled for this investigation. Children and parents from the ten public schools and ten private schools in the city of San Pedro de Macoris received an online questionnaire. The site audit data were collected for each street segment within a 400-m radius of each school. A quarter-mile buffer was utilized since it is the normal distance that youngsters are willing to walk [63–66].

3.3.1. Site Audit Data: Physical Environment Measurement

The site audit approach of gathering data for this study was based on a visual evaluation of the elements of the built environment that encourage walkability and active transportation. A variety of instruments for measuring the built environment have been developed via the study of how the environment affects walking [50,67–71]. There are

several audit techniques available to quantify the walkability of neighborhoods [72–78]. The Irvine Minnesota Inventory (IMI) [79] was used for this study because it is one of the most comprehensive and reliable assessments of individual local environments [80–82]. A total of 75 items were chosen from the 229 metrics assessed by the IMI for the Dominican Republic setting.

The audit tool utilized in this study was divided into ten categories, with each category containing variables that were assessed for each street segment in the 400-m radius surrounding the 20 schools. Figure 4 depicts one of the study areas and the street segments that were measured and analyzed with the audit tool. This research was carried out on an average of 35.5 segments (range, 8–67 segments) per school. Table 1 displays the audit variables. The value of each variable ranges from 0 to 3; the higher the value, the better the condition or the greater the existence. After evaluating each variable for each street segment, the average number for all street segments within a school zone was utilized for school environment comparison.

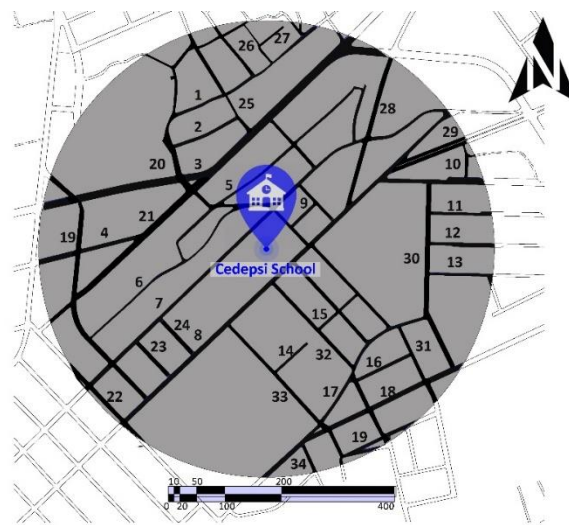


Figure 4. Street segments surrounding Cedepsi. (Source: made by the author.)

Table 1. Audit categories.

Audit Categories	Audit Variables
1. Street signage	Neighborhood entrance signage, speed limit signage, school area signage, clear street signage, stop/yield signage, pedestrian crossing signage
2. Sidewalks	Sidewalk existence, proper width, universal design, sidewalk surface quality, street furniture, cleanliness, vegetation, rain garden, drainage, bollards, connectivity, sidewalk amenities
3. Traffic road	Proper width, vehicles lanes, alley, street direction, traffic road surface quality, speed bumps
4. Street crossing	Curb cuts, crosswalk, traffic road light, pedestrian light, pedestrian bridge
5. Street safety	Safety perception for crossing, vandalism, street dogs, abandoned buildings, buildings with windows to the street, street lighting
6. Land use	Residential, education, public space, recreational/leisure/fitness, public/civic building, institutional, commercial, office/ service, industrial/manufacturing, transportation center, undeveloped land, mixed-use, bar (disco), liquor store, adult uses (strip club, motel)
7. Barriers	Highway, impassable land use, river/lake, drainage ditches
8. Architecture/design	Segment attractiveness, historic building existence, landmark existence
9. Public transportation	Existence, condition–quality, location, signage
10. Parking	Availability of parking lots, parking entrance near school, illegal car parking, illegal motorcycle parking

3.3.2. Survey Data

The primary data were acquired using two survey tools, which collected 566 responses and asked comparable questions to children (N = 305) and parents (N = 261) to examine differences in their impressions of school communities. Primary school children (6–12 years) comprised 33.44% (N = 102) of the entire sample, while secondary school students (13–18 years) represented 66.56% (N = 203) of the sample.

