RESILIENCE AND LIVABLE CITIES IN A WARMING WORLD

A FESTSCHRIFT IN HONOUR OF

TPL. DR. JOSHUA ADEWUMI ADEBISI FNITP, RTP

EDITED BY

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TABLE OF CONTENTS

SECTION FIVE: DIGITAL INNOVATION AND SMART URBAN ADAPTATION

SECTION SIX: INCLUSIVE AND PARTICIPATORY URBAN GOVERNANCE

SECTION SEVEN: HEALTH, WATER, SANITATION AND URBAN WASTE

SECTION EIGHT: PUBLIC SPACE, HOUSING AND LAND USE PLANNING

SECTION NINE: RISK REDUCTION AND DISASTER-RESILIENT CITIES

SECTION TEN: URBAN MOBILITY AND LOW CARBON TRANSPORT

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CHAPTER 26

ROAD INFRASTRUCTURE VULNERABILITY AND URBAN MOBILITY SAFETY RISKS IN SOUTHWESTERN NIGERIAN CITIES

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Abstract

Road infrastructure vulnerability and urban mobility safety risks have emerged as critical challenges confronting cities in Southwestern Nigeria, where rapid urbanisation, increasing motorisation and inadequate investment in transport infrastructure continue to undermine safe, efficient and sustainable urban mobility. This study assessed the nature of road infrastructure vulnerability, examined associated urban mobility safety risks and identified priority measures for mitigating these risks across selected Southwestern Nigerian cities. A cross-sectional survey design was adopted using a structured electronic questionnaire administered through convenience sampling. Out of 1,671 respondents, 1,267 (76%) completed the survey and were retained for analysis. Data were analysed using descriptive statistics, weighted mean analysis, and ranking techniques. The findings revealed that potholes, eroded road shoulders, inadequate drainage systems, flood-prone road segments, and narrow or capacity-deficient carriageways constitute the most prevalent forms of road infrastructure vulnerability across the study area. These deficiencies compromise urban mobility by disrupting traffic operations, reducing roadway capacity, increasing vehicle conflicts and exposing pedestrians, cyclists and other vulnerable road users to heightened safety risks. The study further identified critical mobility safety risks associated with both infrastructural and behavioural factors, including drivers swerving to avoid potholes, speeding, risky overtaking, unsafe lane and carriageway crossing, roadway encroachment by informal activities, infrastructure vandalisation and inadequate pedestrian facilities. Respondents identified comprehensive pavement rehabilitation, improved drainage and street lighting, provision of safe pedestrian infrastructure, strengthened road safety education, enhanced traffic law enforcement and improved institutional coordination as the most effective measures for reducing mobility safety risks. The study concludes that addressing urban mobility safety risks in Southwestern Nigerian cities requires an integrated, infrastructure-led and evidence-based transport planning approach that combines resilient road infrastructure investment with effective governance, proactive maintenance, behavioural interventions, and coordinated institutional management. The findings provide valuable empirical evidence for transport policy formulation, infrastructure investment prioritisation, and road safety planning aimed at improving urban resilience and fostering safer, more inclusive and sustainable mobility systems in alignment with Sustainable Development Goals (SDGs) 3, 9 and 11.

Keywords: Road infrastructure vulnerability, urban mobility safety, road safety, transport planning, sustainable mobility, Southwestern Nigeria

1.0 Introduction

Urbanisation has fundamentally reshaped the spatial, economic, and social structure of cities worldwide, transforming them into centres of economic productivity, innovation, and human interaction. Since the Industrial Revolution, cities have experienced unprecedented population growth, expanding travel demand and increasing dependence on transport infrastructure to sustain economic activities and improve accessibility. Consequently, the efficiency, quality, and resilience of urban transport systems have become critical determinants of sustainable urban development, social inclusion and economic competitiveness (Rodrigue, Comtois & Slack, 2016). According to the United Nations (2014), more than half of the world's population currently resides in urban areas, a figure projected to increase to nearly 68% by 2050, with approximately 95% of future urban growth occurring in developing countries, particularly across Sub-Saharan Africa (UN-Habitat, 2016). This rapid urban expansion has intensified pressure on existing transport infrastructure, particularly road networks, which remain the dominant mode of urban mobility in most developing countries.

Urban mobility represents the ability of people and goods to move safely, efficiently, affordably, and sustainably within urban environments. It serves as a fundamental driver of economic productivity, accessibility to employment, education, healthcare and social interaction while supporting the overall functionality of cities (Akanmu & Salisu, 2024; Salisu, Odewumi & Abdul-Azeez, 2023). However, the effectiveness of urban mobility depends largely on the quality, availability, and resilience of transport infrastructure. Where road infrastructure deteriorates or becomes vulnerable to physical degradation and environmental stressors, mobility systems become less reliable, less efficient and increasingly unsafe for all categories of road users. Consequently, road infrastructure vulnerability has emerged as a major determinant of urban mobility safety, particularly in rapidly urbanising cities where infrastructure development has failed to keep pace with increasing travel demand.

