Evaluation of Pedestrian Safety on Highway Infrastructure in Ibadan

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Article Info	ABSTRACT
	Pedestrian safety is becoming increasingly important in metropolitan settings, especially in developing nations like Nigeria. This study examines the pedestrian safety state in Ibadan, Nigeria, highlighting the main difficulties and hazards pedestrians confront. A mixed-methods approach was used, combining quantitative and qualitative data gathering and analysis techniques. Five hundred people shared their experiences. The study revealed that 48% of respondents rated the roads as fair, while 27% described them as poor and 6% as very poor, citing concerns such as poor road design, inadequate pedestrian facilities, and careless driver behaviour as major safety issues for walkers. Pedestrians are most worried about poor traffic control, a lack of pedestrian bridges, and inadequate lighting. The study identified particular Ibadan streets that desperately require improvements for pedestrian safety. The findings of this research emphasize the need for a comprehensive plan to tackle the challenging issues regarding pedestrian safety in Ibadan. Enhancing pedestrian safety should be regarded as a primary concern; this may include appropriate pedestrian infrastructure, better road design, and more effective traffic management, for policymakers, urban planners and other interested parties. The study contributes to the information already available on pedestrian safety in Nigeria and provides practical analysis for improving pedestrian safety

INTRODUCTION

Since pedestrians account for a large portion of traffic deaths on roadways, pedestrian safety is a big problem globally. Likewise, pedestrians face multiple dangers traversing Nigerian roads. Being a major Nigerian city centre, Ibadan shares some challenges with pedestrian safety. Pedestrian injuries and fatalities are a major public health concern for the World Health Organisation (WHO) given that more than 270,000 pedestrians perished on roads across the world in 2019 (WHO, 2019). According to FRSC 2020 reports for Nigeria, pedestrians accounted for 22% of road traffic deaths in 2020. Among the multiple variables contributing to the pedestrian safety concerns on Ibadan's roads are inadequate road design, reckless driver conduct and inadequate pedestrian infrastructure. For

instance, a (2017) Oluwaseyi *et al.* study revealed that inadequate lighting, poor road maintenance and the lack of walkways and crossings were major determinants of pedestrian accidents in Ibadan. Furthermore, the lack of good traffic management worsens the already bad condition brought on by the growing number of vehicles on the road. Adebayo *et al.*'s (2015) study found that increased traffic congestion from Ibadan's rapid increase in vehicle ownership and use raises the risk of pedestrian accidents.

Pedestrian safety depends on conduct as much as it does on infrastructure. According to a (2017) Akinwande *et al.* research, pedestrian behaviour, including jaywalking and distracted walking, greatly contributes to pedestrian accidents in

Ibadan. Highways in Ibadan still pose a major threat to pedestrians despite rising concern about pedestrian safety; insufficient safety infrastructure, bad road design, and dangerous behaviours combine to produce a high rate of pedestrian accidents and fatalities. There is a considerable information vacuum in Ibadan, Nigeria. The absence of a complete evaluation of pedestrian safety measures on Ibadan's roads impedes the development of effective answers to address this significant public health concern. Though earlier studies have investigated pedestrian safety in other parts of the world, few have focused on the particular problems pedestrians in Ibadan face. Given Nigeria's high rate of pedestrian accidents and fatalities, this scarcity of studies is particularly disappointing.

Particularly, there is scant research on the current state of pedestrian safety devices installed on Ibadan's roads. This excludes studies on the impact of traffic control and road design on pedestrian safety as well as the role pedestrian awareness and behaviour contribute to accident avoidance. Moreover, very little is known about how effectively existing Ibadan walking safety enhancement plans and programs are operating. Considering the disparate numbers of pedestrian fatalities in African countries—especially Nigeria—this research gap is particularly surprising. According to the World Health Organisation (2018), few studies on this topic have been conducted in Africa despite the continent accounting for a significant portion of global walking fatalities. This research aims to evaluate the highway pedestrian safety infrastructure in Ibadan, Nigeria, close this knowledge gap, and point out development areas to lower pedestrian risks and promote safe and accessible mobility for all.