The questionnaires were delivered via email and text message to ten public and ten private schools using a Google Form link and were addressed to the respective institutions' directors and principals. All respondents who participated in the study gave their informed consent. The total number of public school samples comprised 138 children and 132 parents, while the total number of private school samples comprised 167 children and 129 parents. Minimum replies from ten children and ten parents from each public and private school comprised the final sample.

The majority of respondents from primary schools were over the age of ten because the questionnaire was given to senior students who would have no trouble reading and responding to it. Children's surveys, unlike adult surveys, were designed with pictures to make them easier to understand.

3.4. Variables Used in the Mode Choice Model

The list of variables taken into account in the model is illustrated in Table 2. Individual factors, such as the child's gender, age, and school type, as well as physical environment factors of the school neighborhood, were included as explanatory variables. In addition, the survey included data on children's travel behavior and individual perceptions of the school neighborhood's surroundings.

The original data for dependent variables included walking, bicycling, public bus, car, motorcycle, and private transport (e.g., shuttle). We replaced the original count variables with two categorical variables. The variable was coded as 1 for active travel modes, such as walking and bicycling, and 0 for other modes of transportation to school that the respondents chose. We explored the correlation between variables using Pearson correlation and significances and selected variables after analyzing multicollinearity between alternative independent variables using the Statistical Program for Social Sciences (SPSS, version 26.0). Consequently, we included ten street environment variables in the mode choice model, which were assessed using the street segment audit procedure and GIS.

Table 2. Descriptions of variables.

Class	Variable	Description	Data Source
Mode choice	Child's mode to school (D.V.)	Child's mode choice to school (other modes = 0, walking or bicycling = 1)	Survey
Demographic	Child's gender	Gender of child respondents (male = 0, female = 1)	
	Child's age group	Age group of child respondents (6–12 years old = 0, 13–18 years old = 1)	
	School type	Type of school (public school = 0, private school = 1)	
	Number of vehicles	How many vehicles are in your house?	
Perception and preference	The perceived safety of walking/bicycling to school	How safe do you feel riding your bike and walking near your school? (not very safe = 1, somewhat safe = 2, and quite safe = 3)	
	Familiarity with the school neighborhood	Are you familiar with the area surrounding your school?	
	Feels vehicles are too fast	Do you feel uneasy because the cars move fast?	
	Feels there are many interesting things to look at	Are there a lot of interesting sights to see while strolling through the area around your school?	
	Prefers to commute by car	Do you prefer going to school by car?	
	Sees other children walking	I see other students walking to school	

Table 2. Cont.

Class	Variable	Description	Data Source
Physical environment	Intersections	Number of four-way intersections	GIS source
	Irregular street pattern	Irregular or curvilinear street pattern	
	Grid street pattern	Gridiron street layout	
	LU_Residential	Streets where single-family residences, condominiums, and apartments predominate	Audit data
	LU_Commercial	Streets where stores, restaurants, banks, car dealerships, and gas stations predominate	
	LU_Industrial	Streets with chemical plants and factories	
	Vandalism	Streets with visible graffiti, vandalism, and destruction of public property	
	Abandoned buildings	Streets with boarded-up or broken-window buildings	
	Bars	The presence of bars that serve alcohol and/or hold dances	
	Illegal parking	Cars parked in a restricted area	

4. Results

4.1. Descriptive Statistics

4.1.1. Children's Commuting Mode and Independent Mobility

In the survey, there were two age groups: 6–12 years old (primary school), which made up 33.44% (N = 102), and 13–18 years old (secondary school), which made up 66.56% (N = 203). Children aged 6 to 12 years old had a higher percentage of students who walked to school (42.2%) and rode bicycles to school (10.8%) compared to those aged 13–18 years old, where only 34.0% walked and 2% rode bicycles. The older group utilized vehicles (30.5%) and private transportation (12.8%) more than the younger group, which used cars (11.8%) and private transportation (8.8%) (Figure 5a). For children aged 6–12 accompanying their parents, motorcycle (25.5%) was the second most favored form of transportation, while for children aged 13–18, motorcycle (17.2%) was the third most popular mode of transportation after walking and automobile use.

