

Research Paper

School Trip Mode Choice and Sustainable Transportation for Secondary School Students in Developing Countries: Evidence from Nigeria

Bruno Ben-Ejeagwu¹, Tomi Okedairo², Oghenerunor Angel Ederewhevbe³

¹Nile University of Nigeria, Abuja, Nigeria

²University of Alberta, Canada

³University of New Haven, West Haven, Connecticut, USA

*runorederebs2@gmail.com

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Abstract

Efficient transportation systems are essential for mobility, safety, and economic productivity, particularly in regions experiencing rapid population growth and increasing travel demand. This study investigates travel behavior patterns among secondary school students aged 10–18 years in Delta State and Ogun State, Nigeria, with the objective of identifying factors that influence transportation choices and affect network performance. Data were collected through questionnaires administered to 150 respondents and analyzed to examine the relationships among travel mode selection, infrastructure quality, safety conditions, and travel time. The findings indicate that private motorized transportation is the dominant mode of travel despite relatively short travel distances. Safety concerns, poor road conditions, inadequate transportation infrastructure, and limited public transportation availability emerged as the primary factors influencing travel decisions. Furthermore, road quality, route safety, and travel time were found to significantly affect both transportation mode choice and the overall travel experience. These results suggest that deficiencies in transportation infrastructure and traffic management contribute to inefficiencies that constrain mobility and accessibility within the study area. The study demonstrates the value of transportation data in understanding travel patterns and identifying operational challenges within transportation networks. By analyzing travel behavior and infrastructure-related constraints, the research provides insights that can

support the development of data-driven transportation management strategies, predictive traffic models, and intelligent mobility solutions. Such approaches can enable transportation agencies to identify congestion-prone corridors, anticipate mobility disruptions, and implement proactive measures to improve network performance. The findings contribute to the growing body of knowledge on transportation planning and provide practical evidence for the design of smarter and more resilient transportation systems. The study contributes to the growing body of transportation planning literature by providing empirical insights into the factors shaping travel behavior among students in developing transportation environments.

Keywords: school trip, sustainable transportation, active travel, developing countries, road safety

Introduction

Transportation systems in many developing countries face growing challenges as rapid urbanization increases pressure on existing infrastructure and transportation networks. In Nigeria, a nation of more than 200 million people, the transportation sector relies heavily on fossil fuels and is affected by inadequate infrastructure, safety concerns, and limited mobility options (Akujor & Uzowuru, 2022). These challenges contribute to environmental impacts while creating transportation barriers for vulnerable populations, including school-age children.

School transportation is an important but often overlooked component of urban mobility. Secondary school students represent a substantial share of daily travelers, yet their travel patterns remain insufficiently studied in many sub-Saharan African countries. Understanding how students travel to school is important because it affects access to education, transportation safety, public health, and overall traffic conditions. As vulnerable road users, children and adolescents depend on safe, reliable, and accessible transportation systems to reach educational opportunities.

Sustainable transportation is founded on three interconnected principles: economic efficiency, social equity, and environmental sustainability. In the context of school travel, it involves promoting active transportation modes such as walking and cycling, providing safe and reliable public transit options, reducing reliance on private vehicles, and minimizing transportation-related emissions. Achieving these objectives in developing countries, however, requires a clear understanding of the complex relationships among infrastructure quality, safety conditions, socioeconomic factors, and institutional capacity. According to the European Conference of Ministers of Transport, a sustainable transportation system should be accessible, safe, environmentally

responsible, and affordable (Nasrudin, 2014). Meeting these standards remains a significant challenge for many transportation systems in Nigeria.

Nigeria's transportation sector faces persistent structural and operational challenges. The heavy dependence on road transportation, combined with deteriorating infrastructure, aging vehicle fleets, and weak regulatory enforcement, has created conditions in which safety concerns often take precedence over sustainability objectives. Road traffic accidents remain a major public health concern, while institutional and funding limitations continue to hinder the effectiveness of road safety programs and transportation improvements (Adenigbo, 2024). Although the road network remains the most widely used mode of transportation in the country, decades of underinvestment and inadequate maintenance have reduced its reliability and safety, particularly for young commuters.

This study addresses an important gap in the literature by examining school travel behavior among secondary school students in Delta State and Ogun State, Nigeria. These states represent diverse urban and peri-urban settings characterized by varying levels of transportation infrastructure and accessibility. Delta State, which is located in the Niger Delta region, is a major petroleum-producing state with key urban centers such as Warri and Asaba, while Ogun State, which borders Lagos, has experienced rapid urbanization and increasing transportation demand. Using questionnaire-based data collected from secondary school students, the study investigates travel patterns, mode choice determinants, trip characteristics, and barriers to active transportation. Specifically, the study seeks to answer the following questions: Which transportation modes are most commonly used by secondary school students for school trips? What factors influence transportation mode choice? How do road conditions, route safety, and travel time affect travel behavior? What barriers limit the adoption of active transportation modes? And what policy measures can support the development of more sustainable school transportation systems?

By providing empirical evidence from Nigerian secondary schools, this research contributes to the limited body of knowledge on school transportation in sub-Saharan Africa. The findings offer insights for transportation planning, educational policy, public health initiatives, and sustainable mobility strategies. In addition, the study supports broader development objectives related to improving transportation safety, expanding access to education, promoting healthier travel behaviors, and advancing sustainable urban development. As Nigeria and other developing countries continue to address the challenges of rapid urbanization and growing transportation demand, understanding school travel behavior will be essential for designing safer, more efficient, and more sustainable transportation systems.

2. Literature Review

2.1 School Travel Mode Choice in Developing Countries

Transportation mode choice for school trips represents a complex decision influenced by distance, infrastructure quality, safety perceptions, socioeconomic status, and cultural norms. Research from developing cities demonstrates that mode choice patterns differ substantially from developed country, reflecting distinct infrastructure constraints, institutional capacities, and household income distributions (Mwale et al., 2024). In sub-Saharan African contexts, public buses and walking emerge as predominant modes for work and school trips, particularly in high-density urban areas. A study of Lusaka, Zambia, found that residential density significantly influences mode choice, with high-density areas favoring public transit and walking, while low-density areas promote greater private vehicle use (Mwale et al., 2024). This relationship between urban density and mode choice has direct implications for school transportation planning, as it suggests that spatial patterns of school location and residential distribution should inform transit provision strategies. Key determinants of mode choice include travel time, cost, safety, and comfort. Safety considerations encompass both traffic safety (accident risk) and personal security (crime risk), with parents often prioritizing perceived safety over environmental or health benefits when deciding how their children travel to school. Poor road conditions, absent sidewalks, and insufficient street lighting create substantial barriers to active transportation, with students using roads in very poor condition experiencing considerably longer and more challenging journeys. Research consistently demonstrates that the built environment, including road design, pedestrian infrastructure, and land use patterns, shapes mode choice through both objective conditions and subjective perceptions of safety and convenience (Wangzom et al., 2023).