Road infrastructure vulnerability refers to the susceptibility of transport infrastructure to physical deterioration, environmental hazards, operational deficiencies, and institutional neglect that impair its functionality, safety and resilience. Manifestations such as potholes, pavement failures, eroded shoulders, inadequate drainage systems, flood-prone road sections, narrow carriageways, poor road geometry and deficient pedestrian facilities reduce roadway performance and significantly increase the likelihood of crashes, traffic conflicts, travel delays, and infrastructure failures. These vulnerabilities are further intensified by climate variability, recurrent flooding, poor maintenance culture, overloading by heavy-duty vehicles, weak enforcement of engineering standards and inadequate investment in transport infrastructure renewal.

In Nigeria, where road transport accounts for more than 90% of passenger and freight movement (Federal Ministry of Transport, 2021), the implications of deteriorating road infrastructure extend beyond mobility inefficiencies to encompass significant public safety, economic and environmental challenges. Rapid urbanisation,

increasing motorisation and expanding metropolitan regions have substantially increased demand for road infrastructure without corresponding investments in road expansion, rehabilitation, or maintenance. Consequently, many urban roads are characterised by deteriorating pavements, inadequate drainage, insufficient traffic control devices, poor geometric design and limited pedestrian infrastructure, creating hazardous operating conditions that expose motorists, pedestrians, cyclists, and public transport users to elevated mobility safety risks (Adewumi & Alade, 2020).

These challenges are particularly evident in Southwestern Nigeria, one of the country's most economically vibrant and rapidly urbanising regions. Cities such as Lagos, Ibadan and Abeokuta continue to experience accelerated population growth, increasing vehicle ownership, expanding commercial activities, and rising freight movements, all of which place enormous pressure on ageing road infrastructure (Oyesiku, 1998; UN-Habitat, 2022). Simultaneously, climate-induced flooding, encroachment on road reserves, inadequate drainage systems, informal roadside commercial activities and insufficient maintenance have accelerated infrastructure deterioration, thereby increasing mobility safety risks across urban road networks (Olanrewaju & Adebayo, 2021; Ogunsesan, Akanmu, & Salisu, 2024). The consequences include frequent traffic congestion, vehicle damage, unpredictable travel times, increased crash exposure and rising transport costs, all of which undermine urban productivity and residents' quality of life.

The burden of infrastructure vulnerability is disproportionately borne by vulnerable road users, including pedestrians, cyclists, children, older adults and persons with disabilities. In many Nigerian cities, sidewalks are either absent or encroached upon by commercial activities, pedestrian crossings are inadequate, street lighting is insufficient and traffic calming facilities are poorly maintained. Consequently, pedestrians are often compelled to share road space with motorised traffic, substantially increasing their exposure to crashes and injuries. Similarly, operators of informal transport modes, including motorcycles, tricycles, minibuses and commercial buses, navigate deteriorating road conditions that compromise operational safety while simultaneously contributing to accelerated pavement deterioration through intensive road usage (Oladeji, 2020; Fasina, Salisu & Akanmu, 2021). The interaction between deteriorating infrastructure, risky driving behaviour, inadequate regulation and weak institutional capacity has created increasingly unsafe urban mobility environments across the region.

Despite growing recognition of these challenges, existing studies in Nigeria have predominantly examined road traffic crashes, congestion, or transport operations in isolation, with relatively limited attention devoted to the interrelationships between road infrastructure vulnerability and urban mobility safety risks. Furthermore, empirical evidence integrating physical infrastructure conditions, behavioural factors, environmental influences, and residents' mobility experiences remains scarce, particularly within Southwestern Nigerian cities. This fragmented understanding constrains the development of evidence-based policies capable of improving infrastructure resilience, reducing mobility-related risks and promoting safer urban transport systems (Salisu, Akanmu & Sani, 2025).

Against this backdrop, this study investigates the nature of road infrastructure vulnerability, examines associated urban mobility safety risks and identifies priority measures for reducing these risks across Lagos-Ikeja, Ibadan, Abeokuta, Akure, Osogbo and Ado-Ekiti, the historically significant urban centres and major economic gateways in Southwestern Nigeria, historically designated as urban centres under the 1917 colonial Township Ordinance. By integrating residents' perceptions with assessments of infrastructure conditions, the study provides a comprehensive understanding of how infrastructure deficiencies influence mobility safety within rapidly urbanising cities. The findings are expected to contribute to transport planning practice by providing evidence for infrastructure investment prioritisation, urban road safety strategies and integrated mobility governance. More broadly, the study supports the achievement of Sustainable Development Goals (SDGs) 3 (Good Health and Well-being), 9 (Industry, Innovation and Infrastructure), and 11 (Sustainable Cities and Communities) by promoting safer, more resilient, inclusive and sustainable urban mobility systems.