This research is important because it might help decrease highway pedestrian accidents and fatalities in Ibadan, Nigeria. By emphasizing areas where pedestrian safety infrastructure needs to be improved, this study will aid in road safety policy and decision-making in Ibadan, thereby preserving lives and lowering injuries. This study should help to improve road safety in Ibadan, which is important for promoting sustainable development and quality of life in the city. By examining the current state of pedestrian safety infrastructure and identifying effective enhancement methods, this study will help to build a better and more accessible transportation system for all residents and visitors. As stated in the Sustainable Development Goals (SDGs) of the United Nations, this research can also support the worldwide endeavour to lower road traffic injuries and fatalities. By tackling the knowledge gap on pedestrian safety infrastructure in Ibadan, this study can offer insightful analysis for urban planners, legislators, and stakeholders trying to enhance road safety in similar settings. This research also offers urban design and development insights for Ibadan by emphasizing the requirement of pedestrian-centric design and infrastructure development prioritizing safety and accessibility. This research will help to improve the general quality of life for visitors and residents of Ibadan by encouraging safe and easy mobility, therefore allowing them to navigate the city freely and securely.

METHODOLOGY

Research Design

The study uses a descriptive survey design combining qualitative and quantitative methods. This design is appropriate for gathering precise, measurable information on pedestrian safety infrastructure present condition, road design and traffic management on pedestrian safety, and for maximising improvement by means of effective strategies. To give a complete view of the problems, the research also consists of observational evaluations and interviews with interested parties.

Study Area

The study was done in Ibadan, the capital city of Oyo State, Nigeria. Ibadan is located on a hilly terrain; It has an elevation of about 210 meters above sea level. It is located between latitudes 7° 05N and 7° 25N and longitudes 32 °40 E and 32° 55 E and lies approximately at a distance of 145 kilometres northeast of Lagos, as shown in Figure 1. It is one of the largest cities in West Africa, with a diverse mix of urban and suburban environments, and several major highways traversing its landscape. These highways, such as Lagos-Ibadan Expressway, as shown in Figure 2, Ibadan-Ife Road, as shown in Figure 3, and the Ibadan-Abeokuta Road, as shown in Figure 4, are critical to the study due to their high pedestrian usage and the frequency of pedestrian-related accidents. The choice of these locations is based on preliminary data suggesting significant safety challenges for pedestrians.
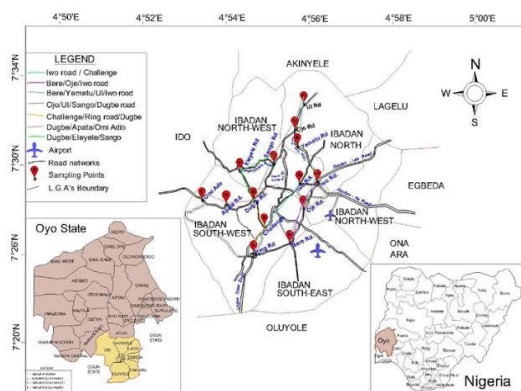

Figure 1: Map of Oyo State showing selected centers for the study

Figure 2: Lagos-Ibadan Expressway (Left Side)

Figure 3: Ibadan-Ife Road (T-Junction)

Figure 4: Ibadan Abeokuta Road

Population and Sample Size

The target population for this study consists of pedestrians who are regular users of highways in Ibadan, as well as key stakeholders (e.g., traffic management authorities, road safety officers, urban planners, and residents). We used the Yamane Formula (1967) for finite populations to arrive at both a suitable sample size and a statistically significant sample of the described population, defined as:

$$N = \frac{N}{1+N(e^2)} \qquad (1)$$

Where:

n = sample size

N = estimated population

e = margin of error (0.05 for 95% confidence level)

Using the expected pedestrian user population and stakeholders estimated at over 1000 people within the study area, we were able to derive a sample size of approximately 150 pedestrians using the Yamane formula. In addition to the estimated 150 pedestrians, we purposively selected 50 stakeholders as well. Stakeholders were selected due to their job responsibilities in highway safety and highway infrastructure. This included both selective and purposeful sampling for a statistically significant sample and a practical sample that can help with analysis and extrapolation of results to other urban highway safety relevance. This sample size permits significant analysis and generalization of results to the more general population.

