

Vulnerable Road User Safety in Monrovia, Liberia: A Survey Study.

Jefferson T. Banquando, Dr. Ahmed E. Aboud

Dept. Transportation Engineering, Huaiyin institute of technology, Jiangsu, China

Abstract: Both developed and developing nations depend heavily on infrastructure development particularly safe roads, railways, electricity, water supply, and housing to support their economic growth and social progress, but in developing countries like Monrovia, Liberia, the socio-economic impact of poor road safety is particularly severe and leads to several negative consequences, such as loss of life, injury, property damage, and medical bills. This research aims to explore the poor road safety issues on vulnerable road users (VRUs) including pedestrians, cyclists, and motorcyclists etc, are disproportionately affected by road traffic accidents in Monrovia, Liberia, also this paper examines the consequences of road poor safety on VRUs by a comprehensive survey conducted using both qualitative and quantitative methods, or a mixed-methods approach, to identify the major factors related to poor VRUs road safety in Monrovia, including physical injuries, disabilities, and fatalities, inadequate infrastructure, lack of resources, inadequate traffic regulations, poor education, and limited law enforcement etc. which impose significant burdens on individuals, families, and communities. Moreover, it analyzes the economic repercussions of road poor safety, such as increased healthcare costs, loss of productivity, and potential strain on social welfare systems. Furthermore, the paper concludes by highlighting the need for comprehensive strategies with both short-term and long-term solutions that serve as a strategic plan to enhance VRUs road safety, this suggested solutions focuses only on the solutions according to the findings of the study, It underscores the significance of implementing measures such as improving infrastructure, enhancing traffic regulations and enforcement, and promoting public awareness campaigns.

Keywords: Poor road safety, developing countries, VRUs, social economy, low- and middle-income countries (LMICs), fatalities.

1. Introduction

1.1. Background

The Republic of Liberia, a West African country with an estimated population of 5.6 million as of 2025 (a 2.17% increase from 2024) [1], and an area of approximately 43,000 square miles, faces significant infrastructure challenges. Its capital, Monrovia, serves as the country's principal port, through which goods must be transported. This has an impact on commodity prices, such as the cost of rice, a major meal in

Liberia that is primarily imported. The cost of rice is generally 30% higher outside the city than inside. The country has over 111,379 square kilometers of roads, but only 657 km are paved, while 9,943 km are unpaved and in very poor condition. This leads to severe travel disruptions, with journeys taking much longer than expected, causing loss of goods/property, disabilities/sickness, income & time loss, and highway robberies.

As shown in Fig.1 [2], 90% of paved roads are in good or fair condition, but 60% of unpaved roads are poor or very poor, severely hindering transportation and economic activity.



Figure 1. First ever georeferenced road survey carried out, with 11,423km of road surveyed [2]

Roads are the primary mode of transportation in urban areas. Unlike developed countries, developing nations like Liberia are undergoing a tremendous increase in road traffic

accidents, which have become an embarrassing national stigma. Poor infrastructure and traffic management have led to rising road accidents, creating a national crisis. Key issues

include congestion and blocked walkways: street vendors, parked cars, and bus stops force pedestrians onto roads, reducing usable space.

In Liberia, Monrovia, the capital with more than one-fourth of Liberia's overall population estimated at 1.7 million as of 2025 (a 3.46% increase from 2024)[1], is located on Bushrod

Island, Cape Montserrado. The traffic crisis is overwhelmed due to poor safety measures, lack of pedestrian lanes and modern terminals, inadequate roadside facilities, and high fatality and economic losses. Frequent accidents cause deaths and financial damage due to insufficient road capacity and maintenance, as shown in Fig.2.



Figure 2. Street vending and roadside parking in Monrovia [2]

Furthermore, road capacity has been reduced by roadside parking and illegal public bus stops, street vending, and pedestrians who are compelled to walk on the carriageways. Most of the walkways are full of parked vehicles and petty businesses.

1.2. Problem Statement

Road and VRUs safety challenges are considered a tremendous threat to all citizens in Monrovia, Liberians most especially vulnerable road users (VRUs) like pedestrians, cyclists, motorcyclists, skateboarders, and road workers, As Monrovia can hardly deal with the rapid increase in road traffic volume due to Rising traffic volume with poor infrastructure (narrow roads, no expansion space), Lack of

safety measures: No proper pedestrian lanes, road signs, or traffic signals, Inadequate facilities: Insufficient parking, walkways, and spaces for non-motorized transport, Poor road maintenance: Leads to higher accident rates, vehicle costs, and rural isolation.

These accidents that are caused by unsafe road traffic conditions add to the misery causing deaths, disabilities, income loss, and property damage. It's also said that poorly maintained roads constrain economic & social mobility, significantly raise vehicle operating costs, increase accident rates and their associated human and material costs, and poverty, poor health, and illiteracy in rural communities as shown in Fig.3[3].



Figure 3. Road traffic injuries and deaths in Monrovia [3]

In addition, VRUs victims of these accidents all experience financial hardship, so this terrible condition necessitates the declaration of improvement on road safety to the situation, this is to say that safety and mobility must be improved together, as the improvement of safety should not take place at the reduction of mobility in Monrovia, Liberia.

1.3. Objectives of the Study

This research main purpose is to examine road and VRUs safety situations in Monrovia, Liberia includes the following objectives:

1. Analyzing the existing condition of road infrastructure and transportation facilities in Monrovia, Liberia.

2. Determining the contributing factors to the existing poor road safety on VRUs in Monrovia.
3. Suggest and evaluate the strategies and policies that can be implemented to improve transportation VRUs safety situations in Monrovia, Liberia without reducing mobility and accessibility.

2. Literature Review

Developing nations aiming for economic growth and improved citizen well-being must prioritize safe transportation systems, which are vital for economic progress and satisfaction. However, many struggle to address vulnerable road user (VRU) safety due to government leaders' unawareness of its socioeconomic impact or limited resources to tackle it [4]. This research focuses on VRU safety in developing nations and suitable remedies for their unique challenges.

2.1. Road Safety and its Importance.

Road safety is a global crisis, causing 1.35 million deaths annually and 20–50 million injuries, primarily affecting youths aged 5–29 [5]. These accidents impact all road users, including vehicle drivers, passengers, transit users, cyclists, and pedestrians, but the impact on vulnerable road users (VRUs) is significantly greater than on protected road users [6]. The issue of VRUs first appeared in the literature in the 1950s [7, 8], yet many countries continue to struggle with implementing effective solutions. VRUs, including

pedestrians, cyclists, and motorcyclists, face higher risks, accounting for 80% of urban traffic deaths, with pedestrians facing a tenfold higher fatality risk than car occupants [9,1]. Traffic accidents cost countries approximately 3% of their GDP annually due to medical expenses, lost productivity, and property damage (World Bank). International databases, such as CARE, FARS, IRTAD, IRF, UNECE, and WHO's Mortality Database, support road safety research.

Globally, VRUs, particularly the elderly, face elevated risks of fatal traffic accidents, leading to significant human, economic, and social consequences, including increased poverty risks for affected families [10]. The WHO estimates 1.35 million annual road deaths and up to 50 million injuries, equating to approximately 3,700 daily fatalities [11]. In the EU, VRUs account for 46% of traffic fatalities and 53% of serious injuries [12]. In the US, 895 VRUs were fatally injured, comprising 52% of road deaths [13]. In India, VRUs accounted for 80% of 193 road deaths in a study, with higher rates in cities such as Bengaluru and Mumbai [14]. The ITF found that VRUs constitute 80% of urban traffic deaths, with pedestrians facing a tenfold higher fatality risk than car occupants [15].