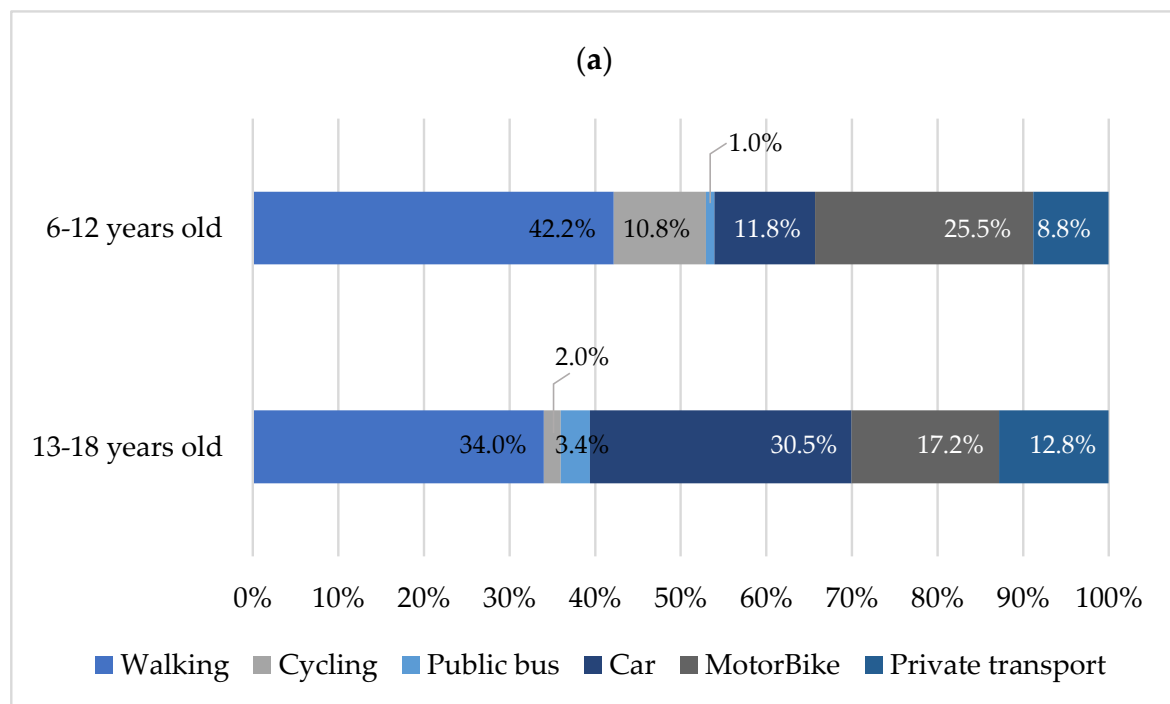


Figure 5. Cont.