Sampling Technique

This research employs a multi-stage sampling method. Initially, specific roads with recognized pedestrian traffic and safety concerns are chosen using purposive sampling. Then, systematic random sampling is used to choose pedestrians at various intervals along these roadways. For stakeholder interviews, purposive sampling guarantees that only people with pertinent knowledge or interest in road safety are included.

Data Collection Methods

Data gathering consists of both primary and secondary source inquiry. Quantitative data is gathered from pedestrians along the chosen highways using structured questionnaires; qualitative information is obtained from stakeholders via semi-structured interviews. Observational evaluations of the physical state of pedestrian infrastructure are also carried out. Secondary data is gathered from traffic control records, road safety inspections, and official government reports. These sources offer supplementary primary data and contextual background.

Instrumentation

Research tools consist of an interview guide for stakeholder discussions and a structured questionnaire meant to gather data on pedestrian safety infrastructure and behaviour. The survey has both closed and open-ended questions organized in sections matching the research goals. The interview guide aims to help with in-depth conversations on certain safety concerns and possible solutions. Instruments are pre-tested for reliability, relevance, and clarity.

Survey Schedule

Planned to reflect various traffic patterns throughout the day and week, the survey was conducted during the morning (7:00 AM - 9:00 AM) and evening (4:00 PM - 6:00 PM) rush hours to record the peak volumes. Additional surveys were conducted during off-peak hours (10:00 AM - 12:00 PM) to assess differences in traffic density. Weekdays and Weekends: The survey included both weekdays and weekends to capture variations in traffic conditions.

Data Analysis Techniques

Descriptive and inferential statistical techniques frequencies, percentages, mean comparisons, chi-square tests, and regression analysis, are used to examine relationships between variables in quantitative data from the questionnaires. Thematic analysis, which uses coding answers to highlight patterns and themes about pedestrian safety, qualifies data from interviews. Combining quantitative and qualitative results gives a whole view of the problems.

Validity and Reliability

Expert review and pilot testing of the questionnaire and interview guide help to guarantee the validity and reliability of the research tools. Aligning the questions with the goals of the research helps to build content validity. Factor analysis evaluates

construct validity; reliability is measured using Cronbach's alpha, with a target value of 0.7 or higher indicating acceptable internal consistency.

Ethical Considerations

Ethical considerations are important in this study. Informed consent is obtained from all participants, ensuring they know the study's purpose and their right to withdraw at any time. Confidentiality is strictly upheld, with all data anonymised before analysis.

RESULTS AND DISCUSSION

Socio-demographics of Respondents

Table 1 shows that about half (52%) of respondents were female, and the majority (86%) were within the age group 18- 29 years, while 3% were aged 50 years and above.

Table 1: Socio-demographics of Respondents

Variables		n (%)
Gender	Male	48 (48%)
	Female	52 (52%)
Age group	18-29years	86 (86%)
	30-39years	11 (11%)
	40-49years	0 (0%)
	50years and above	3 (3%)
Occupation	Unemployed	9 (9%)
	Students	35 (35%)
	Self-employed	14 (14%)
	Graduate	1 (1%)
	Employed	40 (40%)
	Others (Serving Corp member)	1 (1%)
Frequency of highway use		
	Never	4 (4%)
	Rarely	26 (26%)
	Daily	40 (40%)
	Weekly	21 (21%)
	Monthly	9 (9%)

Less than half (40%) of respondents were employed, while 1% was a serving Corps member. About two-fifths (40%) of respondents claimed to use highways daily, while 4% never used the highway.