2.2. Road safety in developing countries.

Road safety is a critical issue in both developed and developing nations, but it is more severe in low-income countries (LICs), as shown in Fig. 4. LICs face significant challenges due to inadequate safety standards, poor vehicle maintenance, and deficient infrastructure [16].

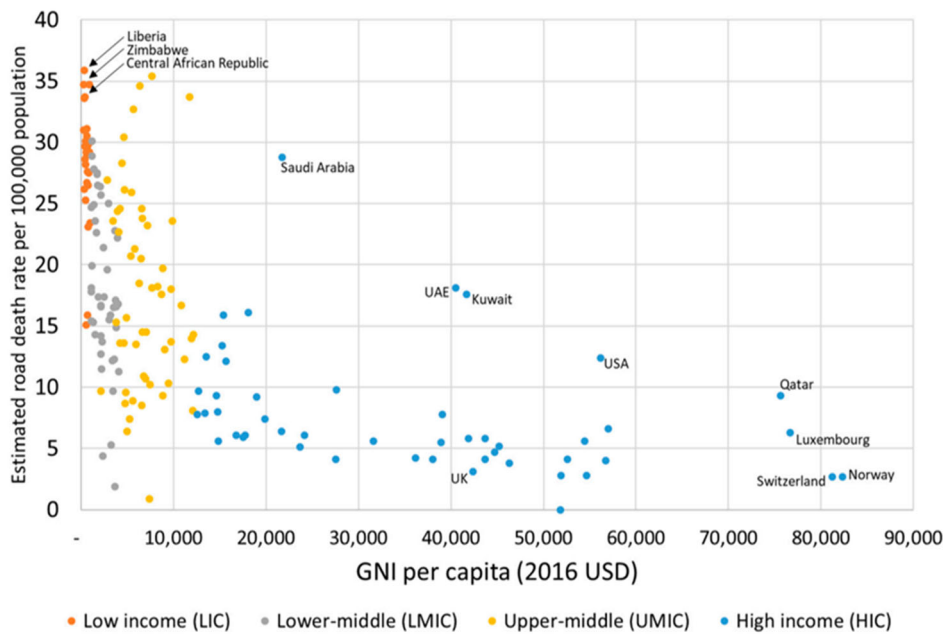


Figure 4. Comparing Road traffic death rates with national wealth [16].

The risk of road traffic deaths is over three times higher in developing countries, with 90% of global road fatalities occurring in low- and middle-income nations [11]. In developing countries, up to 80% of road deaths involve vulnerable road users (VRUs) due to inadequate infrastructure and safety measures [12]. Studies indicate that VRUs account for 60% of injuries and 40% of fatalities in India, 66% of fatalities in Nigeria, 70% in South Africa, 47% in Brazil, and 60% in China, underscoring the need for improved infrastructure and enforcement [17,18,19]. In

developing nations such as Ethiopia, Kenya, and Malawi, pedestrians and bus passengers dominate fatalities, in contrast to the US, where drivers constitute the majority, as shown in Fig. 5. This highlights the urgent need for targeted VRU safety interventions [17,18,19]. It estimates that halving road traffic deaths and injuries from 2014 to 2038 could lead to significant GDP per capita growth: 22% in Thailand, 15% in China, 14% in India, and 7% in both the Philippines and Tanzania [20].

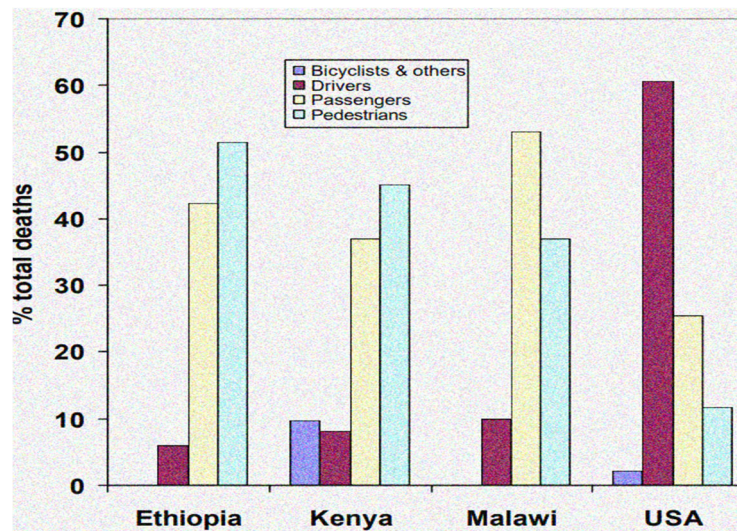


Figure 5. People Killed in Traffic Crashes by Road User Category [20]

2.3. Types and Characteristics of VRUs.

Vulnerable Road Users (VRUs) are individuals without external protection, such as pedestrians, road workers, wheelchair users, electric scooter users, cyclists, and motorcyclists, who face higher injury risks in vehicle collisions [21].

The main characteristics of VRUs are:

1. Lack physical protection and safety features available to vehicle occupants.
2. Face greater risks of serious injury or death in crashes.
3. Include users of all ages and abilities, such as children, elderly, and those with disabilities.
4. Primarily non-motorized users like pedestrians and cyclists.
5. Highly prone to injury in collisions.
6. Over represented in road traffic injury and casualty statistics.

2.4. Factors contributing to VRUs poor road safety.

Literature reveals diverse, interrelated causes of accidents, particularly for vulnerable road users (VRUs), with inconsistent categorizations across studies due to varying perspectives. Malik, F. et al. [22] identify accidents as resulting from a chain of events involving road users, vehicle conditions, road design, and environmental factors[23]. highlights VRU safety factors, including vehicle design, frontal aggressiveness, road layout, legislation (e.g., speed limits), and safety systems like cameras/LIDAR/RADAR or cyclists' helmets. Among the factors affecting VRUs safety mentioned in the literature; bad infrastructure, bad vehicle conditions, inadequate traffic regulations and law enforcement, environmental conditions, drivers' behavior,

and VRUs behavior.

3. Methodology

The causes of VRU road safety issues and their solutions differ between developed and developing countries. Research methodologies used in developed nations cannot be fully applied in developing countries like Liberia, particularly in Monrovia, due to the lack of reliable, up-to-date data on urban transportation systems and accident statistics.

3.1. Study Design:

Given the absence of official data, this study focuses on surveys to investigate VRU road safety issues and potential solutions in Monrovia. The survey approach aims to assess the real situation through two methods:

1. Assessing road safety conditions and socioeconomic impacts on VRUs in Monrovia, Liberia, through observation, social media, local news, and interviews.
2. Designing two questionnaires targeting specific VRU safety stakeholders: Questionnaire 1 for traffic police officers and Questionnaire 2 for VRUs.

3.2. The existing condition of poor road safety.

Road traffic crashes in Monrovia, Liberia, are a major public health issue, with the world's highest estimated road traffic death rate (35.9 fatalities per 100,000) [24]. Most crashes involve VRUs (pedestrians, cyclists, motorcyclists), causing economic losses up to 7% of GDP [25]. Monrovia's roads, primarily unpaved (9,943 km of 10,600 km total), are in poor condition, with 60% of unpaved roads rated poor or very poor, threatening VRU safety [24] as shown in Fig.6,7. Issues include traffic congestion, inadequate infrastructure, lack of pedestrian lanes, poor maintenance, street vending, and a long rainy season.