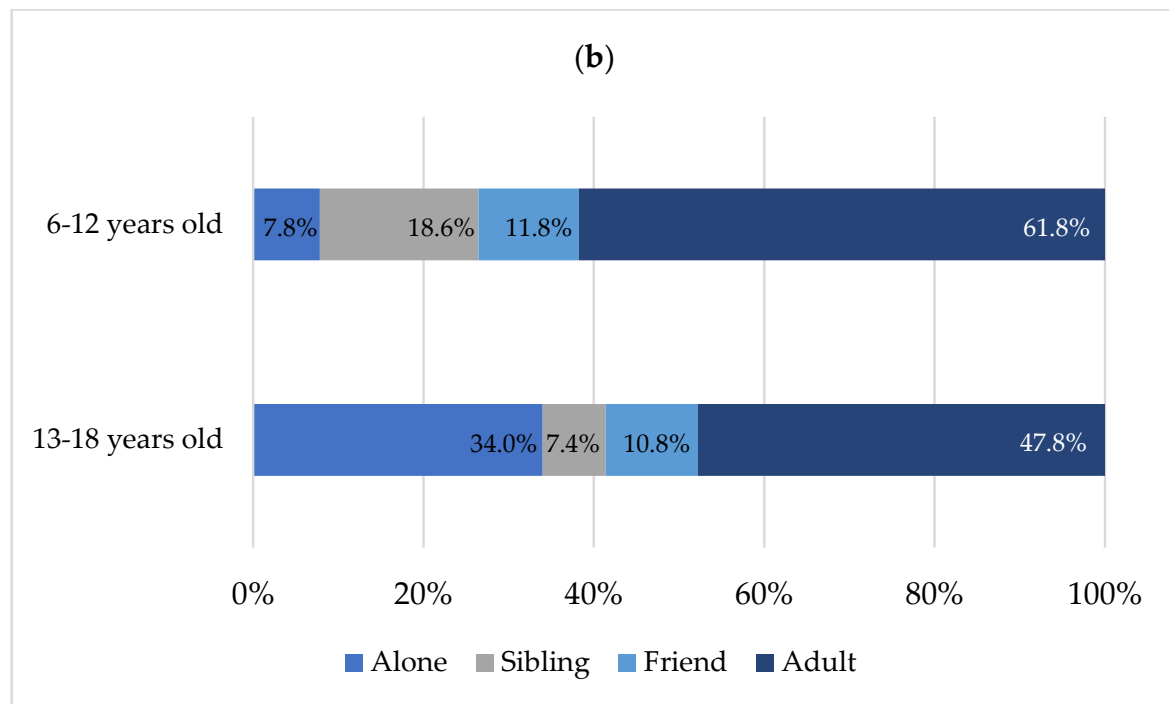


Figure 5. (a) Children's commuting mode by age and (b) travel companion by age group.

Figure 5b illustrates the situation, showing that although children aged 6 to 12 traveled more by foot and bicycle, they were typically accompanied by an adult or an older sibling due to safety concerns; however, those aged 13–18 were more independent and traveled alone. Even though half of all parents in the sample were employed, the majority of parents of children who walk to school were unemployed, indicating that children with a stay-at-home parent were likely to walk or bike to school.

4.1.2. School Choices and Environment in the Dominican Republic

Not all children in the Dominican Republic are assigned to a public school based on their domicile. That is, parents in the Dominican Republic can choose the school of their choice regardless of geography, indicating class stratification. Families have seemingly been left with little choice but to send their children to private schools due to the shortcomings of the public education system [83]. One of the unique questions in the parent survey queried why parents had not selected the school closest to their residences (Figure 6). Parents can select the school that best meets their child's needs based on enrollment availability and accessibility. In addition to the disparity in educational quality (24.1%), safety concerns (17.6%) were cited as a major factor. This indicated that parents were concerned about child pedestrians being involved in accidents in the neighborhood. Also ranked highly was job convenience (14.8%), implying that parents chose a school that was on their way to work so they could drive their child there.

The context surrounding these public/private school neighborhoods in the Dominican Republic is completely different due to various factors such as socioeconomic status and variation in neighborhood quality of life, which includes different characteristics of the neighborhoods, such as poor housing conditions, few gas, water, or electricity resources, and other factors. Public schools are often placed near low-income neighborhoods with inadequate road infrastructure, but private schools are only affordable to high-income families living in better-positioned San Pedro de Macoris neighborhoods.

We looked at a variety of characteristics connected to the school's street environment, such as land use, street network configuration, and graffiti. We utilized a *t*-test to compare the mean values of physical environment variables between public and private schools, and differences were considered significant if the *t*-test *p* values were less than 0.10.