Socioeconomic factors also exert powerful influences on mode choice. In developing countries, household income determines access to private vehicles, the ability to pay for public transit fares, and residential location relative to schools. Lower-income households are more likely to depend on walking or informal transit, while middle- and upper-income households more frequently use private vehicles. This socioeconomic stratification of mode choice has equity implications, as lower-income students may face longer, more difficult, and less safe trips to school. Studies show that the important effects of home-school proximity, household socioeconomic attributes, neighborhood-built environment characteristics, and parental perceptions of neighborhood safety and vehicular traffic conditions on the path to and from school are well established in the literature (Vasconcellos, 2016).

2.2 Active Transportation and Health Implications for Children and Adolescents

Active transportation offers multiple benefits including increased physical activity, reduced emissions, and improved community connectivity. For children and adolescents, active school travel provides opportunities for

daily physical activity and potentially establishes lifelong active transportation habits. Walking and cycling are examples of active travel modes that rely on human physical power rather than fossil fuel consumption and, in the context of short-distance journeys, are advocated as both feeder modes to public transit and primary travel modes in their own right (Chanpariyavatevong et al., 2024). The health benefits of active transportation for children are substantial and well-documented. Regular walking and cycling to school are associated with improved cardiovascular fitness, reduced risk of obesity, better mental health outcomes, and enhanced cognitive performance. The World Health Organization (WHO) has identified physical inactivity as a major risk factor for chronic disease, and active school travel represents one of the most feasible strategies for integrating physical activity into children's daily routines. Studies have shown that cycling uses the large skeletal muscles of the body in a rhythmic pattern, providing aerobic exercise that improves physical fitness, while walking provides cardiovascular benefits accessible to nearly all children regardless of socioeconomic status (World Health Organization, 2002).

Systematic reviews identify effective strategies for promoting active travel among children and adolescents. Educational interventions show modest effectiveness when combined with infrastructure improvements, while environmental and policy interventions demonstrate stronger impacts (Chanpariyavatevong et al., 2024). Effective interventions identified in the literature include Walking School Buses (supervised group walking), Safe Routes to School programs, school travel plans, and cycling promotion initiatives. However, interventions from high-income countries may not translate effectively to developing settings, emphasizing the need for context-specific approaches that account for local infrastructure conditions, safety environments, and cultural norms (Chanpariyavatevong et al., 2024). Perceived safety emerges as a critical determinant of active school travel. Built environment factors including traffic volume, vehicle speed, and pedestrian infrastructure significantly influence parental perceptions of safety (Wangzom et al., 2023). Parents consistently identify traffic danger as a primary barrier, with concerns intensifying in contexts with poor road conditions and high accident rates. Research from diverse international contexts demonstrates that improving the built environment along school routes, including traffic calming, improved crossings, and dedicated pedestrian paths, can significantly increase rates of active school travel (Wangzom et al., 2023). These findings are particularly relevant for Nigerian contexts where pedestrian infrastructure is severely limited.

2.3 Road Safety Challenges in Developing Countries and Nigeria

Road safety remains a major public health challenge worldwide, with low- and middle-income countries accounting for nearly 90% of global road traffic fatalities despite owning only about 60% of the world's vehicles (Godthelp & Ksentini, 2024). This disproportionate burden is driven by inadequate infrastructure, weak enforcement of traffic regulations, limited road safety education, and insufficient post-crash response systems. Nigeria faces significant road safety challenges that directly influence transportation choices, particularly for

school-aged children. Road traffic accidents remain a leading cause of death among vulnerable road users, including pedestrians, cyclists, and motorcycle passengers. Although road user education is recognized as an important strategy for improving safety, its effectiveness is constrained by institutional, participatory, and funding limitations (Adenigbo, 2024). Weak policy implementation, limited coordination among stakeholders, low public engagement, and inadequate funding continue to hinder progress in road safety management (Adenigbo, 2024).

The internationally recognized Safe System approach offers a comprehensive framework for improving road safety but requires adaptation to the realities of developing countries (Godthelp & Ksentini, 2024). In Nigeria, improving safety requires coordinated efforts across transportation planning, infrastructure development, regulation, education, and enforcement. Until these challenges are addressed, safety concerns will continue to influence school transportation decisions, leading many parents to favor private motorized transportation over more sustainable alternatives. As a result, improving the safety environment is a critical step toward promoting sustainable school transportation systems.

2.4 Sustainable Transportation and Environmental Implications

Nigeria's transportation sector is entirely dependent on fossil fuels, making it a significant source of greenhouse gas emissions and air pollutants (Akujor & Uzowuru, 2022). The combustion of petroleum products in road vehicles produces carbon dioxide, nitrogen oxides, volatile organic compounds, and particulate matter that contribute to climate change and local air pollution. These environmental impacts are particularly significant in urban areas where traffic congestion concentrates emissions, creating health hazards for residents including school-age children who spend time commuting in polluted environments. The concept of sustainable transportation requires that mobility systems meet present needs without compromising the ability of future generations to meet their needs. For school transportation specifically, sustainability encompasses environmental dimensions (minimizing emissions and resource consumption), social dimensions (ensuring safe and equitable access to education), and economic dimensions (minimizing costs to households and governments). Sustainable transportation methods may be defined as the means by which transportation takes place in line with the principles of sustainability, which entail as little CO₂ emission as possible in urban mobility and process management (Nasrudin, 2014). This definition aligns with global frameworks including the Sustainable Development Goals and the Paris Agreement on climate change.

Decarbonizing Nigeria's transportation sector requires a transition from fossil fuel-dependent vehicles to cleaner alternatives including electric vehicles, compressed natural gas vehicles, and non-motorized transport (Akujor & Uzowuru, 2022). For school transportation, the most immediately achievable sustainability improvements involve promoting active transportation for short-distance trips and improving public transit systems to provide viable alternatives to private vehicle use. These measures can yield multiple co-benefits including reduced

emissions, improved health through increased physical activity, reduced traffic congestion, and lower transportation costs for households.

2.5 Transportation Needs of Children and Adolescents in Sub-Saharan Africa

Children living in rural areas of underdeveloped or developing sub-Saharan countries face significant transportation challenges that affect their ability to access education. The problem of transportation has affected children's accessibility to school, with distance-time travel from homes to schools sometimes being prohibitively long for children without access to affordable transportation (Vasconcellos, 2016). Among the factors influencing school attendance are patterns of school supply (particularly the location of quality schools relative to residential areas), household income levels, and parental appreciation of education's value. Transportation needs of children with disabilities require particular attention in any discussion of school transportation equity. Children with disabilities face heightened transportation challenges and are at greater risk than children without disabilities in terms of security and safety (Graham et al., 2014). Appropriate transportation provision for children with disabilities is essential for ensuring equal access to educational opportunities and preventing social exclusion. Unfortunately, in many developing country contexts including Nigeria, the transportation needs of children with disabilities receive insufficient attention in policy and planning. The mode choice for school trips among children in developing countries is shaped by the interplay of social demographic factors, infrastructure conditions, and institutional capacity (Mwale et al., 2024). Key factors include distance to school, household socioeconomic status, availability and reliability of public transit, safety of routes, and parental perceptions of risk. Understanding these determinants is essential for designing effective interventions to promote more sustainable and equitable school transportation systems.