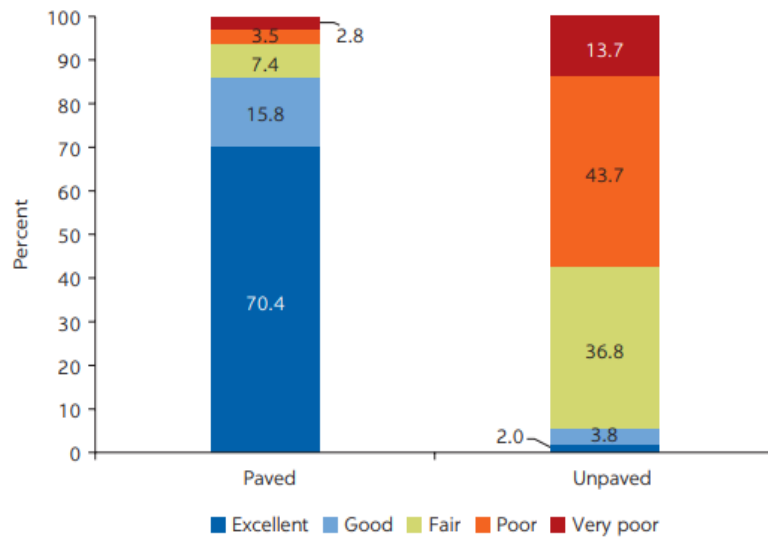


Figure 6. Paved roads and unpaved roads condition

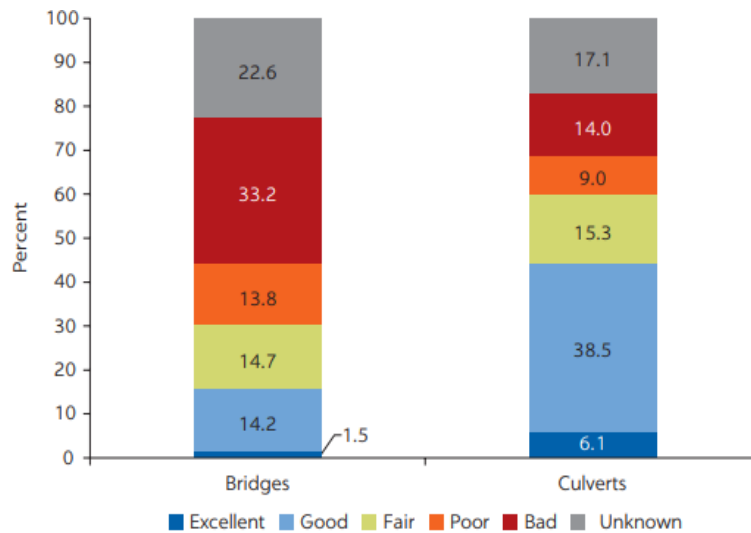


Figure 7. Bridges and culverts condition

3.2.1. Socio-economic condition

Monrovia, in Liberia, Africa’s oldest country, faces poor urban planning, civil conflict aftermath, and inadequate infrastructure. GDP grew 4% in 2021, reaching 3.7% by 2022 [26]. Safe roads are vital for economic activity, rural living

standards, and commerce. Poor road safety, driven by poverty, forces reliance on unsafe transport like walking or cycling, leading to high accident rates, medical costs, and lost productivity.

The economic impact is staggering, with losses from road traffic crashes estimated to cost as much as 7% of GDP [27].



Figure 8. A bustling street scene in Monrovia, Liberia [24]

3.2.2. Pot-holes

Potholes in Monrovia's roads cause accidents, strand

travelers, and hinder economic gains from efficient transport [25].



Figure 9. Potholes on the roadways of Monrovia [25]

3.2.3. The Inefficiency of Public Transport Infrastructure

Public transport infrastructure is an essential component of any modern city. It provides a cost-effective and efficient means of transportation for the masses, reducing traffic congestion and pollution. However, public transport in Monrovia is unreliable and poorly connected, increasing congestion and pollution.

3.2.4. Road Traffic Congestion and Poor Traffic Signs & Signers

Traffic congestion in Monrovia, worsened by damaged war-era infrastructure, poor traffic signals, and roadside vending, impedes movement as shown in Fig.10. Causes include rapid urbanization, inadequate road networks, and lax enforcement.



Figure 10. Traffic congestion in Red Light, Waterside

The main causes of congestion in Monrovia city are:

1. Poor Infrastructure: Unpaved, poorly maintained roads hinder economic growth and increase accidents [24].
2. Ineffective Transport Planning: Lack of coordination and underfunded public transport cause congestion and pollution.
3. Rapid Urbanization: Population growth strains infrastructure, increasing vehicle numbers.
4. Corruption: Systemic issues like bribery slow infrastructure progress.
5. Lack of Safety Culture: Civil wars and instability foster weak safety ethics, raising crime and accidents.

Traffic congestion is a major problem in Monrovia city, Liberia, and its effects are far-reaching. Congestion causes economic losses (fuel, time, productivity), environmental pollution, and health issues (32% of transport operators report

fever, 30% headaches, 28% stress). It also increases accidents and stress-related illnesses. Globally, 1.2 million die annually in road crashes [28].

3.3. The questionnaire formulation.

To grasp the real causes and the real situation of VRUs Safety Issues in Monrovia, Liberia, and to find the suitable solutions to it, two questionnaires' surveys with mixed methodology is conducted.

- a. Questionnaire 1- Targeting Traffic Police Officers.
- b. Questionnaire 2- Targeting Vulnerable Road Users.

Each questionnaire will be formatted differently based on the target group, taking into account varying education levels in the country. To ensure clarity and accuracy, questions will be designed to minimize misunderstandings and avoid

unreasonable responses. Additionally, duplicate questions will be included to verify response consistency. This approach will also help filter the data; responses deemed unreliable will be excluded from the final survey results.

3.3.1. Questionnaire 1- Traffic Police Officers:

This survey questionnaire targets Traffic Police Officers with the aim of analyzing the perceived effectiveness of current traffic control measures. It seeks to understand the frequency and nature of traffic accidents within their

jurisdiction, evaluate the traffic monitoring equipment and tools utilized by officers, and gather data on accident hotspots and how effectively these areas are managed. The questionnaire is designed to collect both quantitative (closed-ended questions) and qualitative (open-ended responses) data. Demographic information about the participants, including professional background, age, and years of experience, is also collected. The complete questionnaire 1 sheet is in appendix A

QUESTIONNAIRE 1 FORM:

Name:		Institute:		Occupation (Position):	
Age :		Years of Service:		Experiences with VRUs	
Area of data collection:			Date:		
Types of VRUs Encountered					
1- Is there a unified form for filling in accident data? (Yes/No)					
2- What is the average time to reach the accident spot? (in minutes from the time of the accident)					
3- What is the average time to reach the accident spot? (in minutes from the time of reporting)					
4- Is there a formal way of exchanging information between Police and Medical staff? (Yes/No)					
5- What are the most common VRU injuries resulting from road accidents: (write in percentage)					
a) Death ()					

Figure 11. sample of the Questionnaire 1 (Targeting Traffic Police Officers)

3.3.2. Questionnaire 2- Vulnerable Road Users (VRUs):

This survey questionnaire targets Vulnerable Road Users (VRUs), encompassing pedestrians, cyclists, and motorcyclists in Monrovia, Liberia. The primary goal is to directly collect insights from VRUs about their experiences, challenges, and perceptions regarding road safety in Monrovia. By gaining an understanding of their viewpoints, this study aims to evaluate the awareness and experiences of VRUs concerning road safety in Monrovia, identify key challenges faced by VRUs, including issues with

infrastructure and the behaviour of other road users, and to grasp VRUs' perceptions of current road safety measures and regulations. The questionnaire employs a mixed-methods approach, incorporating both quantitative (closed-ended questions) and qualitative (open-ended responses), and is designed to target various demographic groups. Additionally, demographic information about the participants, such as gender, age, and their preferred mode of road use (walking, cycling, or motorcycling), is also gathered. The complete questionnaire 2 sheet is in appendix A