Assessment of Pedestrian Safety Infrastructure

The assessment of pedestrian safety infrastructure is a critical aspect of enhancing safety measures for susceptible road users. Figure 5 reveals that approximately 40% of respondents rated the condition of pedestrian crossings on highways in Ibadan as "fair," while only 1% rated it as "very good." This shows that there is a large room for improvement in the condition and safety of pedestrian crossings in Ibadan.
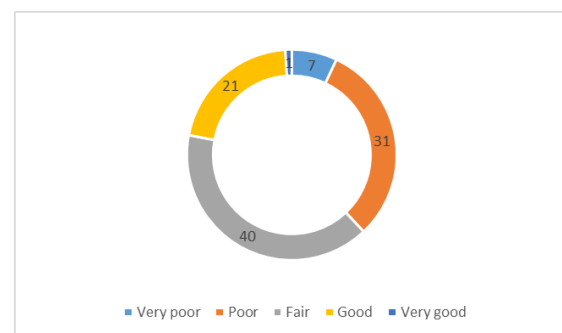

Figure 5: Assessment of the Current Pedestrian Safety on Highways in Ibadan

This result supports earlier studies stressing how crucial pedestrian infrastructure is for lowering the risk of pedestrian crashes (World Health Organisation, 2018). Miranda-Moreno *et al.* (2011) found that pedestrian crossings and other safety elements could greatly reduce the likelihood of pedestrian injury. Akinwuntan *et al.* (2017) claim that inadequate funding, poor maintenance and disregard of pedestrian safety may all help to explain the terrible condition of pedestrian crossings in Ibadan. The result of this research emphasises the growing importance of improving investment in pedestrian safety infrastructure and the regular

maintenance of pedestrian crossings. The findings indicate a possible disparity between the actual condition of pedestrian crossings and their perceived safety. Supporting this is research by Zhou *et al*. (2018) on components, including traffic volume, road design and safety features, all influencing pedestrians' views of safety.

Figure 6 shows that 68% of those surveyed thought pedestrian paths along frequently travelled roads were insufficient. Additionally, 12% of those surveyed were uncertain whether pedestrian walkways were adequate. This suggests that walkers in Ibadan feel there is a severe shortage of suitable walking routes along important highways.
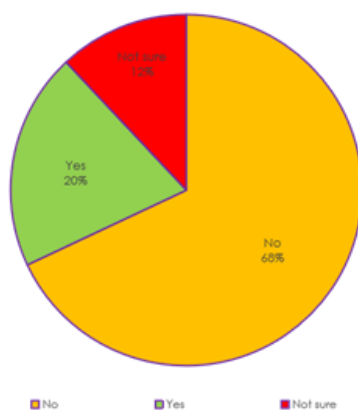

Figure 6: Sufficiency of pedestrian walkways along the highways

This result aligns with recent studies highlighting the importance of proper pedestrian facilities in ensuring pedestrian safety and mobility. The study by Wang *et al*. (2020) found that considerably reducing the likelihood of pedestrian collisions comes from sidewalks and pedestrian walkways. Similarly, a 2019 study by Dias *et al*. emphasises the need for adequate walking routes and crossings, pedestrian infrastructure to promote pedestrian safety.

Poor urban design, lack of funding and neglect of pedestrian safety (Akinwuntan *et al*., 2017) are among several factors that could help explain the insufficiency of pedestrian walkways in Ibadan. The results of this study emphasise the need to improve funding for pedestrian facilities and proper sidewalks along highways. The results also suggest that Ibadan's lack of proper pedestrian paths might put pedestrians at risk. Supporting this is Zhou *et al*. (2018) research showing that pedestrians strolling along roadways without sidewalks or walkways slip more frequently to be engaged in crashes.