2.0 Literature Review

Urban transport plays a critical role in facilitating economic activities, social interactions and access to essential services in Nigerian cities. In Southwestern Nigeria, which includes Lagos, Ogun, Oyo, Ondo, Ekiti and Osun states, rapid urbanisation, high population densities and increasing motorisation have placed significant pressure on urban transport systems. Despite its centrality to urban development, transport infrastructure in the region has historically suffered from inadequate planning, fragmented governance, limited investment and over-reliance on road-based modes (Akinboade & Mokwena, 2012; Nkanu, 2017; Salisu, et al., 2023). These deficiencies have contributed to widespread mobility challenges, including congestion, delays and elevated risks to road users.

The status and condition of urban road infrastructure in Southwestern Nigeria are central to understanding mobility safety risks. Major urban roads in Lagos, Ibadan, Abeokuta, Akure and other cities frequently exhibit severe deterioration, including potholes, collapsed pavements, eroded shoulders, weak drainage systems and unmarked lanes (Ogunbodede, 2008; Olanrewaju & Adebayo, 2021). These defects compromise the structural integrity and functional capacity of the road network, reducing its ability to support safe, efficient and resilient mobility. In many urban centres, arterial and secondary roads fail to meet basic engineering and safety standards due to substandard construction, overloading and reactive rather than preventive maintenance practices (Adetunji & Oladapo, 2020). Additionally, deficiencies in traffic control infrastructure, such as malfunctioning traffic signals, missing road signage and inadequate pedestrian facilities, further exacerbate safety hazards for all road users (Eze & Abiola, 2021).

Urban road transport infrastructure vulnerabilities in Southwestern Nigeria manifest in both structural and functional terms. Structural vulnerabilities include weakened pavements, poor alignment and erosion, while functional vulnerabilities include inadequate drainage, missing or damaged road markings and insufficient traffic management devices (Olanrewaju & Adebayo, 2021; Zhou & Wang, 2019). Environmental stressors, particularly intense rainfall and seasonal flooding, compound

these vulnerabilities by eroding road surfaces, reducing friction and obstructing traffic flow (Akanmu & Salisu, 2024; Olorunfemi, 2021 & Odesanya, 2021). Roads in flood-prone areas such as Lagos Island, Apapa, Ikeja and sections of Ibadan's inner city frequently experience partial or full closures, which heighten crash risk and disrupt mobility (Akanmu, 2023). The combined effect of structural deficiencies and environmental pressures amplifies mobility hazards, forcing road users to adopt unsafe behaviours in order to navigate compromised infrastructure.

Urban mobility in Southwestern Nigeria is therefore highly constrained by the condition and resilience of road infrastructure. The region's urban transport is predominantly road-based, with private vehicles, minibuses, motorcycles and tricycles dominating the modal mix, while formal public transport options are limited in coverage and capacity (Nkanu, 2017). High traffic density, mixed-mode interactions and insufficient traffic management create conditions where mobility is unpredictable and unsafe. Road users, including drivers, riders and pedestrians, must constantly negotiate infrastructural hazards, often engaging in evasive manoeuvres, lane encroachment and risk-prone overtaking to maintain movement along compromised corridors (Eze & Abiola, 2021; Oyeleye, 2022). Pedestrians and non-motorised users are particularly vulnerable in areas where sidewalks, crossings and safety measures are absent or damaged.

The prevalence of mobility safety risks in Southwestern Nigeria is intrinsically linked to road infrastructure vulnerabilities. Poor road conditions, such as potholes, eroded shoulders and collapsed drainage systems, directly contribute to crashes, injuries and fatalities (Akanmu & Salisu, 2025; Aderamo, 2012; Ogunbodede, 2008). Mixed traffic streams in congested corridors increase the likelihood of collisions, while environmental stressors like flooding further compromise road safety. Informal transport modes, which dominate many urban streets, exacerbate these risks, creating frequent conflict points and unsafe interactions between different road users (Oyeleye, 2022). Weak institutional oversight and limited enforcement of traffic regulations further intensify mobility hazards, as infrastructure deteriorates unchecked and road users adapt unsafely to compromised conditions (Adetunji & Oladapo, 2020).

Despite significant attention to road conditions and traffic crashes, there remains a critical gap in understanding how urban road infrastructure vulnerability directly influences mobility safety in Southwestern Nigerian cities. Existing studies largely examine road defects, human behaviour, or crash statistics independently, without integrating these dimensions to explore their combined impact on safety outcomes. Limited research addresses how environmental stressors interact with infrastructure vulnerabilities to amplify mobility risks, or how different transport modes experience differential exposure to unsafe conditions. This lack of integrated empirical evidence hampers the development of targeted interventions to improve road safety and infrastructure resilience in the region.