QUESTIONNAIRE 2 FORM:

Name:		Institute:		Occupation (Position):	
Gender:		Age Distribution:			
Area of data collection:				Date:	
1- In the past year, have you avoided walking, biking, or using other non-motorized transportation modes due to safety concerns on the roads in your local area?					
a) Yes, frequently					
b) Yes, occasionally					
c) No, I have not avoided these modes					
2- On a scale of 1 to 5 (1 being "very unsafe" and 5 being "very safe"), how safe do you feel when using the road in Monrovia Liberia? ()					
3- What time of the day do you feel most unsafe as VRUs in your community?					
a) Early morning (before 8 am)					
b) Daytime (8 am - 5 pm)					
c) Evening (5 pm - 9 pm)					
d) Night (after 9 pm)					
e) Others					

Figure 12. sample of the Questionnaire 2 (Targeting Vulnerable Road Users (VRUs))

3.4. Data Collection:

3.4.1. Questionnaire 1- Traffic Police Officers:

Data was collected through face-to-face interviews

conducted over a four-month period. The sample selection was random, ensuring representation from various districts in Monrovia. To encourage honest participation, responses were recorded anonymously. The responses to Questionnaire 1

were gathered and reviewed. A total of 38 questionnaires were collected, out of which 4 contained inconsistent answers (If a participant has more than 20% inconsistent answers, all his other answers will be rejected). The remaining 34 questionnaires provided consistent answers that were suitable for analysis. Inconsistent responses were discarded, while the consistent ones were compiled and analyzed. Inconsistent

responses are those that are logically unacceptable or contradict other answers provided by the same participant. These usually arise from misunderstandings of the questionnaire's objectives or a lack of adequate knowledge. Table 3.1 presents the statistical summary of the sample participants in Questionnaire 1.

Table 1. The statistics data of the questionnaire 1 participant

Age Distribution	Years of Service	Frequency of Encounters	Types of VRUs Encountered
20-30years: 30%	Less than 5 years: 25%	Daily encounters with VRUs (pedestrians, cyclists): 80%	Pedestrians: 39%
31-40 years: 40%	5-10 years: 35%	Weekly encounters: 15%	Cyclists: 8%
41-50 years: 20%	More than 10 years: 40%	Rarely encounters: 5%	Motorcyclists and cars (commercial): 53%
Above 50 years: 10%			

3.4.2. Questionnaire 2 - Vulnerable Road Users (VRUs):

Data collection was conducted through face-to-face interviews over a four-month period. The sample selection was random, ensuring representation across various districts in Monrovia. Responses were recorded anonymously to encourage honest participation. The answers to the questionnaire were collected and revised. A total of 143 Vulnerable Road Users (VRUs) participated, comprising 71 pedestrians, 27 cyclists, and 45 motorcyclists. Among them,

12 pedestrians, 6 cyclists, and 6 motorcyclists provided inconsistent answers, while 119 provided consistent answers suitable for analysis. Inconsistent responses were discarded, and consistent ones were compiled and analyzed. Inconsistent answers are those that are logically unacceptable or contradict other answers provided by the same participant. These inconsistencies typically arise from misunderstandings of the questionnaire's objectives or a lack of adequate knowledge. Table 3.2 presents the statistical summary of the sample participants in Questionnaire 2.

Table 2. The statistics data of the questionnaire 2 participant

Gender	Age Distribution	Type of VRU
Male: 75%	18-30 years: 45%	Pedestrians: 50%
Female: 25%	31-45 years: 35%	Cyclists: 25%
	46-60 years: 15%	Motorcyclists: 25%
	60+ years: 5%	

4. Results

This research survey employs a mixed-methods approach, integrating both quantitative and qualitative data collection techniques. The quantitative analysis will involve calculating the percentage distributions for each data point and will be complemented by appropriate graphical representations. The qualitative analysis will consist of thematic coding of responses to group them based on similar meanings [20], followed by determining the percentage frequencies for each categorized theme.

4.1. Data Analysis:

4.1.1. Questionnaire 1- The traffic police officers data analysis:

The analysis of the consistent answers of the Questionnaire1 showed the following:

Accidents data reporting:

From the consistent answers to the first and fourth questions, 90% of the participants stated that the police use a unified form to fill in accident data and that there is a formal way to exchange information between the Police and the Medical staff.

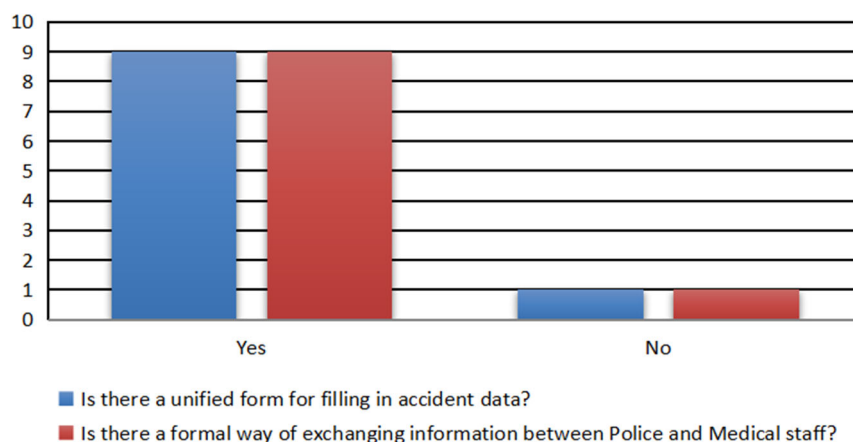


Figure 13. percentage of officers reporting unified forms

From the consistent answers to the second question about the average time the police take to reach the accident spot from the time of the accidents, 20% of the sample answered within one hour, and 10% answered with a time of less than 45 minutes. The answer with maximum time was 60 minutes and the answer with minimum time was 45 minutes. By taking the average time of the all-consistent answers, it was found that the average time to reach the accident spot from the time of the accident is about 51 minutes.

From the consistent answers to the third question about the average time the police take to reach the accident spot from the time of receiving the reporting the accidents, only 10% of the sample answered with a time of less than 40 minutes. The answer with maximum time was 55 minutes and the answer with minimum time was 35 minutes. By taking the average

time of the all-consistent answers, it was found that the average time to reach the accident spot from the time of the accident reporting is about 46 minutes.

From the answers to the second and third questions, it can be concluded that the accident reporting average time is around five minutes.

Injuries resulting from road accidents

From the consistent answers to the fifth question, it is found that about 21.5% of the VRUs involved in road accidents are subject to death. While 31% are subject to head and brain injuries, 35.1% are subject to limb injuries, 23.5% are subject to Chest and abdominal injuries, 17.1% are subject to Spinal cord injuries, and 14.6% are subject to other types of injuries. The sum of the percentages is above 100% because multiple injuries can occur to the same causality.