3. Methodology

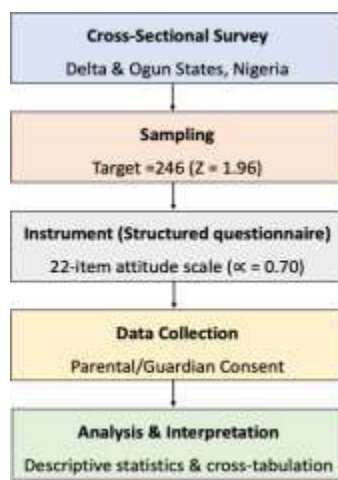


Figure 3.1. Study workflow, from research design through interpretation.

3.1 Study Area

This research was conducted in Delta State and Ogun State, Nigeria, representing diverse geographic and infrastructural contexts. Delta State is located in southern Nigeria between latitudes 5°00 and 6°30'N and longitudes 5°00 and 6°45'E, with a total land area of 16,842 square kilometers. Delta State is a major petroleum-producing state, and its transportation infrastructure reflects both the economic significance and the developmental challenges of the Niger Delta region. Ogun State is located in western Nigeria, bounded by Ondo State to the east, Oyo and Osun states to the north, Lagos State to the south, and the Republic of Benin to the west. Ogun State's proximity to Lagos makes it a significant economic corridor, with substantial urbanization pressures particularly in areas bordering Lagos. Both states feature secondary schools serving students aged 10–18 years from diverse socioeconomic backgrounds.

3.2 Research Design

The study employed a cross-sectional survey design using structured questionnaires to collect data on school trip patterns, mode choice, and associated factors across four schools in Delta and Ogun States.

3.3 Sampling and Data Collection

The study employed purposive sampling to select four secondary schools across Delta State and Ogun State (Ogbe Secondary School and Epic Study Centre in Delta State; Iju Ebiye High School and Bethel Demonstration School in Ogun State), and random sampling to select student respondents aged 10–18 years within those schools. A total of **150** questionnaires were administered and retrieved, **75** from each state. The sample size was determined using the formula for categorical data: $n = Z^2 \times P \times Q / E^2$, where $Z = 1.96$ (corresponding to a 95% confidence level)¹, $P = 0.2$, $Q = 0.8$, and $E = 0.05$, yielding a theoretical sample of 246. The actual sample of 150 represents approximately **61%** of this target (see Section 3.7). Per-item analytic counts in the tables that follow range from 140 to 150 rather than a constant 150, because a small number of respondents left individual items blank; the thesis reports each item's own valid-response total rather than a single overall response rate, so that is what is reproduced below.

3.4 Variables and Measures

The questionnaire contained 50 items across three sections: Section A covered demographic and socioeconomic information (13 items: age, gender, physical condition, grade level, language, state, parent/guardian occupation, and similar); Section B covered trip patterns for school and non-school trips (15 items: mode, duration, route safety, road condition, busiest day, frequency, cost, and similar); and Section C covered attitudes toward

different transportation modes and ratings of infrastructure aspects (22 items, 5-point Likert/rating scales). The reliability analysis reported below corresponds to Section C in full.

The key variables were measured as follows. Dependent variables: school trip mode (eight categories which include: public bus, school bus, tricycle, bicycle, motorcycle, taxi, private car, walking); school trip duration (four ordered categories: 10–30 minutes, 30 minutes - 1 hour, 1 - 2 hours, above 2 hours); and trip ease (binary: “Do you find it easy to travel to school?”, yes/no). Independent variables: road condition (four categories: very poor, poor, good, very good; there is no “fair” category in the instrument used); route safety (binary: “Is the route you take to school safe?”, yes/no); major transportation problem (cost, distance, other); frequency of public transportation use per week (count); attitudinal items on the safety and stressfulness of each mode (5-point Likert, strongly disagree to strongly agree); and infrastructure-quality ratings for eleven specific features such as sidewalks, crosswalks, bike lanes, and traffic congestion (5-point scale, excellent to poor, plus don't know).

Instrument reliability was assessed with Cronbach's alpha across the Section C items, yielding $\alpha = 0.70$ (22 items), indicating acceptable internal consistency. Item-level analysis (deleting one item at a time) showed that removing “Cycling to school is safe” or “Walking to school is safe” would raise α to approximately 0.72, suggesting these two items contribute the least to the scale's internal consistency, while removing items such as “Taxis are in poor condition” or “the use of tricycle is stressful” would lower α to approximately 0.67, indicating these items are comparatively more central to the scale. No reliability or pre-testing evidence was obtained for Sections A or B.

3.5 Data Analysis

Data were analyzed using descriptive statistics (frequencies and percentages) to characterize mode choice, trip duration, road condition, and infrastructure ratings. Cross-tabulation was used to examine bivariate relationships, including trip duration by mode, and trip ease by route safety and by road condition. Because school trip duration is an ordered categorical outcome with more than two levels, an Ordered Logistic Regression was estimated to identify predictors of trip duration, with route safety, road condition, mode of transportation, major transportation problem, frequency of public transportation use, and perceived stressfulness of cycling entered as predictors.

3.6 Ethical Considerations

The research adhered to ethical principles for research involving minors. Informed consent was secured from parents or guardians, and student assent was obtained prior to participation. Participation was voluntary, and respondents could withdraw at any time without penalty.

3.7 Limitations

Several limitations should be noted. The cross-sectional design captures mode choice and trip duration at a single point in time, limiting ability to assess change. The achieved sample of 150 falls short of the corrected target of 246 (Section 3.3), which limits statistical power, particularly for the smaller cells in the ordered logit model (for example, only one respondent reported using a boat, and its coefficient has an implausibly large standard error as a direct result; see Table 6). Several key variables are binary or categorical self-reports collected from the same respondent in the same instrument (route safety, trip ease), which creates a risk of common-method bias. The study focused on four schools in two southern Nigerian states, limiting generalizability. Finally, trip distance was not measured in kilometers, so this analysis cannot separate the effect of objective distance from the effect of perceived distance.

4. Results and Findings

4.1 Sample Characteristics

The study sample comprised 150 secondary school students aged 10–18 years from Delta State and Ogun State, Nigeria (Table 1). Gender distribution was close to even, skewing slightly female. Most respondents fell in the 13–18 age range and the SSS1–SSS3 grade levels. The sample was evenly split between Delta and Ogun States by design (75 each).