The rationale for this study is therefore anchored on the need to fill these knowledge gaps by systematically examining the relationship between urban road infrastructure vulnerability and mobility safety risks in Southwestern Nigeria. Understanding this relationship is critical for informing evidence-based transport planning, proactive infrastructure maintenance and policy interventions that reduce

crash frequency, enhance the safety of all road users and improve the resilience of urban road networks. By focusing specifically on Southwestern Nigerian cities, where urban growth, traffic density and infrastructural decay converge, the study will provide actionable knowledge for transport authorities, urban planners and policymakers seeking to improve urban mobility safety in a contextually relevant and sustainable manner.

3.0 Materials and Methods

3.1 The Study Area

The study area is Nigeria's southwestern region, comprising Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States, with capitals in Ado-Ekiti, Ikeja, Abeokuta, Akure, Osogbo and Ibadan. Located between latitudes 6°N and 8.5°N and longitudes 3°E and 5°E, the region covers about 79,048 km² and contains a hierarchy of cities, including first-class (Ikeja), second-class (Abeokuta, Ibadan) and several third-class centres. Southwestern Nigerian cities face critical mobility safety risks and road infrastructural vulnerabilities due to rapid urbanisation, increasing motorisation and chronic underinvestment in road networks. Major highways such as the Lagos–Ibadan Expressway, Lagos-Abeokuta Expressway, Ibadan-Akure Road, Ibadan-Oyo-Ogbomoso-Ilofrin Expressway and Lagos–Badagry Expressway are often congested, structurally deteriorated and frequently overloaded by heavy-duty vehicles, creating hazardous travel conditions. Within urban centres, arterial roads and corridors including Lagos' Marina, Ikorodu, Agege and Oshodi roads; Ibadan's Ring Road and UI-Agodi corridor; Abeokuta's Kuto-Ibara and Abeokuta-Ijebu-Ode roads; and Akure-Ondo and Akure-Ile Oluji roads-experience intense traffic pressure, insufficient maintenance and poor geometric alignment. These conditions exacerbate mobility risks and vulnerability, especially for pedestrians, cyclists and informal transport users.

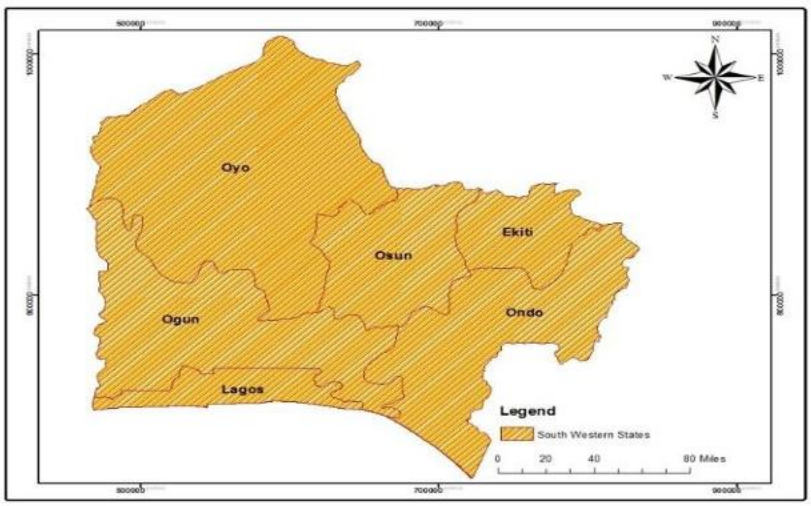

Figure 1: Southwestern Nigerian States: The Study Area

3.2 Methodology

A survey research design was adopted for this study through the electronic survey method which has gained prominence in academic research due to its cost-effectiveness, convenience, rapid response rates and capacity for time-efficient data collation, while reducing potential social biases. In this study, convenience sampling, a non-probability method, was employed to target internet users across southwestern Nigerian cities. This approach allowed participation from any resident with access to mobile devices running Android or iOS platforms, thereby facilitating widespread inclusion across diverse urban and peri-urban communities affected by mobility safety risks and road infrastructural vulnerabilities.

A structured questionnaire was designed and administered using Google Forms, with invitations circulated via social media platforms, including WhatsApp and Telegram. The survey was initially shared among the author's network, who further disseminated it across their contacts. The survey remained active for three months, from June 25 to August 30, 2023 and was updated between September 1 and 24, 2023. Out of 1,671 respondents, 1,267 (76%) completed the instrument and were retained for analysis, while 24% of incomplete responses were excluded.

The reliability of the instrument was confirmed through Cronbach's Alpha values of 0.78 and 0.76 for relevant sections, indicating acceptable internal consistency. Data were analyzed using descriptive statistics (percentage distributions) and summary measures, including the Mean Weighted Value (MWV) on a four-point Likert scale ranging from strongly disagree (1) to strongly agree (4). Following established procedures (Akanmu et al, 2025; Akanmu et al., 2021; Fasina et al, 2021), an index for each variable was calculated by dividing the Summation of Weighted Values (SWV) by the total number of responses.