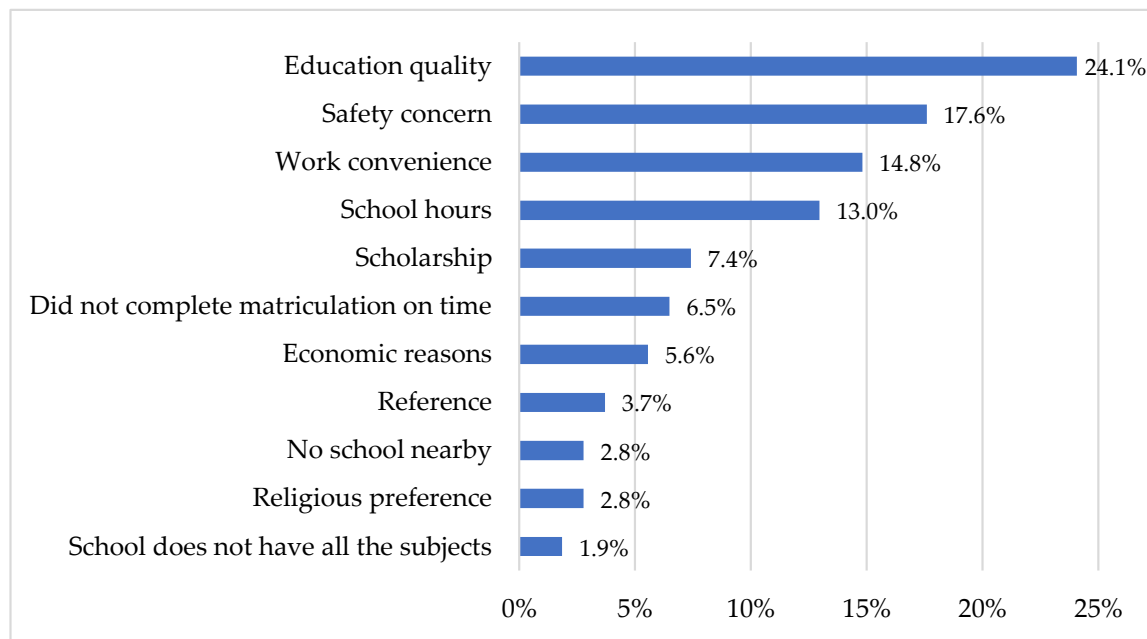


Figure 6. Parents' reasons for not choosing the school nearest to their home.

The results indicated that, in general, private schools were located in safer and higher-quality communities than public schools. Private school communities have higher mean scores for school area signs, better sidewalk conditions, and greater connectivity. In addition, greater road drainage, speed bumps, and crossing markers are present at private schools. On the other side, public school areas have a higher number of abandoned buildings (which symbolizes public safety) and irregular street patterns, which might impede children's walking activities (Table 3).

Table 3. Differences in physical environment variables between the public and private schools.

Variable	Groups	Mean	SD	Mean Difference	SE Difference	p(Sig)
Intersections	Public	13.50	11.45	−11.80	6.49	0.09 *
	Private	25.30	17.04			
Irregular street pattern	Public	0.60	0.52	0.40	0.21	0.07 *
	Private	0.20	0.42			
Grid street pattern	Public	0.00	0.00	−0.40	0.16	0.04 **
	Private	0.40	0.52			
School area signage	Public	1.55	0.37	−0.40	0.15	0.01 **
	Private	1.95	0.28			
Sidewalk existence	Public	2.38	0.40	−0.39	0.17	0.04 **
	Private	2.76	0.36			
Sidewalk connectivity	Public	1.88	0.58	−0.66	0.21	0.01 **
	Private	2.54	0.33			
Road drainage	Public	1.94	0.55	−0.55	0.23	0.03 **
	Private	2.50	0.48			
Speedbumps	Public	1.86	0.36	−0.32	0.14	0.03 **
	Private	2.19	0.23			
Crosswalk marks	Public	1.50	0.64	−0.53	0.23	0.04 **
	Private	2.03	0.35			
Vandalism	Public	2.03	0.50	−0.37	0.23	0.12
	Private	2.39	0.52			
Abandoned buildings	Public	0.49	0.12	0.09	0.04	0.05 *
	Private	0.40	0.07			

Table 3. Cont.

Variable	Groups	Mean	SD	Mean Difference	SE Difference	p(Sig)
LU_Residential	Public	2.70	0.18	−0.10	0.07	0.16
	Private	2.80	0.13			
LU_Commercial	Public	1.46	0.30	−0.09	0.19	0.65
	Private	1.55	0.50			
LU_Industrial	Public	1.13	0.20	0.08	0.07	0.23
	Private	1.05	0.07			
Bars	Public	2.73	0.14	−0.13	0.06	0.04 **
	Private	2.86	0.12			
Illegal parking	Public	2.50	0.54	0.16	0.24	0.51
	Private	2.34	0.51			

Note: SD, standard deviation; SE, standard error; *p*(sig), significance level. ** significant at the 0.05 level; * significant at the 0.1 level.

4.1.3. Children Versus Parents' View Regarding School Environment

The *t*-tests were analyzed by comparing the children's (N = 305) and parents' (N = 261) views of the school environments (Table 4). According to the data, more children than parents believed their backpacks were too heavy to walk to school and that it was too hot to walk. Children also detected and remembered more details about their surroundings. More children than parents believed that the neighborhood had a large number of trees, but the traffic light signals were too short for them to cross the street. Parents, on the other hand, were more concerned with school commute times than children and were more likely to assume that their children needed help crossing the street, while children's responses remained equivocal.

Table 4. Differences between children's and parents' perceptions.