Table 1. Sample Characteristics

Characteristic	Category	n	%
Gender	Male	71	47.3
	Female	79	52.7
Physical condition	Abled	144	98.0
	Disabled	3	2.0
Age	10–12 years	10	6.7
	13–15 years	69	46.3
	16–18 years	59	39.6
	18–20 years	9	6.0
	Above 20 years	2	1.3
Grade level	JSS 1	6	4.1
	JSS 2	12	8.1
	JSS 3	7	4.7
	SSS 1	27	18.2
	SSS 2	56	37.8

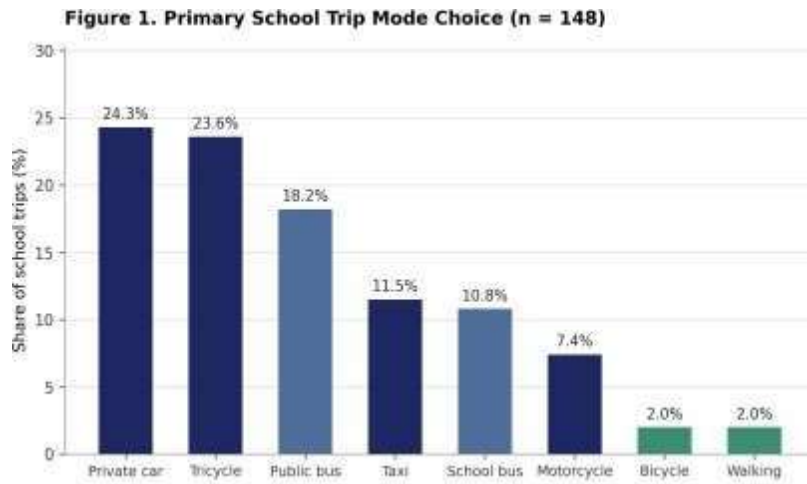
	SSS 3	40	27.0
State of residence	Delta	76	50.7
	Ogun	74	49.3
Most spoken language	English	68	45.9
	Yoruba	28	18.9
	Igbo	20	13.5
	Hausa	5	3.4
	Other	27	18.2
Parent/guardian occupation	Trading	70	49.6
	Engineer	16	11.3
	Farming	10	7.1
	Skilled craft	8	5.7
	Civil servant	8	5.7
	Retired	8	5.7
	Accountant	7	5.0
	Other	14	9.9

4.2 School Trip Mode Choice Patterns

Table 2 and Figure 1 report the modal split for school trips (n = 148). Private car (24.3%) and tricycle (23.6%) were the two most common modes, followed by public bus (18.2%), taxi (11.5%), and school bus (10.8%). Private car, tricycle, taxi, and motorcycle together (the privately-arranged or informally-operated motorized modes) accounted for 66.8% of school trips. Walking and bicycle were both rare, at exactly 2.0% each, together accounting for only 4.0% of trips; the near-total absence of active transportation found in the journal excerpt is borne out by the underlying data. Interestingly, when asked their most preferred mode “if you had no constraints,” only 8.4% of students chose private car and 1.4% chose walking, while taxi (chosen by 35.7%) and motorcycle (18.2%) became the top preferences, a clear gap between actual and preferred mode worth highlighting in the Discussion.

Table 2. Primary School Trip Mode (n = 148)

Mode	n	%
Private car	36	24.3
Tricycle	35	23.6
Public bus	27	18.2
Taxi	17	11.5
School bus	16	10.8
Motorcycle	11	7.4
Bicycle	3	2.0
Walking	3	2.0
Total	148	100.0

**Figure 1.** Primary mode used for school trips (n = 148). Real data.

4.3 Trip Duration

Trip duration was measured in four ordered time bands rather than as continuous minutes (Table 3; Figure 2). The large majority of students, 63.1%, reported a one-way school trip of 10–30 minutes, and a further 33.6% reported 30 minutes to 1 hour; only 3.4% of students reported trips of 1 hour or more. Cross-tabulated against mode, tricycle users were the most likely to report a 1–2 hour trip (8.6% of tricycle users), and private car was

the only mode with any respondent reporting a trip above 2 hours (2.8% of private car users). Walking trips were uniformly short: 100% of the three students who walked reported a 10 – 30 minute trip.

Table 3. Distribution of School Trip Duration (n = 149)

Duration	n	%
10–30 minutes	94	63.1
30 minutes–1 hour	50	33.6
1–2 hours	4	2.7
Above 2 hours	1	0.7
Total	149	100.0

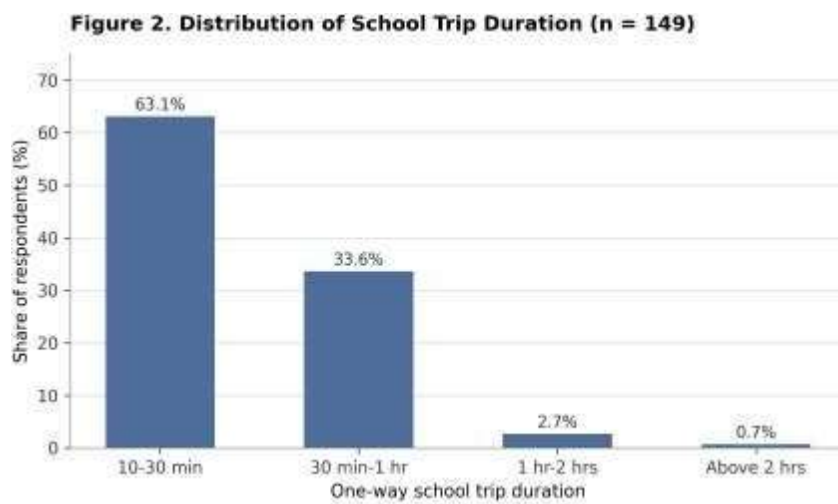


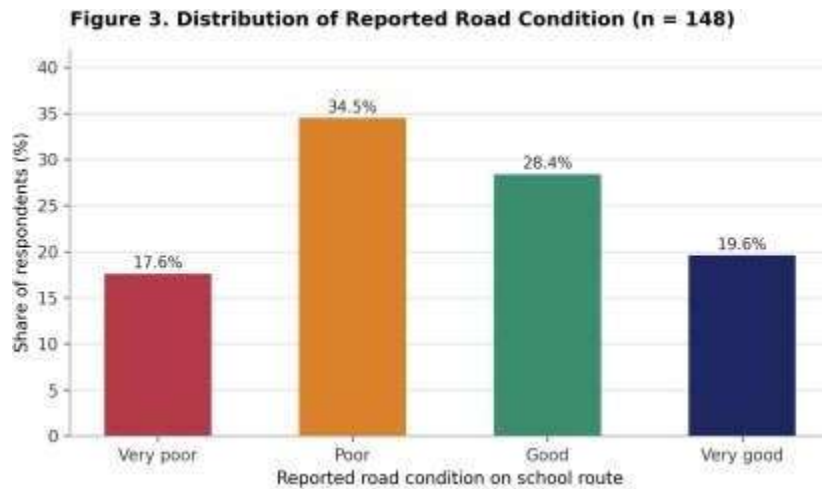
Figure 2. Distribution of school trip duration (n = 149). Real data.