The SWV was derived by summing the products of response counts and their corresponding weight values. This methodological framework allowed the systematic assessment of residents' perceptions regarding mobility safety risks, road conditions and infrastructural vulnerabilities across southwestern Nigerian cities, providing quantitative knowledge into factors affecting urban transport safety and resilience and is expressed mathematically as thus:

$SWV = \sum_{l=1}^{4} X_i Y_i$ ..... equation 1

Where:

SWV = Summation of Weight Value,

X_i = number of respondents to rating i

Yi = the weight assigned a value (i= 1, 2, 3, 4)

Thus, the higher the RMI, the higher the level of effectiveness for the variable under consideration is and this is expressed quantitatively as

'RMI' $= \frac{SWV}{\sum_{i=1}^{4} i = X_i}$ ... . equation 2

Moreover, inferential (Fisher's Exact Test) statistical techniques were used to test the hypothetical statement, while the Statistical Package for Social Sciences (SPSS) version 21 was used for data presentation and analysis.

4.0 Results and Discussion

4.1 Residents' Socio-Economic Profiles

The analysis of residents' socio-economic profiles across southwestern Nigerian cities presented in Table 1 provides critical knowledge into exposure to mobility safety risks and vulnerability of urban road infrastructure. The study sampled 1,267 respondents from Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States, with the largest proportion residing in Lagos (31.2%) and the smallest in Osun (10.5%). This distribution reflects the relative population densities and urbanisation gradients in the region, with larger cities exhibiting higher traffic volumes, greater road congestion and increased infrastructural strain.

First, gender and marital status also influence exposure to mobility risks. Male respondents constitute 60.4% of the sample, reflecting higher participation in vehicular travel, while married residents (81.4%) may undertake additional family-related trips, increasing road usage frequency. In addition, age and income distributions further highlight differential vulnerability. Respondents aged 46–55 years (26.2%) and 56–65 years (23.3%) comprise a substantial share, with mobility often dependent on both formal and informal transport. The educational attainment among respondents is diverse consisting of 31.8% possess NCE/ND qualifications, 14.0% hold first degrees or HNDs, 9.5% have postgraduate education, while 23.8% completed primary or secondary education. Higher educational levels may enhance awareness of road safety regulations and risk mitigation strategies, whereas lower educational attainment may correlate with limited knowledge of safe road practices, potentially elevating vulnerability to traffic incidents and unsafe infrastructural conditions.

On the employment patterns, results indicate that 40.3% are self-employed, 27.1% are government employees, 10.5% work in the private sector, 10.8% are students and 4.4% are retirees. Self-employed individuals and informal workers typically engage in frequent intra-urban mobility, often using poorly maintained roads or informal transport modes such as motorcycles, tricycles and minibuses. This travel behaviour increases exposure to high-risk corridors and structurally deficient road networks, exacerbating mobility safety hazards. Also, approximately 36.5% earn below ₦70,000 monthly, reflecting low-income populations who are more likely to rely on informal and non-motorised transport. Limited financial capacity constrains access to safer vehicles and increases reliance on roads with poor geometric design, inadequate drainage and minimal pedestrian facilities.

Collectively, these socio-economic characteristics including education, employment, age, income, gender and settlement location interact with urban transport infrastructure to shape differential exposure to mobility safety risks and reinforce the need for targeted interventions aimed at improving road quality, traffic regulation enforcement and pedestrian safety in southwestern Nigerian cities.

Table 1: Socio-economic characteristics of residents

Nature of settlement location			Educational Attainment		
State	Frequency	Percent	Primary education	108	8.5
Ogun	170	13.4	Secondary education	194	15.3
Osun	133	10.5	NCE/ND	403	31.8
Ondo	198	15.6	First Degree/HND	178	14.0
Oyo	194	15.3	Postgraduate	120	9.5
Ekiti	177	14.0	Total	1267	100.0
Lagos	395	31.2	Nature of Employment		
Total	1267	100.0	Unemployed	87	6.9
Period of residency in the area			Student	137	10.8
Below 5 years	284	22.4	Govt. employee	343	27.1
5-10 years	240	18.9	Private employee	133	10.5
11-15 years	359	28.3	Self-employee	511	40.3
16-20 years	292	23.0	Retiree	56	4.4
Above 20 years	92	7.3	Total	1267	100.0
Total	1267	100.0	Marital status		
Gender classification			Single	214	16.9
Male	765	60.4	Married	1031	81.4
Female	502	39.6	Divorced	22	1.7
Total	1267	100.0	Total	1267	100.0
Age classification			Monthly income		
18-25 years	31	2.4	Below #70,000	462	36.5
26-35 years	132	10.4	#70,000-#100,000	216	17.0
36-45 years	182	14.4	#100,001-#150,000	46	3.6
46-55 years	332	26.2	#150,001-#9200,000	188	14.8
56-65 years	295	23.3	#200,001-#250,000	114	9.0
Above 65 years	295	23.3	Above #250,000	241	19.0
Total	1267	100.0	Total	1267	100.0

Source: Authors' Fieldwork (2023 & 2024)

4.2 Road Infrastructure Condition and Vulnerability

Table 2 presents a detailed assessment of road infrastructure conditions and their associated vulnerabilities across southwestern Nigerian cities. The evaluation covers key structural and functional deficiencies, highlighting factors that directly influence mobility safety risks. Among the variables assessed, potholes recorded the highest Relative Importance Measure (RIM = 3.3173), ranking first in terms of severity. This indicates that pavement deterioration, manifested as potholes, is the most pressing infrastructural challenge, significantly affecting vehicular and pedestrian safety by increasing the likelihood of accidents and vehicle damage.