Questions	Groups	Mean	SD	Mean Difference	SE Difference	p(Sig)
Time it takes to get to school	Children	1.72	0.781	−0.15	0.06	0.02 **
	Parents	1.87	0.748			
Thinks there is too much to carry	Children	2.47	0.799	0.27	0.07	0.00 **
	Parents	2.2	0.898			
Gets too hot and sweaty	Children	2.53	0.752	0.18	0.07	0.01 **
	Parents	2.35	0.867			
Prefers to commute by car	Children	2.7	0.618	0.17	0.06	0.00 **
	Parents	2.52	0.772			
Sees other students walking to school	Children	2.81	0.505	0.19	0.05	0.00 **
	Parents	2.62	0.673			
Feels familiar walking around the school neighborhood	Children	2.38	0.778	0.2	0.07	0.00 **
	Parents	2.2	0.814			
School neighborhood is well shaded by trees	Children	2.33	0.818	0.17	0.07	0.02 **
	Parents	2.16	0.891			
Traffic road light time is too short to cross the street	Children	1.98	0.771	0.14	0.07	0.04 **
	Parents	1.84	0.849			
Would like more help crossing the street	Children	2.29	0.847	−0.45	0.06	0.00 **
	Parents	2.74	0.609			
Feels vehicles are too fast	Children	2.17	0.852	−0.08	0.07	0.25
	Parents	2.25	0.839			
Feels there are many interesting things to look at	Children	2.09	0.835	0.04	0.07	0.54
	Parents	2.04	0.847			

Note: SD, standard deviation; SE, standard error; *p*(sig), significance level. ** significant at the 0.05 level; * significant at the 0.1 level.

4.2. Regression Results Regarding Perceptions of Walking Environment Mode Choice

To investigate the effects of the physical environment on students' perception and mode choice, two hypotheses were tested: H1 (*the physical elements of the school environment influence children's and parents' perceptions of walking/bicycling safety*); and H2 (*students' mode choice is related to physical characteristics of the school neighborhood and their perception of the environment*).

To ensure consistency, two ordinal logit models of H1 with identical structure were created to assess children's and parents' perceptions of walking/bicycling safety (Table 5). In terms of the physical surroundings of the school zone, the more grid-like the design appeared, the safer it appeared for both children and parents who believe they or their child can stroll or pedal to school. The youngsters felt safer walking and riding if there was less illegal parking. The sense of active mode safety was influenced more by the perceived school environment than by actual physical surroundings. Active mode safety was improved by familiarity with the school community and impressions of the amenities available in the school neighborhood. On the other hand, perceptions of vehicle speed and predilection for car commuting negatively impacted perceptions of walking/bicycling safety. Vandalism harmed parents' perceptions of walking/bicycling safety but had no effect on children.

Table 5. Perceived safety of walking/bicycling to school (ordinal logit model).

	Children			Parents		
	B	p(Sig)	Exp(B)	B	p(Sig)	Exp(B)
Physical environment of the school zone						
Intersections	0.015	0.315	1.015	−0.015	0.346	0.985
Irregular street pattern	0.057	0.894	1.059	−0.315	0.543	0.730
Grid street pattern	1.175	0.053 *	3.238	1.634	0.013 **	5.124
LU_Residential	1.406	0.382	4.076	−1.741	0.307	0.175
LU_Commercial	−0.525	0.296	0.592	−0.009	0.987	0.991
LU_Industrial	−1.270	0.267	0.281	−1.186	0.337	0.305
Vandalism	−0.565	0.104	0.568	−0.864	0.049 **	0.421
Abandoned buildings	1.606	0.417	4.983	−0.718	0.755	0.488
Bars	1.092	0.433	2.980	0.755	0.618	2.128
Illegal parking	−0.666	0.087 *	0.514	−0.011	0.979	0.989
Perception and preference						
Familiarwiththe school neighborhood	0.872	0.000 **	2.392	0.876	0.000 **	2.401
Feels vehicles are too fast	−0.404	0.006 **	0.668	−0.385	0.017 **	0.680
Feels there are many interesting things to look at	0.397	0.010 **	1.487	0.490	0.004 **	1.632
Prefers to commute by car	−0.486	0.014 **	0.615	−0.337	0.051 *	0.714
Sees other students while strolling	−0.025	0.920	0.975	0.260	0.232	1.297
Chi-square (Sig.)	101.918 (0.000)			81.244 (0.000)		
Nagelkerke	0.320			0.304		

Note: ** significant at the 0.05 level; * significant at the 0.1 level; B, coefficient; p(sig), significance level; and Exp(B), odds ratio.