4.4 Road and Route Conditions, and Their Association with Trip Ease

Road condition was rated on a four-point scale (no “fair” category was offered; Table 4a; Figure 3). 52.1% of students rated their road as poor or very poor, against 48.0% rating it good or very good. Separately, 85.7% of students described their route to school as safe, versus 14.3% who described it as unsafe.

Table 4a. Distribution of Reported Road Condition (n = 148)

Road Condition	n	%
Very poor	26	17.6
Poor	51	34.5
Good	42	28.4
Very good	29	19.6
Total	148	100.0

**Figure 3.** Distribution of road condition on respondents' school routes (n = 148). Real data.

Whether students found their trip “easy” (Table 4b) was strongly related to road condition. 73.1% of students on very-poor-condition roads said their trip was *not* easy, compared with only 27.6% of students on very-good-condition roads. Conversely, 72.4% of students on very-good-condition roads found their trip easy, more than two-and-a-half times the 26.9% rate among students on very-poor-condition roads. The relationship was not a simple binary split, either: even “poor” roads already showed a near-even split (48.0% easy vs. 52.0% not easy), suggesting the relationship is closer to a step function between “very poor” and everything else than a smooth gradient. A chi-square test of independence, computed from these reported percentages and the road-condition totals in Table 4a², confirms the association is statistically significant: $\chi^2(3, N = 148) = 19.16$, $p < .001$, Cramér's $V = 0.36$, a moderate-to-strong effect by conventional benchmarks. Route safety showed a similar but weaker pattern: 59.7% of students on safe routes found their trip easy, versus 40.0% of students on unsafe routes. The computed chi-square test for this association, using a Yates' continuity correction appropriate for a 2×2 table,

was $\chi^2(1, N = 140) = 2.04, p = .153$, Cramér's $V = 0.12$, which does not reach conventional significance, despite the descriptive gap, likely reflecting the much smaller “unsafe” group ($n = 20$) limiting statistical power.

Table 4b. Trip Ease by Road Condition

Road Condition	Trip Is Easy %	Trip Is NOT Easy %	n
Very poor	26.9	73.1	26
Poor	48.0	52.0	51
Good	73.8	26.2	42
Very good	72.4	27.6	29
Total	56.5	43.5	148

$\chi^2(3, N = 148) = 19.16, p < .001$, Cramér's $V = 0.36$.



Figure 4. Trip ease by road condition ($n = 148$). Real data.

4.5 Infrastructure Quality and Reported Travel Problems

Among the 43.6% of students who said their trip to school was *not* easy, the leading reasons given were distance (47.1% of this subgroup) and cost (42.6%), with other reasons accounting for the remaining 10.3% (Table 5). Separately, students rated eleven specific infrastructure features on a five-point scale from excellent to poor (Table 5b; Figure 5). Bike parking (rated “poor” by 50.0%) and bike lanes and routes (“poor” by 47.6%) were the two most poorly rated features, consistent with the near-total absence of cycling found in Section 4.2. Condition of streets and traffic calming measures were each rated “poor” by over 43% of respondents. By

contrast, overall ease of travel was rated “poor” by only 21.1%, the most favorably rated item on the list; students appear to judge specific infrastructure features more harshly than they judge their trip as a whole.

Table 5a. Reported Reasons Trip Is Not Easy (n = 68, asked only of students answering “no” to trip ease)

Reason	n	%
Distance	32	47.1
Cost	29	42.6
Other	7	10.3
Total	68	100.0

Table 5b. Infrastructure Features Rated “Poor,” Ranked

Feature	% Rating “Poor”
Bike parking	50.0
Bike lanes and routes	47.6
Condition of streets	43.4
Traffic calming measures	43.1
Crosswalks	39.7
Traffic congestion	34.0
Intersections	29.8
Sidewalks	29.9
Bus stops	26.7
Landscaping / streetscaping	26.4
Overall ease of travel	21.1

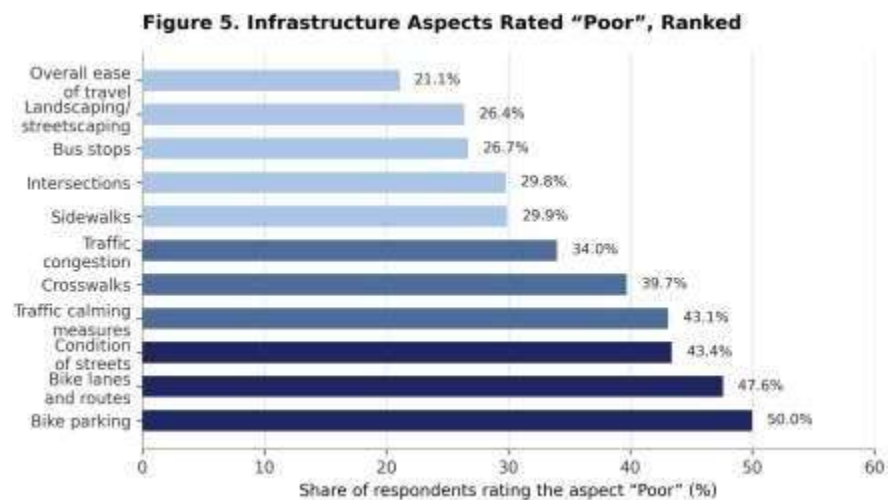


Figure 5. Infrastructure features rated “poor,” ranked. Real data.

4.6 Predictors of School Trip Duration: Ordered Logistic Regression

Because school trip duration has four ordered categories, the thesis estimated an Ordered Logistic Regression with duration as the dependent variable, entering route safety, road condition, mode of transportation, major transportation problem, frequency of public transportation use, and perceived stressfulness of cycling as predictors (Table 6). Coefficients are log-odds of reporting a longer rather than shorter trip-duration category; negative coefficients mean the predictor is associated with *shorter* trips.

Several factors were significantly associated with school travel time. Compared with walking, students who traveled by motorcycle ($b = -4.20$, $p = .01$), private car ($b = -3.32$, $p = .02$), or tricycle ($b = -2.53$, $p = .04$) reported significantly shorter trip durations. Road quality also influenced travel time; compared with very poor roads, good roads were associated with significantly shorter trips ($b = -3.49$, $p = .01$), whereas the effects of poor and very good roads were not statistically significant. Transportation challenges related to distance emerged as an important determinant of travel duration. Respondents who identified distance as their primary transportation problem experienced significantly longer trips than those citing cost or other barriers ($b = 4.10$, $p = .01$). Likewise, more frequent use of public transportation was associated with longer travel times ($b = 0.22$, $p < .001$). Perceptions of cycling stress were also significantly related to travel duration. Relative to respondents who strongly disagreed that cycling is stressful, those who strongly agreed ($b = -5.18$, $p = .03$), agreed ($b = -2.36$, $p = .03$), or disagreed ($b = -3.40$, $p = .01$) reported significantly shorter trip times. However, the relationship did not follow a consistent monotonic pattern across levels of agreement, suggesting that the observed association may reflect unmeasured contextual factors rather than a straightforward effect of perceived cycling stress.