Flood-prone areas and eroded shoulders followed closely, with RIMs of 3.2968 and 3.2202, respectively. Flooding and shoulder erosion compromise road integrity, reduce manoeuvring space and exacerbate crash risks, particularly in low-lying and

coastal cities such as Lagos and Port Harcourt. Inadequate drainage (RIM = 2.9732) similarly contributes to road vulnerability, as poor water management accelerates pavement deterioration and creates unsafe travel conditions during intense rainfall events. Other significant concerns include narrow carriageways (RIM = 3.0182) and limited pedestrian facilities (RIM = 2.8919), which constrain traffic flow and elevate risks for non-motorised road users, while unsafe intersections (RIM = 2.6740) and rutting (RIM = 2.4159) further compromise mobility efficiency and safety. The ranking of these vulnerabilities (RK) highlights a hierarchy of infrastructural deficiencies that directly impact both vehicle and pedestrian safety. Collectively, these findings emphasis the critical interplay between physical road conditions and mobility risks, demonstrating that deteriorating infrastructure, insufficient design standards and inadequate maintenance contribute substantially to unsafe urban mobility in southwestern Nigerian cities. These findings aligned with the findings of Akanmu (2023) and Olorunfemi (2021) on the deplorable condition of road infrastructure in the country, which enhances the vulnerability of all users in Nigeria, irrespective of socio-economic status.

Table 2: Road Infrastructure Condition and Vulnerability

Nature of Road Infrastructure Condition and Vulnerability	Very low	Low	High	Very High	Total Weighted Value	Relative Index Mean	Mean index value	Ranks
Potholes	32	418	1053	2700	4203	3.3173	23.8075/8= 2.9076	1
Rutting	346	572	1191	952	3061	2.4159		8
Eroded shoulders	18	776	474	2812	4080	3.2202		3
inadequate drainage	190	414	951	2212	3767	2.9732		5
Flood-prone	23	542	840	2772	4177	3.2968		2
Narrow carriageways	193	260	1215	2156	3824	3.0182		4
unsafe intersections	220	590	1290	1288	3386	2.6740		7
Limited lack of pedestrian facilities/sidewalks or designated crossing points	151	460	1473	1580	3664	2.8919		6

Source: Authors' Fieldwork (2023 & 2024)

4.3 Urban Mobility Safety Risks

The results of mobility safety risk evaluated with the mobility safety risks index (MSRI) presented in Table 3 showed a ranked assessment of mobility safety risks based on residents' perceptions, using the Relative Index Mean (RIM) and Mean Index Value (MIV) to quantify the severity of each factor. The analysis reveals a strong interaction between human behaviour, infrastructural failures, security concerns and operational deficiencies that collectively shape road safety outcomes in southwestern Nigerian cities. Accordingly, the highest mobility safety risk is drivers swerving to avoid potholes (RIM = 3.3702; Rank 1). This indicates that deteriorated pavements remain the most critical driver of unsafe manoeuvres. Potholes on major roads and intra-urban corridors force abrupt lane changes, increase sideswipe collisions and heighten conflict between fast-moving vehicles and vulnerable road users. This finding aligns with earlier results showing potholes as the highest-ranked infrastructure vulnerability, reinforcing the direct link between pavement failure and crash likelihood.

The second-ranked risk, infrastructure defects and vandalisation (RIM = 3.6330; Rank 2), reflects widespread degradation and sabotage of essential road safety assets, including traffic signs, streetlights, pedestrian rails and median barriers. High RIM values emphasis how structural failures and vandalised road furniture reduce visibility, impair road guidance and expose users to night-time hazards. Closely related is infrastructure vandalisation (RIM = 3.3583; Rank 3), which reinforces the vulnerability of transport assets to theft and destruction. The high perception index illustrates the negative impact of missing manhole covers, damaged drain slabs and stolen installations on safe mobility, particularly along major expressways. Also, lane/carriageway crossing also presents notable risk (RIM = 2.3425; Rank 4), indicating frequent unsafe pedestrian movements. This is linked to inadequate footbridges, discontinuous sidewalks, encroached rights-of-way and poor pedestrian priority measures across cities like Lagos, Ibadan, Osogbo, Ado-Ekiti, Abeokuta and Akure.