Figure 7 shows that about half (48%) of respondents expressed "fair" regarding the accessibility of other pedestrian safety equipment, such as traffic signals on Ibadan streets and pedestrian bridges. Only 2% of respondents rated these features as "very good." This suggests that pedestrians in Ibadan believe there is a severe deficit of suitable pedestrian safety features on highways.
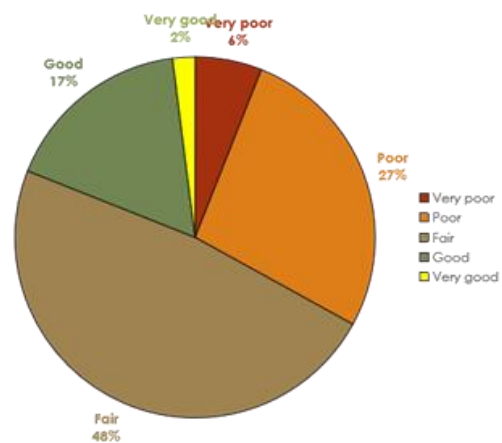

Figure 7: Rating of availability of other pedestrian safety features (e.g., pedestrian bridges, traffic signals) on highways in Ibadan

This finding is in line with a (2017) Akinwuntan *et al*. study that the lack of pedestrian safety devices, such as traffic signals and bridges, largely contributes to pedestrian accidents in Nigeria. The

authors emphasised how important better financing of pedestrian safety infrastructure was for reducing the probability of pedestrian incidents.

The findings of this study are further supported by Zhou *et al.*'s (2018) study, which found that the inclusion of pedestrian safety features such as traffic signals and pedestrian bridges can significantly reduce the probability of pedestrian accidents. The authors argued that providing these features would promote pedestrian movement and safety.

55% percent of respondents in Figure 8 expressed worries about the condition of or missing pedestrian safety devices on Ibadan roads. Still, 21% of respondents reported that such qualities exist, giving examples of blocked pedestrian walkways, broken or missing pedestrian bridges and inadequate security measures.
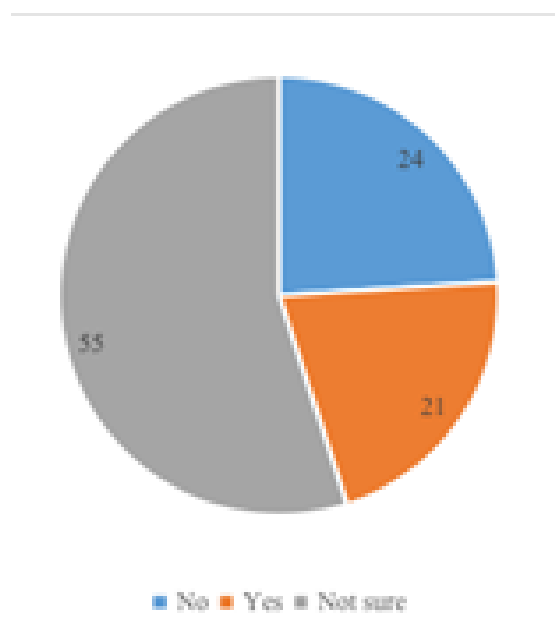

Figure 8: Presence of damaged or missing pedestrian safety features on highways in Ibadan

This finding supports studies by Miranda-Moreno *et al.* (2011) in the magazine Accident Analysis and Prevention, which shows that broken or missing

pedestrian safety facilities could largely increase the risk of pedestrian accidents. To guarantee their effectiveness, the need for regular maintenance and inspection of pedestrian safety devices was emphasised.

Anciaes *et al.*'s (2016) study, published in the journal Transportation Research Part F: Traffic Psychology and Behaviour, supports reports from respondents of broken or missing pedestrian bridges, inadequate safety devices, and congested pedestrian walkways. The authors found that pedestrians' perceptions of safety depend on the condition and presence of pedestrian amenities such as bridges and pathways. Moreover, the fact that 55% of respondents didn't know whether there were damaged or missing pedestrian safety components highlights the urgent need for improved public awareness and education on pedestrian safety issues. Published in the Journal of Safety Research, Zhou *et al.* (2018) investigation is consistent with this finding that pedestrian accidents can be decreased by public awareness and education initiatives.