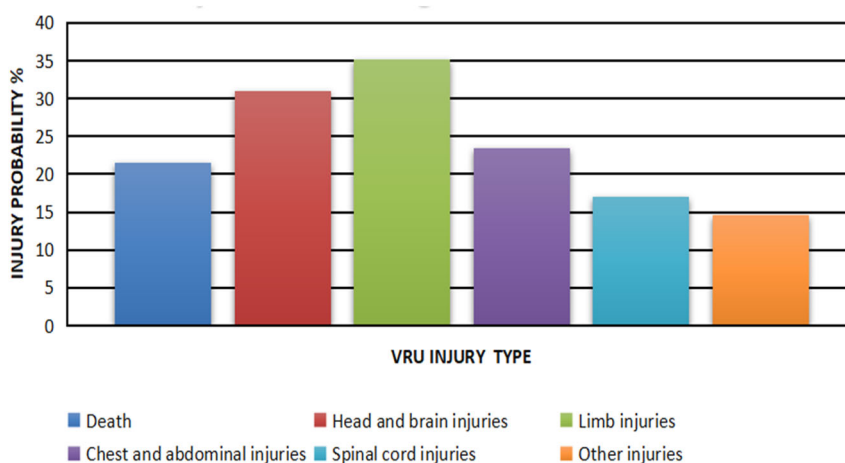


Figure 14. VRUs injuries resulting from road accidents (according to police staff)

Common VRU injuries resulting from road accidents:

Police investigation of road accidents:

From the consistent answers to the sixth question, 40% of the participants stated that the police time of the investigation before writing the accident report can be 24 hours or more, while 50% stated that it would take less than six hours. The answer with maximum time was 48 hours and the answer with minimum time was only one hour. By taking the answers average it is found that the average investigation time the

police will take before writing the accident report is about 16.7 hours.

From the consistent answers to the seventh question, it is found that the percentages of the use of the accident investigation procedures are; 32.6% for securing the scene, 40.7% for Gathering Preliminary Information, 36.3% for Interviewing/Investigating Parties Involved, 41.7% for documenting evidence, 35% examining vehicles, 22.5% for determining factors, 89.2% for creating Report, and 6.4% for other procedures.

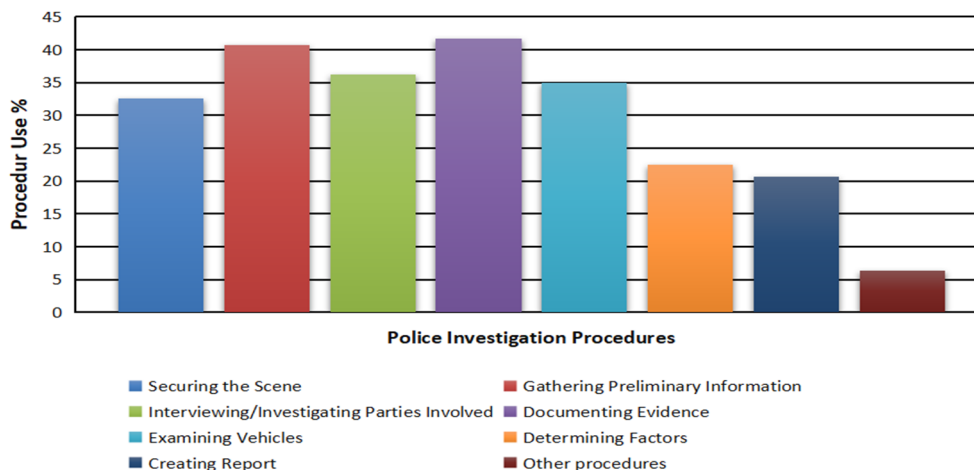


Figure 15. Police investigation procedures for road accidents

Road infrastructure, Traffic management equipment and law enforcement:

From the consistent answers to the eighth question, it is found that the percentage of the existence of a VRUs-

dedicated road infrastructure in the places of frequent VRU accidents is; 31.2% for Sidewalks, 21.6% for Crosswalks, 6% for Bicycle lanes, 8.1% for other infrastructures, and 8.5% for no infrastructures are exist.

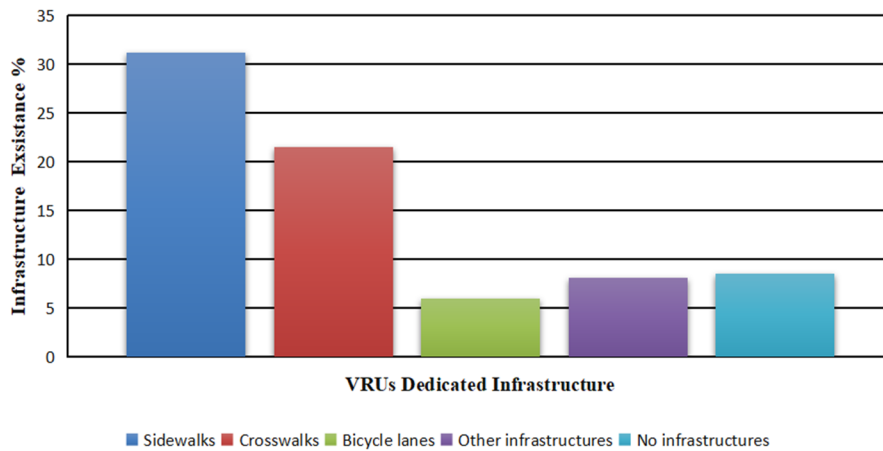


Figure 16. VRUs dedicated infrastructure in the places of frequent VRU accidents Road infrastructure dedicated to the VRUs:

From the consistent answers to the ninth question, it is found that the percentages of the existence of traffic management equipment and law enforcement personnel in the places of frequent VRU accidents are; 22.9% for Traffic signals, 15.9% for Traffic management personnel, 17.3% for

Traffic police patrol, 6.1% for other traffic management equipment and law enforcement methods, and 6.7% for no existence of traffic management equipment and law enforcement methods used in the places of frequent VRU accidents.

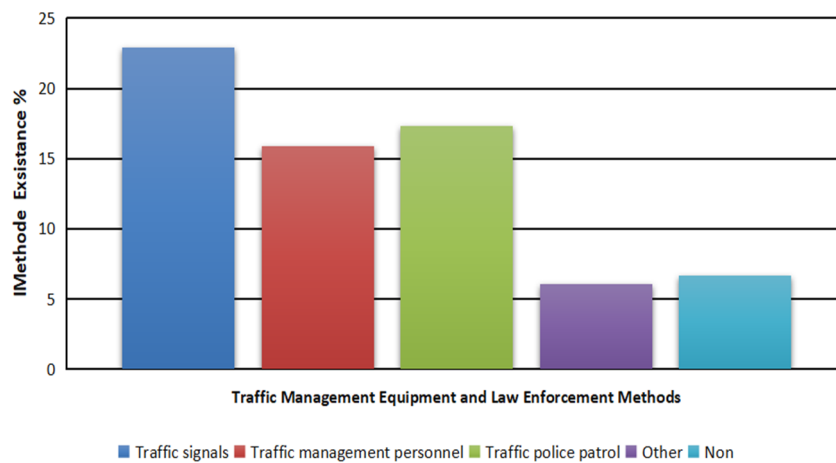


Figure 17. The traffic management equipment and law enforcement methods in the places of frequent VRU accidents

4.1.2. Questionnaire 2- Vulnerable Road Users (VRUs) data analysis:

From the consistent answers of the first question substantial 62.5% of the sample reported that they have occasionally avoided these modes of transportation due to safety concerns. Additionally, 37.5% indicated that they have frequently avoided walking, biking, or other non-motorized transport for

the same reason. Notably, 0.0% of the respondents stated that they have not avoided these modes of transportation due to safety concerns.

This highlights that road safety is a considerable issue for a large majority of individuals in the local area, with all respondents indicating that they have at least occasionally avoided walking, biking, or similar activities due to these concerns.