In addition, encroachment (RIM = 3.3331; Rank 5) constitutes another major challenge, reflecting residents' concerns about roadside trading, informal transport stops, mechanical workshops and temporary structures that intrude into carriageways. These activities reduce lane width, obstruct visibility, increase conflict points and slow down traffic across high-density urban corridors. Also, the absence or weakness of pedestrian infrastructure (RIM = 3.2731; Rank 6) further highlights the vulnerability of non-motorised users. High scores indicate widespread challenges such as poor sidewalks, lack of crossings and unprotected pedestrian routes, especially near schools, markets and transport terminals. Road traffic incidents (RIM = 3.3268; Rank 7) reflect persistent crash occurrence across the region. Although the ranking is moderate, the high MIV suggests that crashes remain recurrent due to combined infrastructural and behavioural risks common on major highways and intra-city roads.

The menace of kidnapping (RIM = 3.3047; Rank 8) indicates that insecurity has become an integral mobility hazard. Fear of abduction prompts unsafe driving speeds, reduces night-time travel and affects mobility choices along intercity corridors such as Ibadan–Akure and Lagos–Ibadan highways, while driver frustration at checkpoints (RIM = 3.2968; Rank 9) demonstrates the operational challenges created by frequent roadblocks, extortion and long queues. Such conditions induce erratic manoeuvres,

sudden stops and frequent lane changes, increasing crash exposure. Traditional behavioural risks, however, including speeding (RIM = 3.1239; Rank 10) and risky overtaking (RIM = 3.0221; Rank 11) rank comparatively lower but still reflect consistently high-risk indicators with their indicating that unsafe driving behaviour persists due to weak enforcement, poor geometric alignment, inadequate signage and limited speed-calming facilities on both highways and urban roads. Therefore, the distribution of RIM and MIV values reveals that the highest mobility risks are rooted not in driver behaviour alone but in infrastructure failure, insecurity, operational inefficiencies and poor or lack of pedestrian facilities. These results provide strong empirical evidence that mobility safety risks in southwestern Nigeria are systemic and require integrated interventions.

Table 3: Mobility Safety Risks Index

Safety risk induced factors	Very low	Low	High	Very High	Total Weighted Value	Relative Index Mean	Mean index value	Ranks
Road traffic incidents	48	372	1011	2784	4215	3.3268	35.3845/11= 3.2168	7
Speeding	69	606	891	2392	3958	3.1239		10
Risky overtaking	261	216	720	2632	3829	3.0221		11
Encroachment	37	504	690	2992	4223	3.3331		5
Menace of kidnapping	14	500	1017	2656	4187	3.3047		8
Drivers swerving to avoid potholes	128	300	342	3500	4270	3.3702		1
Lane/carriage crossing	164	1398	630	776	2968	2.3425		4
Infrastructure vandalization	176	38	741	3300	4255	3.3583		3
Driver's frustration at the checkpoints	113	248	912	2904	4177	3.2968		9
Absence/ weak pedestrian infrastructure	32	516	927	2672	4147	3.2731		6
Infrastructure defects and vandalization	28	106	555	3824	4603	3.6330		2

Source: Authors' Fieldwork (2023 & 2024)

4.4 Mobility Safety Risks Reduction Measures

The results in Table 4 indicate that repairing and upgrading pavements emerged as the highest-ranked safety intervention (RIM = 3.62) indicating that respondents perceive roadway surface integrity as the most immediate and effective mechanism for reducing mobility-related risks in Southwestern Nigeria. This aligns with previous findings by Aderamo (2012) and Orioke (1977) who emphasized pavement quality as a primary determinant of road safety outcomes and vehicle maneuverability in Nigerian cities. Also, the high ranking assigned to pavement upgrades reflects the widespread presence of potholes, rutting and surface distress noted in earlier results, reinforcing the argument that structural rehabilitation remains the cornerstone of safe mobility.

Table 4: Mobility Safety Risks Reduction Measures Index

Measures of reduction in safety risk and vulnerability	Total Weighted Value	Relative Index Mean	Mean index value	Ranks
Provision of functional signage	1758	2.66	28.4053/9=3.1561	9
Improving drainage and streetlights	2208	3.35		3
Repairing and upgrading pavements	4588	3.6212		1
Enforcement	3392	2.6772		8
Road safety education and institutionalisation	4098	3.2344		4
Prioritization of vulnerable users	4311	3.4025		2
Limiting unsafe roadside trading	2023	3.07		7
Efficient roadmap for safe mobility	2124	3.22		5
Prioritization of transport incident emergency facility	2089	3.17		6

Source: Authors' Fieldwork (2023 & 2024)

Following closely is the prioritisation of vulnerable users (RIM = 3.40), reflecting a growing recognition of the disproportionate risks faced by pedestrians, cyclists and roadside traders. Studies by Salisu et al (2024), Gbadamosi, Omole & Akanmu (2021) and the WHO (2018) similarly show that over 50% of traffic fatalities in African cities involve vulnerable road users due to weak pedestrian facilities and unsafe crossing environments.