Table 6. Ordered Logistic Regression: Predictors of School Trip Duration

Variable	Category (ref.)	Coef.	Std. Err.	Z	p
Route safety	Yes (ref: No)	-1.47	1.20	-1.22	.22
Road condition	Very Good (ref: Very Poor)	-0.46	1.08	-0.43	.67
	Good (ref: Very Poor)	-3.49	1.42	-2.45	.01
	Poor (ref: Very Poor)	-2.37	1.98	-1.20	.23
Mode of transport	Public Bus (ref: Walking)	0.65	1.57	0.42	.68
	Tricycle (ref: Walking)	-2.53	1.25	-2.02	.04
	Bicycle (ref: Walking)	1.03	3.64	0.28	.78
	Motorcycle (ref: Walking)	-4.20	1.70	-2.47	.01

	Taxi (ref: Walking)	−1.66	1.65	−1.01	.31
	Private Car (ref: Walking)	−3.32	1.39	−2.40	.02
	(ref: Walking)	−14.26	1523.10	−0.01	.99
Major problem	Cost (ref: Other)	0.59	0.94	0.63	.53
	Distance (ref: Other)	4.10	1.62	2.54	.01
Public transport use (per week)		0.22	0.05	4.09	<.001
Cycling stressful	Strongly Agree (ref: Strongly Disagree)	−5.18	2.31	−2.24	.03
	Agree (ref: Strongly Disagree)	−2.36	1.08	−2.18	.03
	Neutral (ref: Strongly Disagree)	−1.97	1.78	−1.11	.27
	Disagree (ref: Strongly Disagree)	−3.40	1.13	−3.01	.01

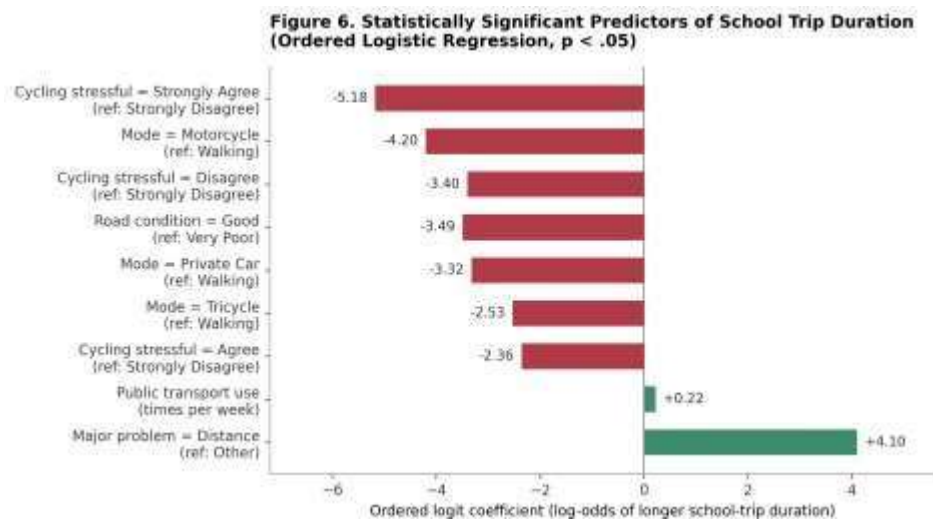


Figure 6. Statistically significant predictors of school trip duration ($p < .05$), ordered logistic regression. Real coefficients.

4.7 Implications for Sustainable Transportation Planning

Taken together, these findings reveal a transportation system dominated by private and informally-operated motorized modes (66.8% of trips by private car, tricycle, taxi, or motorcycle combined) even though active

transportation is essentially absent (4.0% combined for walking and cycling). Road condition and route safety both relate to trip ease, but only road condition's relationship is strong enough to be statistically distinguishable from chance at this sample size, and even that relationship is concentrated in the gap between “very poor” roads and everything else rather than a smooth gradient. The regression results in Section 4.6 point toward a specific, actionable pattern: mode and road-condition effects on trip duration are large and significant for several categories, while the “distance as major problem” and “public transport use frequency” effects suggest that students who experience their commute as distance-constrained, or who rely most heavily on public transport, are particularly exposed to longer trips. Infrastructure ratings (Table 5b) make the cycling-infrastructure gap concrete: bike lanes and bike parking are the two most poorly rated features in the entire instrument, a plausible part of the explanation for why cycling's mode share is effectively zero.

5. Discussion

5.1 Mode Choice Patterns in Context

The dominance of motorized transport for school trips in Nigerian contexts aligns with patterns observed in developing cities where infrastructure constraints and safety concerns shape transportation behavior (Mwale et al., 2024). However, the particularly low rates of active transportation distinguish Nigerian patterns from some other sub-Saharan African contexts where walking is more prevalent. This distinction reflects the specific challenges of Nigerian transportation environments, including severe road safety problems, inadequate pedestrian infrastructure, and the widespread availability of informal motorized transit (okada and keke napep) that provides affordable alternatives to walking. The findings contrast with developed country contexts where active school transportation has increased through comprehensive programs combining infrastructure improvements, safety initiatives, and behavior change campaigns (Chanpariyavatevong et al., 2024). These contrasts underscore the importance of context-specific approaches that address local infrastructure deficits rather than transplanting interventions from different contexts. The literature on active travel interventions consistently demonstrates that strategies must be adapted to local conditions, with environmental and policy interventions showing stronger effects than educational interventions alone (Chanpariyavatevong et al., 2024).

5.2 Infrastructure Quality as a Critical Determinant

The strong relationship between road condition and trip difficulty highlights infrastructure quality as a critical determinant of school transportation patterns. This finding aligns with broader evidence from developing countries demonstrating that infrastructure quality shapes transportation behavior, economic productivity, and quality of life (Mwale et al., 2024). Poor road conditions create cascading negative effects: longer trip times,

increased costs, higher accident risk, and reduced attractiveness of active transportation. Infrastructure improvements must address road surface quality, pedestrian facilities, traffic calming measures, lighting, and drainage. These improvements require substantial investment but offer multiple benefits beyond school transportation, including improved safety for all road users, reduced vehicle operating costs, and enhanced economic connectivity. Infrastructure investments should be prioritized in areas with high concentrations of schools, potentially through dedicated school zone improvement programs that create safe environments for students while also benefiting broader communities.