Effects of Road Design and Traffic Management on Pedestrian Safety in Ibadan

A key component of guaranteeing the safety of vulnerable road users is the influence of road design and traffic control on pedestrian safety. The results of this study in Table 2 show that about half (49%) of respondents rated speed limits as effective in protecting pedestrians on highways in Ibadan, while 7% rated them as very ineffective.

This finding is in accordance with a study by Elvik *et al.* (2009) published in the journal Accident Analysis and Prevention, which found that speed limits can be an effective measure in reducing pedestrian crashes. However, the authors noted that the effectiveness of speed limits depends on various

factors, including enforcement, road design, and driver behaviour.

Table 2: Impact of Road Design and Traffic Management on Pedestrian Safety in Ibadan

Variables	N (%)
Effectiveness of speed limits in protecting pedestrians on highways	
Very Effective	8 (8%)
Effective	21 (21%)
Neutral	49 (49%)
Ineffective	15 (15%)
Very Ineffective	7 (7%)
Impact of traffic volume on pedestrian safety on highways	
Very High Impact	10 (10%)
High Impact	34 (34%)
Moderate Impact	47 (47%)
Low Impact	9 (9%)
No Impact	0 (0%)
Do you believe the road geometry (e.g., curves, slopes) of highways in Ibadan contributes to pedestrian accidents?	
Yes	53 (53 %)
No	22 (22%)
Not Sure	25 (25%)

Regarding the impact of traffic volume on pedestrian safety, about 47% of respondents rated it as moderate, while 9% rated it as low. This result is supported by a study by Karndumri *et al*. (2017) published in the Journal of Transportation Engineering, which found that high traffic volumes can increase the risk of pedestrian crashes. Notably, the finding that about half (53%) of respondents believed that road geometry (e.g., curves, slopes) contributes to pedestrian accidents is in agreement with a study by Anciaes *et al*. (2016) published in the journal Transportation Research Part F: Traffic Psychology and Behaviour. The authors discovered that road design features, such as curves and slopes, can raise the likelihood of pedestrian crashes by reducing visibility and increasing vehicle speeds.

Role of Pedestrian Behaviour and Awareness in Preventing Crashes

Table 3 shows that most respondents 88%, do not often wear safety equipment while strolling along Ibadan highways. This result is in line with a 2010 article in the journal Accident Analysis and Prevention by Oxley *et al*. Concerning traffic rule compliance, around 68% of those surveyed said they always or sometimes followed traffic regulations while crossing highways; 4% never followed traffic rules. Published in the Journal of Safety Research,

Zhou *et al*.'s (2018) study further confirms this result by demonstrating that pedestrians' following of traffic regulations including waiting for signals and utilizing crosswalks greatly lowers their crash risk.

Table 3: Role of Pedestrian Behav iour and Awareness in Preventing Crashes

Variables	n (%)
Do you regularly use safety gear (e.g., reflective clothing) when walking on highways in Ibadan?	
Yes	12 (12%)
No	88 (88%)
How often do you adhere to traffic rules (e.g., using crosswalks, waiting for traffic signals) when crossing highways in Ibadan?	
Always	34 (34%)
Often	34 (34%)
Sometimes	22 (22%)
Rarely	6 (6%)
Never	4 (4%)
Rate your knowledge of pedestrian safety measures on highways	
VeryGood	10 (10%)
Good	37 (37%)
Fair	43 (43%)
Poor	10 (10%)
Very Poor	0 (0%)
Have you ever received any formal education or training on pedestrian safety?	
Yes	38 (38%)
No	62 (62%)

The fact that almost 43% of those surveyed rated their familiarity with highway pedestrian safety measures as "fair" implies that better education and awareness initiatives might be needed to advance pedestrian safety. This is in line with a (2016) Anciaes *et al*. study published in the journal Transportation Research Part F: Traffic Psychology and Behaviour, which found that pedestrians' behaviour and risk of being involved in a crash can be shaped by their knowledge and awareness of safety measures.