The measure improving drainage and streetlighting (RIM = 3.35) ranks third, underscoring the influence of climate-induced flooding, nighttime visibility challenges and blocked drainage channels on road crashes. Poor drainage has been extensively

documented in Lagos, Ibadan, Akure and other major cities in the region as a catalyst for roadway deterioration and crash severity. Correspondingly, adequate lighting contributes significantly to nighttime safety, resonating with findings that highlight visibility as a critical factor in urban mobility safety.

Road safety education and institutionalisation (RIM = 3.23) and establishing an efficient roadmap for safe mobility (RIM = 3.22) occupy mid-level rankings and these values imply that behavioural reforms and strategic frameworks are important but often overshadowed by the urgency of physical infrastructure deficiencies. Similar observations were made by Balogun (2025), who noted that in many Nigerian cities, road-user behaviour is highly influenced by road conditions and educational interventions alone are insufficient without infrastructural support. Lower-ranked measures such as enforcement (RIM = 2.67) and functional signage (RIM = 2.66) illustrate systemic institutional weaknesses. Although enforcement is theoretically crucial, research by Filani & Gbadamosi (2007) indicate that enforcement in Nigeria suffers from inconsistent implementation, resource gaps and public mistrust, reducing its real-world effectiveness. Similarly, the low ranking of signage improvement corroborates studies in Lagos and Osun (Salisu, Akanmu, Fasina & Sanni, 2020 & Fasina, Akanmu, Salisu & 2020; Ogunbodede, 2008), where many signs are either vandalised, poorly positioned, or ignored by drivers due to low enforcement credibility. Finally, prioritisation of emergency response facilities (RIM = 3.17) and limiting unsafe roadside trading (RIM = 3.07) reflect respondents' concerns about delays in crash response and the persistent conversion of road edges into informal markets.

5.0 Conclusion and Recommendations

This study has examined the interconnected nature of mobility safety risks and road infrastructural vulnerability across southwestern Nigerian cities, revealing a transport environment strained by rapid urbanisation, inadequate planning and prolonged neglect of critical road assets. The findings revealed that the region's mobility landscape is heavily influenced by deteriorating pavements, poor drainage, eroded shoulders, narrow carriageways and structurally compromised corridors. These conditions disrupt traffic flow, increase travel-time unreliability and heighten the probability of traffic conflicts and crashes, especially in dense urban settings where mixed traffic dominates. Similar observations in previous studies confirm that infrastructure decay remains a defining constraint to safe and efficient mobility in Nigerian cities (Akanmu, 2023, Olorunfemi, 2021 & Odesanya (2021).

The study further established that mobility risks are not solely infrastructural but also behavioural, institutional and security related as unsafe driving responses to poor road conditions such as swerving to avoid potholes, risky overtaking and sudden lane changes reflecting an adaptive behaviour shaped by infrastructural failure rather than driver preference. Equally critical is the exposure of pedestrians and other vulnerable road users, who often navigate roads without functional walkways, safe crossings, or street lighting, while encroachment of road space by roadside trading and informal transport operations further intensifies conflict between users, consistent with earlier work highlighting the complex interaction between informality and traffic safety in African cities (Fourchard, 2011). The study concludes that addressing mobility safety

risks in Southwestern Nigeria requires integrated, infrastructure-led and institutionally coordinated strategies. In order to improve the urban mobility safety risks and road infrastructure vulnerability, the following recommendations are made:

Adoption of a Comprehensive Road Asset Management Strategy: Government agencies should ensure transition from reactive road repairs to systematic, scheduled maintenance supported by geospatial monitoring and asset management tools towards ensuring early detection of road failure and prolong infrastructure lifespan. Prioritization of Infrastructure for Vulnerable Users: Road designs and redevelopment should emphasise safe pedestrian facilities including sidewalks, zebra crossings, traffic-calming measures, pedestrian bridges and safe-school-zone treatments. Hence, urban mobility policy must shift toward complete-streets principles that balance the needs of all users. Strengthen Urban Drainage and Roadway Lighting: Drainage upgrades and functional streetlighting should be integrated into all major road corridors to reduce flooding impacts, enhance nighttime visibility and address long-standing environmental contributors to crashes. Reform Traffic Enforcement Systems: Traffic enforcement should be modernised through digital tools, automated monitoring and transparent procedures that reduce human interference. Athis should also include the intensification of collaboration between transport agencies, road safety organizations and community groups to achieve effective compliance.

Institutionalise Road Safety Education: Structured road safety programmes in schools, markets, motor parks and workplaces can promote safer behaviours among drivers, riders, pedestrians and transport operators. Thus, public awareness should be continuous rather than crisis-driven or festive-driven. Protect Road Infrastructure from Vandalisation: Local governments should establish community-based monitoring structures, deploy surveillance technologies where feasible and enforce sanctions against vandalism of signage, streetlights and drainage assets. Improve Traffic Incident Response Capacity: State transport authorities should develop corridor-based emergency response networks with strategically located rescue units, ensuring rapid intervention during road crashes to minimise fatalities

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