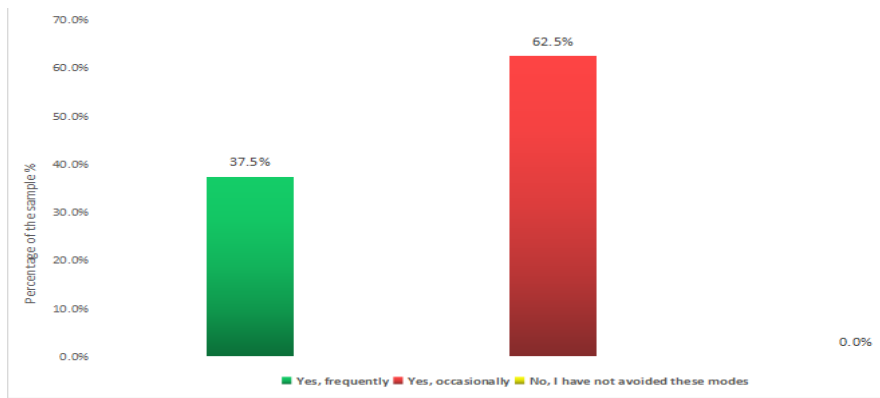


Figure 18. Avoided transportation modes due to safety concerns on the roads.

The results of the second question indicate that only 46.9% of respondents feel safe and this reveals a significant level of perceived unsafely among road users.

From the third question answers, overwhelming (100.0%) of the respondents indicated feeling most unsafe during

daytime (8 am - 5 pm) and also in the evening (5 pm - 9 pm). A small percentage, 12.5%, selected "Others" as the time they feel most unsafe. This survey reveals that VRUs experience the highest levels of unsafely during the daytime and evening hours.

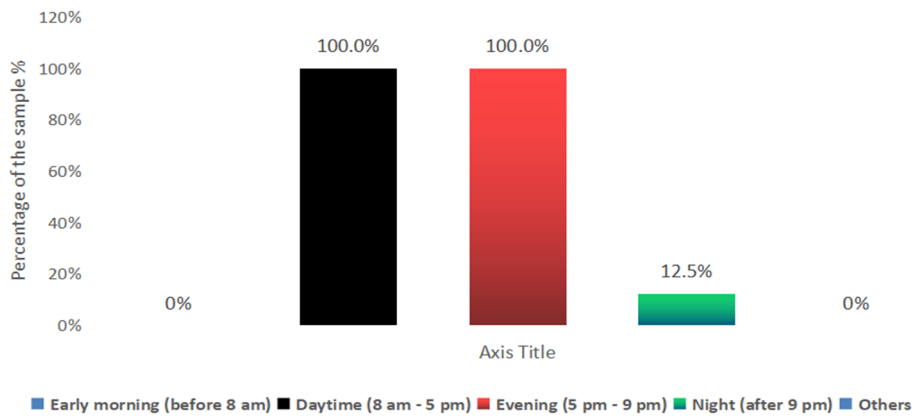


Figure 19. Time of the day do you feel most unsafe as VRUs

From the fourth question answers showed that collisions between cars and pedestrians (27.8%), collisions between cars and motorcycles (20.4%), and motorcycle-related accidents (19.3%) account for a significant majority of the

road traffic accidents, highlighting the vulnerability of pedestrians and motorcyclists in the Monrovia traffic environment.

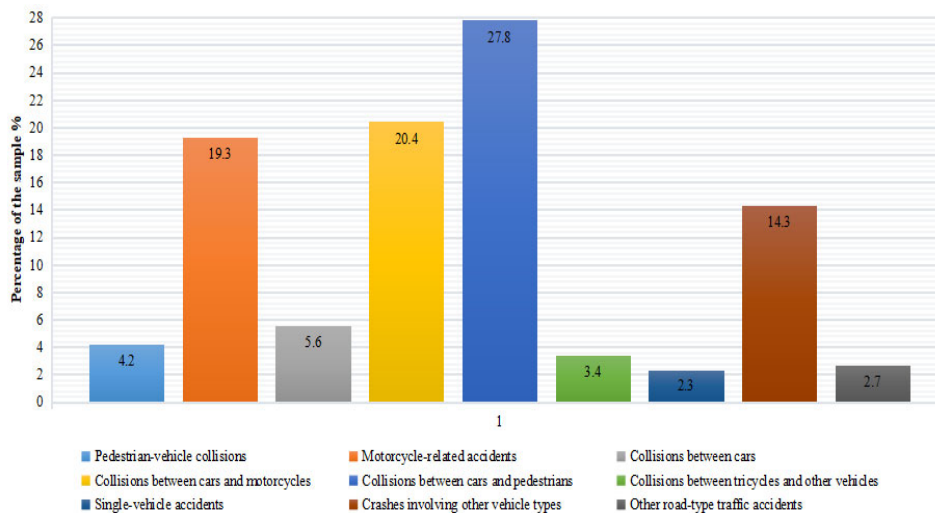


Figure 20. The most common road-type traffic accidents involving VRUs

From the fifth question results, 100% of all the listed infrastructure are needed for the safety features of VRUs.

From the sixth question answers (VRUs) in Monrovia observe that 80% of the drivers failing to check their blind spots or give them enough room when passing. Such behavior creates a consistently dangerous environment for VRUs, significantly increasing their risk of accidents and near misses.

From the seventh question answers, a substantial 56.3% of

respondents indicated that the poor condition of the road network significantly impacts their experience. This suggests issues such as potholes, uneven surfaces, and lack of proper infrastructure are prevalent and pose a considerable obstacle for pedestrians, cyclists, and motorcyclists.

An equal proportion (50.0%) of respondents pointed to reckless driving and defective vehicles as major challenges and (25.0%) of the surveyed VRUs highlighted the lack of traffic lights as a key factor affecting their navigation.

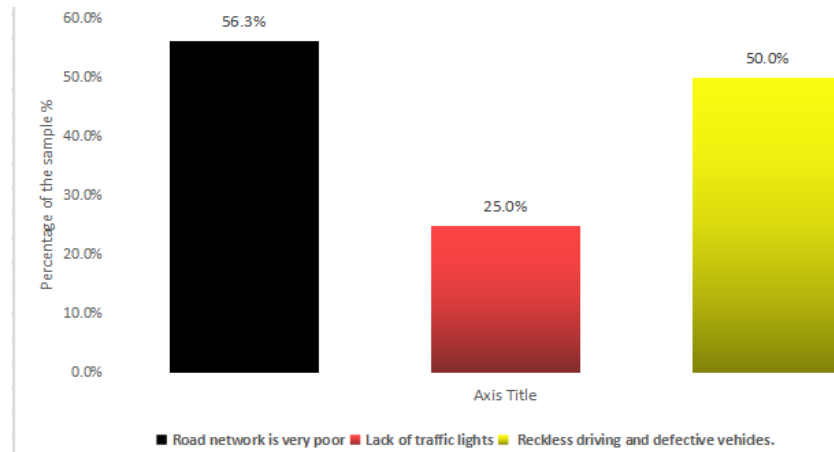


Figure 21. Experience as a VRUs navigating the roads and traffic in Monrovia Liberia.

From the eighth question, a significant portion of VRUs believe that safety education (68.8%) is the most impactful measure, enforcing traffic rules or laws (62.5%) is also considered crucial for improving safety and a notable percentage of respondents also highlighted the importance of

building better road infrastructure (56.3%). Finally, more pedestrian crossings and sidewalks (37.5%) were identified as a measure that would contribute to increased feelings of safety among VRUs.