5.3 Safety as a Barrier and Opportunity

Safety concerns emerged as the primary barrier to active school transportation, consistent with international evidence (Wangzom et al., 2023). In Nigerian contexts, the severity of safety concerns reflects legitimate risks from poor infrastructure and weak enforcement. Road safety in LMICs requires attention to multiple levels of the Safe System framework, from strategic factors such as safety culture and management capacity to operational factors such as speed management and road surface quality (Godthelp & Ksentini, 2024). Addressing safety barriers requires multi-faceted approaches. Infrastructure improvements including traffic calming and pedestrian facilities can reduce objective risks. Enhanced enforcement of traffic regulations, particularly speed limits in school zones, can modify driver behavior. Road safety education, while facing implementation challenges in Nigerian contexts (Adenigbo, 2024), remains important for long-term behavior change, particularly if institutional and funding constraints can be addressed. School-specific interventions including designated school zones, crossing guards, and supervised walking groups can create safer environments. These interventions have demonstrated effectiveness in various contexts (Chanpariyavatevong et al., 2024) and could be adapted to Nigerian conditions.

5.4 Institutional and Policy Challenges

The findings reflect broader institutional challenges in Nigerian transportation governance, including policy fragmentation, limited coordination, inadequate funding, and weak enforcement (Adenigbo, 2024). These weaknesses undermine efforts to promote sustainable school transportation and represent systemic barriers that require sustained reform. The most significant challenges confronting effective road user education in Nigeria are institutional, participatory, and funding in nature (Adenigbo, 2024), suggesting that addressing school transportation sustainability requires institutional reform alongside physical infrastructure investment. Addressing institutional challenges requires reforms at multiple levels. National transportation policy should explicitly incorporate sustainable school transportation objectives with clear targets and accountability

mechanisms. Inter-agency coordination between transportation, education, and urban planning authorities should be strengthened through formal coordination structures. Funding mechanisms should be established to ensure sustained investment in school transportation infrastructure and safety programs. Local government capacity for transportation planning and management requires strengthening through technical assistance and capacity building programs.

5.5 Environmental and Climate Implications

The dominance of motorized transport for school trips contributes to Nigeria's transportation sector emissions. Nigeria's transport sector is entirely dependent on fossil fuels, making decarbonization a significant challenge that requires both technological transitions and behavioral changes (Akujor & Uzowuru, 2022). Shifting school transportation toward more sustainable modes, particularly active transportation and improved public transit, could yield meaningful emission reductions while providing co-benefits for health and educational access. However, sustainability considerations currently play minimal roles in school transportation decisions, overshadowed by safety and convenience concerns. Integrating sustainability requires making sustainable modes the safe and attractive options through infrastructure investment and policy support. The research underscores the need for climate action in Nigeria's transportation sector that specifically addresses school mobility as a significant component of urban transportation demand. School transportation policies that promote active travel and public transit not only reduce emissions but also contribute to the behavioral foundations for sustainable transportation throughout the life course.

5.6 Socioeconomic Dimensions and Equity

Socioeconomic factors clearly influence school trip patterns, with families with private vehicle access predominantly using cars for school trips while those without rely on public transit or walking. This socioeconomic stratification has implications for equity, as lower-income students may face longer, more difficult, and less safe trips. The concentration of road safety risks among lower-income students who depend on informal transit and walking represents a significant equity concern that transportation and education policy must address. Promoting sustainable school transportation must address equity dimensions explicitly. Public transit improvements, safe walking infrastructure, and school bus programs can provide sustainable options accessible to all families, potentially reducing socioeconomic disparities in school transportation quality. Policies that subsidize school transportation for low-income families can ensure that sustainability transitions do not exacerbate existing inequalities. The evidence from developing country contexts demonstrates that

sustainable transportation is achievable across income levels when appropriate infrastructure and services are provided (Mwale et al., 2024).

5.7 Comparative Perspectives and Lessons from Other Contexts

The findings align with research from other developing countries showing that infrastructure quality and safety concerns significantly influence school transportation patterns (Mwale et al., 2024). International evidence emphasizes comprehensive approaches combining infrastructure improvements, safety enhancements, education, and policy support (Chanpariyavatevong et al., 2024). While these principles apply to Nigerian contexts, implementation must be adapted to local conditions, resources, and institutional capacities. Successful examples from other developing countries and cities offer potential models for Nigeria. Safe Routes to School programs in various countries have demonstrated effectiveness in reducing accidents and increasing active travel rates. School bus systems in other African countries have improved transportation equity while reducing traffic congestion. These examples suggest that meaningful improvements in Nigerian school transportation are achievable with appropriate investment and institutional commitment, providing grounds for cautious optimism about the potential for sustainable school transportation transitions.

6. Conclusion and Recommendations

6.1 Summary of Key Findings

This research examined school trip mode choice and sustainable transportation patterns among secondary school students aged 10–18 years in Delta State and Ogun State, Nigeria. The study revealed several critical findings with significant implications for transportation policy, educational access, and sustainable development.

First, motorized transport dominates school trips in Nigerian contexts, even for relatively short distances that could theoretically be covered by active transportation. Private cars, motorcycles, tricycles, and taxis collectively account for the majority of school trips, while walking and cycling remain underutilized. This pattern reflects rational responses to infrastructure deficits and safety concerns rather than inherent preferences for motorized transport. Second, road condition and route safety emerged as critical determinants of mode choice, trip difficulty, and trip duration. Students using roads in poor condition experience substantially longer and more difficult trips, with approximately 73.1% of students on very poor roads reporting very difficult trips. Route safety perceptions strongly influence parental decisions regarding children's school transportation, with

perceived dangers leading to greater reliance on private motorized vehicles. Third, multiple barriers constrain active transportation adoption, including safety concerns (traffic and crime), infrastructure deficits (absent or inadequate sidewalks, crossings, lighting), distance perceptions, weather conditions, and social factors. These barriers interact to create environments where active transportation is perceived as unsafe, uncomfortable, or impractical, even when objectively feasible. Fourth, institutional and policy challenges, including weak coordination, inadequate funding, limited enforcement capacity, and absence of sustainable transportation frameworks, undermine efforts to promote sustainable school mobility. The transportation sector's complete dependence on fossil fuels (Akujor & Uzowuru, 2022) and the significant challenges facing road safety education (Adenigbo, 2024) represent systemic issues requiring comprehensive reform.

6.2 Policy Recommendations

Based on these findings, several evidence-based policy recommendations emerge for promoting sustainable school transportation in Nigerian and similar developing country contexts.

Infrastructure Investment: Substantial investment in transportation infrastructure is essential, prioritizing areas with high concentrations of schools. Infrastructure improvements should address road surface quality, pedestrian facilities, traffic calming measures, street lighting, and drainage. School zone improvement programs could provide frameworks for targeted investments that create safe environments for students while also benefiting broader communities.

Community School Development: Building schools closer to residential areas can reduce trip distances and enable active transportation. Land use planning should prioritize school accessibility, ensuring that students can reach schools within walking or cycling distance. This requires coordination between education and urban planning authorities to align school location decisions with transportation sustainability objectives.