We computed a binary logit regression to investigate the parameters associated with children's mode of transportation to school (H2) (Table 6). We compared the likelihood of walking or bicycling to school to alternative options such as going by car or motorcycle, utilizing public transit, or taking a shuttle in the mode choice to school analysis. The

unit of analysis was an individual student. Explanatory variables included children's demographics, household socioeconomic indicators, the physical environment of school zones, and children's perceptions of the commuting environment. Multicollinearity was investigated using VIF (variance inflation factor). The mode choice model's explanatory variables all have VIFs less than 5, indicating no duplicated measures.

Table 6. Children's active transportation mode choice to school (binary logit model).

	B	p(Sig)	Exp(B)
Child's demographics			
Child's gender (female = 1)	0.251	0.494	1.285
Child's age group (13–18 years old = 1)	0.493	0.234	1.638
School type (private school = 1)	−1.372	0.008 **	0.254
Number of vehicles	−1.450	0.000 **	0.235
Physical environment of the school zone			
Intersections	−0.037	0.037 **	0.964
LU_Residential	−0.440	0.832	0.644
LU_Industrial	−6.077	0.001 **	0.002
Vandalism	−0.715	0.190	0.489
Abandoned buildings	−9.607	0.004 **	0.002
Bars	−6.024	0.004 **	0.002
Illegal parking	1.124	0.089 *	3.076
Perception and preference			
Familiarwiththe school neighborhood	0.731	0.005 **	2.077
Feels vehicles are too fast	0.674	0.002 **	1.962
Prefers to commute by car	−1.086	0.000 **	0.338
Perceived safety of walking/bicycling to school	0.685	0.006 **	1.984
Sees other students while strolling	0.737	0.070 *	2.089
Chi-square (Sig.)	182.705 (0.000)		
Nagelkerke	0.607		

Note: ** significant at the 0.05 level; * significant at the 0.1 level; B, coefficient; p(sig), significance level; and Exp(B), odds ratio.

It is apparent that the socioeconomic aspects of the children's parental factors influence their mode of transportation. Private school students, for example, were roughly four times (1/0.254) less likely to walk or bike to school than public school students. Children who indicated that their household had a greater number of vehicles were less likely to walk or bike to school.

The study's findings indicate that numerous built environment elements in the school neighborhood influence children's mode of transportation choice. The frequency of street crossings, as well as certain types of land and building usage, had a detrimental impact on children choosing walking and bicycling as modes of transportation. Children who faced a lot of traffic junctions on their way to school or lived in industrial areas were less likely to prefer bicycling and walking to school. Bars and abandoned structures appear to have had the most detrimental effect on discouraging youngsters from traveling alone by foot.

The odds ratio in the perception and choice criteria tells us that as children become more familiar with their school neighborhood, the probabilities of walking or cycling to school increase by 2.077. Furthermore, children who feel their school neighborhood is safe are more likely to walk or bike to school than those who do not. In addition, when students

see other students while strolling around the neighborhood, they are more likely to walk or ride their bikes to school than if no other children are present.

In contrast, children who prefer to get to school by car were nearly three ($1/0.338$) times less likely to walk or bike to school than those who do not prefer to ride. Unexpected results revealed that vehicle speed had a positive impact on the choice of active mode. Youngsters, even though they may feel in danger around speeding automobiles and unauthorized parking, still opt to walk and ride their bikes. This suggests that children have been accustomed to these situations as a result of a car-centric culture.

5. Discussion and Conclusions

To the best of our knowledge, this is the first study to examine children's active travel to school in the context of Latin America using audit observations of the built environment and surveys. We surveyed both the children and the parents to get their perspectives and the findings make several important contributions to the corpus of knowledge already available on children's active travel.