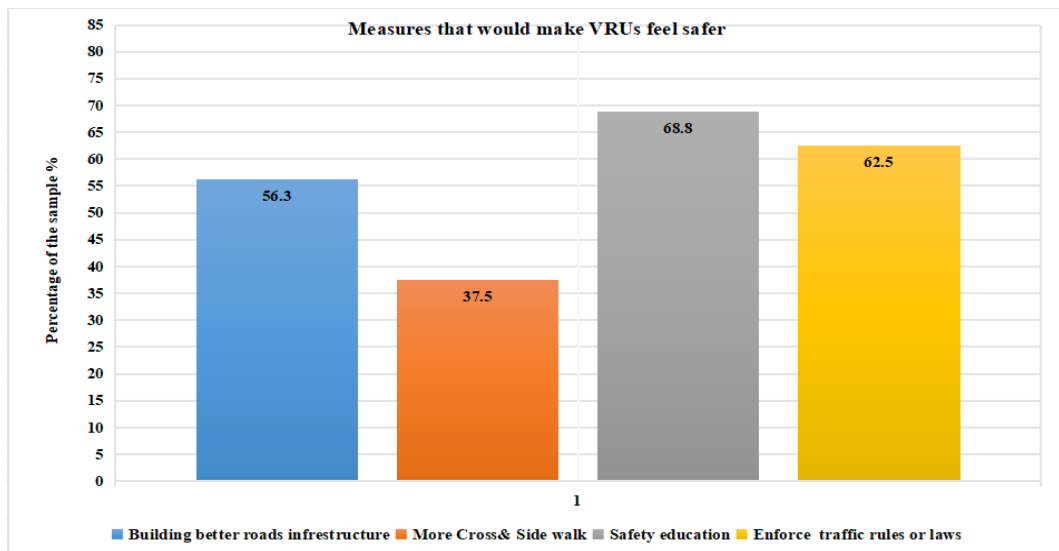


Figure 22. Measures or changes would make you feel safer as a VRU

From the ninth question, the results indicate that reckless drivers are the most significant safety concern, cited by 68.8% of the respondents, no traffic lights pose a substantial challenge, reported by 56.3% of VRUs, no crosswalks or sidewalks, which affect 50.0% of the sample, and bad road

conditions, experienced by 43.8%. Finally, too much CO2 emission was the least cited safety concern among the options provided, with only 12.5% of respondents identifying it as a major challenge.

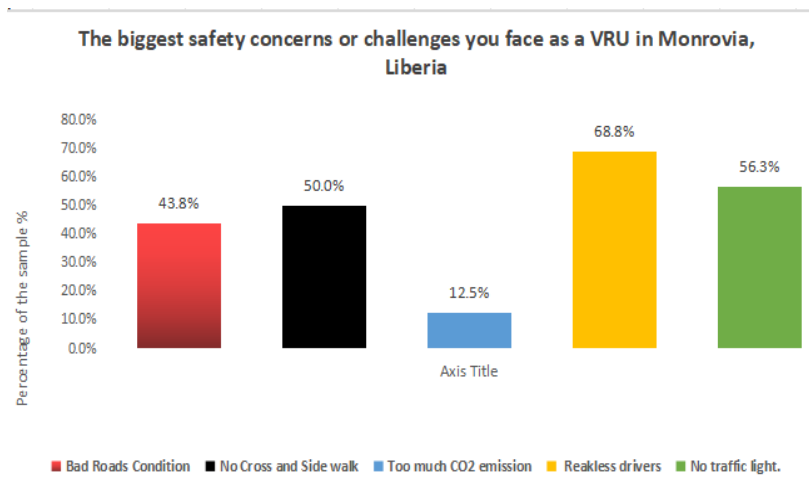


Figure 23. the biggest safety concerns or challenges you face as a VRU

The tenth question answers show that 100% of respondents reported that road traffic accidents have impacted their life or livelihood. This unanimous "yes" response underscores the pervasive and significant negative consequences of road traffic accidents on the individuals surveyed.

From the eleventh question answers, overwhelming majority of the sample, 83.9%, falls under the category of "No infrastructure." there are no specific provisions or dedicated infrastructure in place for vulnerable road users.

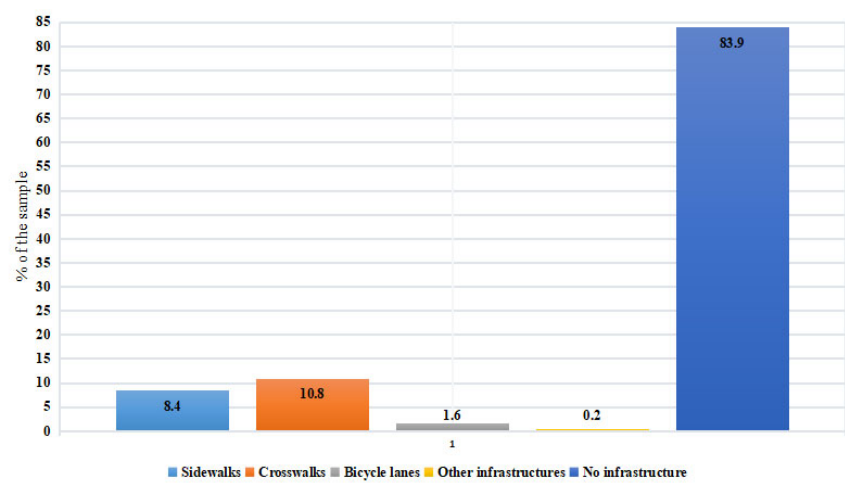


Figure 24. dedicated infrastructure for VRUs

From the twelfth question answers 85.7% of the surveyed locations indicated the absence of any traffic management or

law enforcement. This strongly suggests a significant gap in safety measures at these high-risk areas.

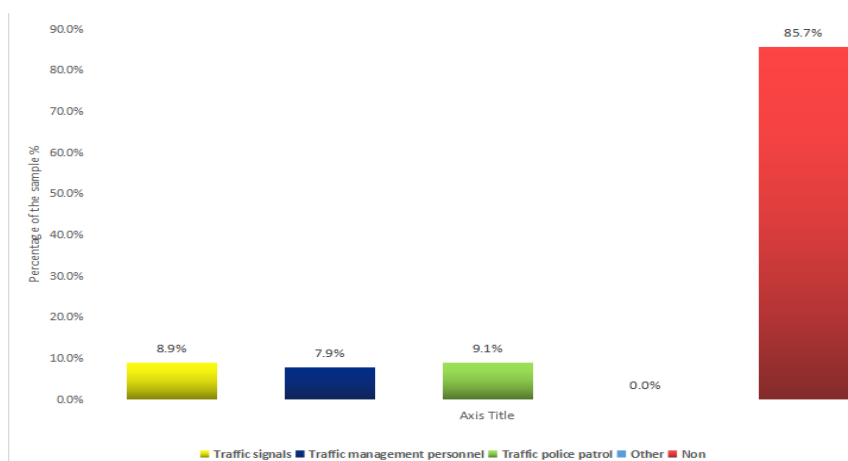


Figure 25. traffic management or law enforcement in the places of frequent VRU accidents.

From the thirteenth question answers, Sinkor 37.5%, Tubman Boulevard Road 31.3%, RIA Road that leads to the

airport 25% sample identified this road as posing high risks to VRUs.