The finding that more than half (62%) of survey respondents have not received any formal Training or instruction on pedestrian safety also stresses the need for concentrated Projects increasing pedestrian safety awareness and knowledge published in the Journal of Transportation Engineering, Karndumri *et al*.'s (2017) study supports this assertion by showing awareness initiatives and automobile safety training can greatly reduce pedestrian accidents

Effective Strategies and Interventions/Recommendations for Improvement of Pedestrian Safety in Ibadan

An astonishing 81% of those surveyed said better walkways should be a main priority for enhancing pedestrian safety in Ibadan, according to Table 4. This result supports recent studies stressing how crucial pedestrian-friendly infrastructure is for lowering the risk of pedestrian accidents.

Table 4: Improvements most needed to enhance pedestrian safety on highways in Ibadan

Variables	n (%)
More pedestrian crossings	71 (71%)
Better walkways	81 (81%)
Improved road design	69 (69%)
Stricter enforcement of speed limits	67 (67%)
Public awareness campaigns	64 (64%)
Others (Restrictions on drivers passing one-way)	1 (1%)

A study by Anciaes *et al.* (2020) published in the journal Transportation Research Part A: General, found that the provision of dedicated pedestrian walkways can significantly reduce the risk of pedestrian crashes. The authors said that properly planned walkways could lower vehicle-pedestrian conflicts and hence enhance pedestrian safety. Published in the Journal of Transportation Engineering, Part A: Systems, Karndumri *et al.*'s (2020) study further shows that pedestrian safety can be much enhanced by pedestrian-friendly facilities such as crossings, walkways, and signals. The writers stressed the requirement for urban planners and legislators to give pedestrian-friendly infrastructure design and execution top priority.

The fact that just 1% of respondents suggested other approaches—such as driver restrictions on passing one-way—indicates either a lack of knowledge or understanding of different techniques to increase pedestrian safety. This emphasises the importance of awareness and educational initiatives aimed at promoting several approaches for enhancing pedestrian safety.

The answers to the inquiry regarding particular roads in Ibadan where urgent pedestrian safety enhancements are needed show a blend of yes and no answers. The most often used non-affirmative answers—which are "No," "None," "Not sure," and "Maybe"—imply that some respondents may not know or lack a definite view on which highways need pedestrian safety upgrades. Still, the positive replies naming specific roads—Iwo Road, Ojoo-Iwo Road, Ojoo Expressway, Iwo Road roundabout, and Mokola/Mokola roundabout—imply that these regions could be seen as especially risky for pedestrians. This aligns with research that has shown that certain road features, such as roundabouts and expressways, can be challenging for pedestrians to navigate safely (Anciaes *et al.*, 2016). The identification of certain roads that call for improvement in pedestrian safety emphasises the importance of this study to solve the specific safety issues caused by these locations. This could call for the application of particular safety precautions, such as enhanced lighting, better signs and pedestrian infrastructure, as well as public awareness campaigns to inform pedestrians and drivers about safe road use practices.

CONCLUSIONS

The results emphasise the requirement for better pedestrian facilities, including better walkways, crossings and signals. The research also highlights the need to handle road design and traffic control problems, including speed limits and traffic volume, to lower the risk of pedestrian accidents. It shows

how important pedestrian awareness and conduct are for avoiding accidents. The results also show an increased risk of pedestrians being in a collision resulting from the lack of or neglect of safety equipment, traffic regulations and knowledge and awareness of safety measures. The identification of certain roads in Ibadan that urgently need enhancements for pedestrian safety emphasises the need for focused efforts to solve the safety difficulties presented by these locations.

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