First, this study revealed that safety is the primary factor limiting children's active commutes to school in the Dominican Republic. With the significant exception of vandalism, parents' and children's responses to the school environment were uniform. Evidently, parents were sensitive to vandalism, suggesting that they care more about public safety in regard to social crime than their children. Recent studies [84–86] have demonstrated that crime-related safety is one of the most significant obstacles to children's active school travel. Moreover, the existing results emphasize the significance of safety-related elements of the school neighborhood. These results are in accordance with prior studies indicating that industrial land use, abandoned structures, and bars reduce the likelihood of youngsters walking or riding their bikes to school [87–90]. More importantly, the study discovered that not only safety-related built environment characteristics, but also children's perception of safety had a substantial impact on their proclivity to walking. Children's perceived safety, as well as watching other kids walking and bicycling to school in particular, were positively associated with active commuting to school, correlating with previous studies [91,92].

Second, the study sheds light on the little-studied effects of Latin American land use and road structure on children's active travel to school. Although there has been discussion over the safety of grid streets [86,93,94], children and parents in the Dominican Republic believe grid streets as safer for active mobility. The Dominican Republic has a variety of street configurations; wealthy neighborhoods and private schools are typically found in areas with grid street layouts and secure environments. The grid street layout brought over from Europe by Spanish colonization formed the foundation of Latin American urban development. For this reason, grid street patterns are common in city centers, especially downtowns where there are more places to visit and things to do.

Third, sociodemographic characteristics of households appeared to be major factors influencing children's mode choice. Parents' automobile ownership was found to be inversely related to walking, meaning that children of lower socioeconomic level walk to school more frequently than their affluent peers. This is consistent with previous research in Western countries showing that increased vehicle ownership is associated with decreased active travel to school and raises the probability of children being driven to class [58,95,96]. A possible explanation for this might be that ownership of cars within households influences children's mode choice, giving preference to car commuting instead of traveling on foot [97–100].

According to the findings of this study, students attending public schools were approximately four times more likely to walk or ride their bikes to school than students attending private schools. This is true despite the fact that public schools are typically located near low-income districts with limited access to basic transportation. Neighborhoods with private and public schools have very different contexts, including socioeconomic level [101,102]. The results of the *t*-tests we ran previously revealed that public schools were in worse shape. Public schools, in particular, were more susceptible to abandoned

structures and also more likely to have irregular street patterns with a lower amount of pavement, sidewalks, school area signage, road drainage, speed bumps, and crossing markers—all of which are essential infrastructure for pedestrian movement.

In a similar vein, this study found that although children perceive being unsafe due to illegal parking, they were more likely to rely on walking as their primary mode of transportation if they lived in an area with a higher concentration of illegal parking spots and fast-moving cars. This group may have included children at high risk who were compelled to walk due to a lack of alternative transportation choices; they are “captive walkers” who attend schools in low-income neighborhoods [103]. This is consistent with existing research showing that children from low-income schools are more likely to walk to school, and socioeconomically disadvantaged children face more challenges in traveling due to limited infrastructure, their reliance on walking as a mode of transportation, and lack of parental supervision [104].

While the findings are significant in the context of the Dominican Republic, the study has some limitations. The information offered in this study may be limited in their relevance to different environmental conditions. Another problem of the study is that the data are cross-sectional, which does not reflect actual causal relationships. Children’s mobility may change over time. Furthermore, the impact of environmental influences on travel behavior can constantly bring up the problem of residential self-selection [105,106]. Longitudinal data should be included in future research approaches, allowing the study to focus more on the physical environment’s influence on children’s mobility. Another potential limitation was sampling bias. Because the survey was conducted using a Google Form link, it could only reach students with internet access, though we received responses from a variety of groups. Despite these challenges, the combination of audit observations with surveys of both parents and children appears to hold promise in terms of generating objective measures of specific built environment attributes as well as implications of school transportation on children’s active commutes.

The built environment can influence children’s independent mobility in ways that encourage them to walk as part of their daily routine, which has piqued the interest of policymakers and practitioners. According to this study, the Dominican Republic’s preference for active transportation modes is mostly influenced by safety considerations. The findings of this study give legitimacy to a number of neighborhood-level measures, including a decrease in industrial land use, the exclusion of abandoned buildings and bars along routes to school, better street crossings, and enhanced public safety. As more public school students walk to school, they may encounter numerous obstacles along the way that are not adequately served by proper sidewalks and transit systems. In this sense, children who reside in disadvantaged communities with limited pedestrian infrastructure may be the target of transportation regulations aimed at minimizing road accidents involving children.

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