School Bus Systems: Developing dedicated school bus systems could provide safe, affordable, and sustainable transportation options. Government provision of free or subsidized school buses with designated stops and trained safety personnel could reduce dependence on private vehicles while ensuring safe transportation. School buses should be equipped with appropriate safety features including seatbelts, first aid equipment, and fire extinguishers.

Safe Routes to School Programs: Implementing comprehensive safe routes to school programs could address multiple barriers to active transportation simultaneously. These programs should combine infrastructure improvements (traffic calming, improved crossings, sidewalk construction), traffic enforcement (speed limits, crossing guards), supervised walking groups, and safety education. Evidence from other countries demonstrates that such programs can significantly increase active travel rates while reducing accidents (Chanpariyavatevong et al., 2024).

Enhanced Road Safety Enforcement: Strengthening enforcement of traffic regulations, particularly in school zones, is essential for creating safer environments for students. This includes speed limit enforcement, pedestrian right-of-way protection, and penalties for dangerous driving near schools. Addressing the institutional, participatory, and funding challenges that undermine road safety education effectiveness (Adenigbo, 2024) is a prerequisite for sustained improvement.

Integration of Sustainability into Transportation Policy: National and state transportation policies should explicitly incorporate sustainable school transportation objectives, with clear targets and strategies for modal shift. This includes integrating school transportation into sustainable urban mobility plans, establishing funding mechanisms for green transportation infrastructure, and developing incentive structures that encourage active and public transit use.

Inter-Agency Coordination: Strengthening coordination between transportation, education, urban planning, and environmental authorities is essential for integrated approaches to school transportation sustainability. Joint planning processes and coordinated implementation can enhance effectiveness and ensure that investments in school transportation yield multiple co-benefits.

Capacity Building: Building technical and institutional capacity at national, state, and local levels is necessary for sustainable transportation planning and implementation. This includes training for transportation planners, strengthening local government capacity for infrastructure management and enforcement, and developing evidence-based monitoring systems to track progress toward sustainable school transportation goals.

6.3 Recommendations for Future Research

Several areas warrant further research. Longitudinal studies tracking mode choice patterns over time could reveal temporal trends and responses to interventions. Comparative research across diverse Nigerian regions and other sub-Saharan African countries could identify context-specific factors and generalizable patterns. Intervention studies evaluating specific programs, such as Safe Routes to School or school bus initiatives, could provide evidence on effectiveness and implementation challenges in Nigerian contexts. Research incorporating objective measures of infrastructure quality and direct observation of travel behavior could complement self-reported data and provide more precise estimates of infrastructure effects on mode choice. Qualitative research exploring stakeholder perspectives, including parents, students, school administrators, transportation providers, and government officials, could provide deeper insights into decision-making processes and barriers to sustainable transportation transitions. Research examining the economic costs and benefits of different school transportation systems could inform investment decisions and make the case for sustainable transportation more compelling to policymakers and funders.

6.4 Contributions and Implications

This research contributes empirical evidence on school trip mode choice in Nigerian contexts, addressing a significant gap in sub-Saharan African transportation literature. The findings have implications across multiple domains. For transportation planning, the research underscores the critical importance of infrastructure quality and safety in enabling sustainable mobility. For educational policy, the findings highlight how transportation challenges affect educational access and student experiences. For public health, the research reveals missed opportunities for promoting physical activity through active school transportation. For climate action, the findings demonstrate the need to integrate school transportation into broader sustainable mobility strategies, recognizing that the transportation sector's fossil fuel dependence (Akujor & Uzowuru, 2022) requires urgent attention.

6.5 Final Remarks

School transportation represents a critical intersection of sustainable development challenges and opportunities in developing countries. The dominance of motorized transport for school trips in Nigerian contexts reflects rational responses to infrastructure deficits and safety concerns rather than inherent preferences. Creating conditions for sustainable school transportation requires comprehensive approaches addressing infrastructure, safety, institutional capacity, and policy frameworks simultaneously. The path toward sustainable school transportation in Nigeria is challenging but achievable. It requires sustained commitment, substantial investment, institutional reforms, and integrated planning. The potential benefits includes: improved

educational access, enhanced safety, increased physical activity, reduced emissions, and more livable communities, justify these efforts and align with Nigeria's obligations under international frameworks including the Sustainable Development Goals and the Paris Agreement on climate change. As Nigeria and other developing countries pursue sustainable development goals, school transportation deserves greater attention as both a challenge requiring solutions and an opportunity for demonstrating sustainable mobility transitions. The evidence presented provides a foundation for informed policy decisions and targeted interventions to promote sustainable, safe, and equitable school transportation systems that serve the needs of current and future generations.

References

- Adenigbo, A. J. (2024). Challenges to effective road user education in reducing road traffic accidents in Nigeria. *Journal of Sustainable Development of Transport and Logistics*, 9(2), 6–20. <https://doi.org/10.14254/jsdtl.2024.9-2.1>
- Akujor, C. E., & Uzowuru, E. E. (2022). Decarbonisation of the transport sector in Nigeria. *Environmental Health Insights*, 16, 11786302221125039. <https://doi.org/10.1177/11786302221125039>
- Chanpariyavatevong, K., Champahom, T., Jomnonkwao, S., Chonsalasin, D., & Ratanavaraha, V. (2024). The intervention design to promote active travel mode among children and adolescents: A systematic review. *Heliyon*, 10(4), e26072. <https://doi.org/10.1016/j.heliyon.2024.e26072>
- Federal Government of Nigeria. (2010). *Draft national transport policy*. Federal Ministry of Transport.
- Godthelp, H., & Ksentini, A. (2024). Specific road safety issues in low- and middle income countries (LMICs): An overview and some illustrative examples. *Traffic Safety Research*, 8, e000068. <https://doi.org/10.55329/sdtu9515>
- Graham, F., Rodger, S., & Ziviani, J. (2014). Enabling occupational performance of children through coaching parents: Three case reports. *Physical & Occupational Therapy in Pediatrics*, 34(1), 4–19. <https://doi.org/10.3109/01942638.2013.784993>
- Mwale, M., Pisa, N., & Luke, R. (2024). Travel mode choices of residents in developing cities: A case study of Lusaka, Zambia. *Journal of Transport and Supply Chain Management*, 18(0), a1005. <https://doi.org/10.4102/jtscm.v18i0.1005>
- Nasrudin, N. (2014). Sustainable transportation: Definition, principles and implementation. *Procedia Social and Behavioral Sciences*, 153, 149–155.
- Vasconcellos, E. A. (2016). *Urban transport, environment and equity: The case for developing countries*. Earthscan/Routledge.

Wangzom, D., White, M., & Trubka, R. (2023). Perceived safety influencing active travel to school, A built environment perspective. *International Journal of Environmental Research and Public Health*, 20(2), 1026. <https://doi.org/10.3390/ijerph20021026>

World Health Organization. (2002). *Physical activity and health in Europe: Evidence for action*. WHO Regional Office for Europe.

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