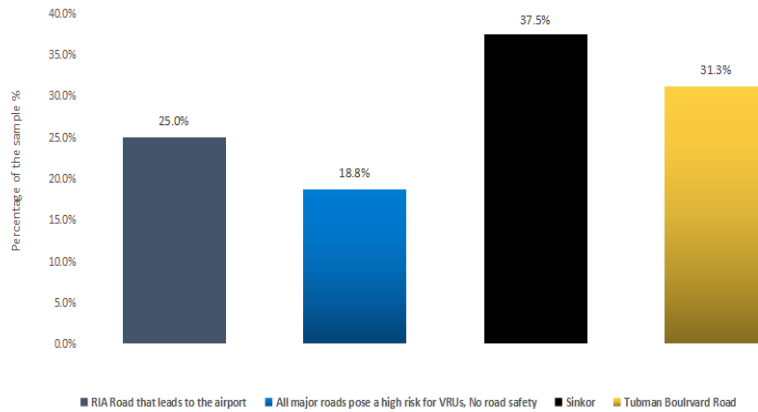


Figure 26. key areas or routes that pose the highest risks to VRU

From the fourteenth question consistent answers 81.3% of respondents, perceived the behaviour of other road users towards VRUs as very bad, 68.8% of the sample felt that reckless drivers pay less attention to VRUs, suggesting a lack

of awareness and consideration from a substantial portion of road users, 37.5%, described the behaviour of other road users as disrespectful towards VRUs.

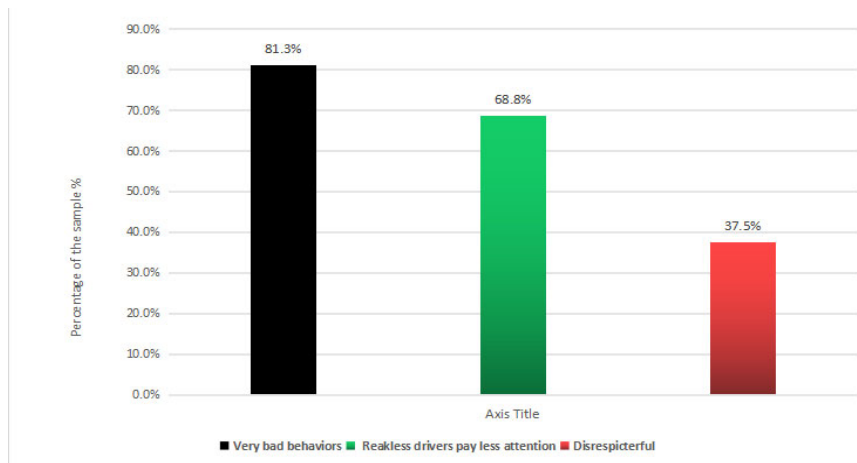


Figure 27. the behaviour of other road users towards VRU

From the fifteenth question consistent answers (81.3%) with over four out of five VRUs identifying the absence of adequate crossing infrastructure as a major issue, (62.5%

worried about the quality and condition of road infrastructure and (43.8%) express concerns regarding the enforcement of existing traffic rules and laws.

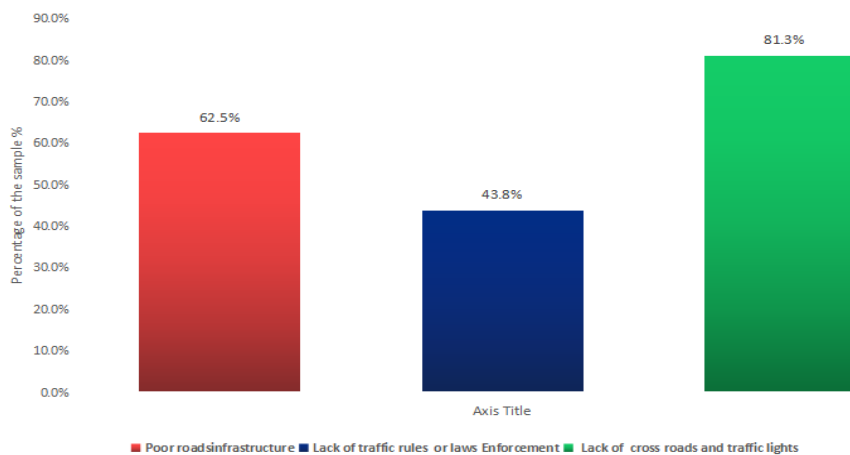


Figure 28. main safety concerns you have as a VRU

From the sixteenth question consistent answers 100% of the surveyed vulnerable road users (VRUs) report having been involved in road traffic incidents or near misses in the past year. This unanimous response strongly indicates a systemic safety issue for VRUs. The fact that every single respondent has experienced either a direct incident or a close call highlights a significant and urgent need for improvements in road safety measures to protect pedestrians, cyclists, and other vulnerable road users. This finding underscores the high risk faced by VRUs on the roads within the past year.

This seventeenth question answers indicates that, on average, respondents believe current road safety measures address the needs of vulnerable road users (VRUs) at a level of 33.8% out of 100%. This relatively low score suggests a significant level of dissatisfaction and indicates that VRUs perceive current measures as largely inadequate in addressing their safety needs.

4.2. Research Findings

The factors contributing to Vulnerable Road Users' (VRUs) poor road safety, as summarized and discussed in Section 2.4, exist in all countries worldwide. However, their relative contribution varies not only between developed and developing countries but also among developing countries according to specific national characteristics. These characteristics include, but are not limited to: GDP, political stability, education levels, geographic location, topography, local culture, car ownership rates, population growth, and existing transportation infrastructure.

One of the main objectives of the survey questionnaire conducted in Section 3.3 is to identify the real causes behind the safety issues of VRUs in Monrovia. Due to the lack of statistics and official data that can be used to support the questionnaire results, the specific factors that significantly contribute to poor road safety in Monrovia will be primarily identified from the survey questionnaire findings. These findings are presented below.

4.2.1. Questionnaire 1 - The traffic police officers

The survey revealed that the police use a unified form to record accident data and that there is a formal way to exchange information between the police and medical staff. This means that the basic data needed to build statistical information about road safety in Monrovia exists and requires an initiative from the government to establish an institute dedicated to collecting and publishing these data, as well as other relevant data.

It was found that most of the VRUs involved in road accidents are subject to death, while some suffer from head and brain injuries, limb injuries, chest and abdominal injuries, spinal cord injuries, and a few sustain other types of injuries. This reveals how poor VRUs road safety is and reflects the severe danger they face on Monrovia's roads.

It was also found that the average investigation time the police take before writing the accident report is about 16.7 hours. The accident investigation procedures involve securing the accident scene, gathering preliminary information, interviewing and investigating parties involved, documenting evidence, examining vehicles, creating a report, and other procedures. This indicates that accident investigations are thorough and time-consuming.

Furthermore, the findings from the survey reveal concerns regarding the existence of VRUs related road infrastructure.

It was found that sidewalks, crosswalks, bicycle lanes, and other infrastructures are present in very low percentages on the roads of Monrovia.

The findings also point to the percentages of the existence of traffic management equipment and law enforcement personnel in places of frequent VRUs accidents: 22.9% for traffic signals, 15.9% for traffic management personnel, 17.3% for traffic police patrol, 6.1% for other traffic management equipment and law enforcement methods, and 6.7% for no existence of traffic management equipment and law enforcement methods. This indicates that the lack of law enforcement and traffic management equipment are significant factors reducing VRUs safety.

4.2.2. Questionnaire 2- Vulnerable Road Users (VRUs)

The survey revealed that a substantial 62.5% of the sample reported occasionally avoiding certain modes of transportation due to safety concerns, while 37.5% indicated that they frequently did so. An overwhelming 100% of respondents reported feeling most unsafe during the daytime (8 AM–5 PM) and evening (5 PM–9 PM).

Additional findings indicate that Somalia Drive, Tubman Boulevard, Sinkor Old Road, RIA Road, and SKD Boulevard are the most heavily trafficked and significantly dangerous main roads, often referred to as black spots. Collisions between cars and pedestrians, collisions between cars and motorcycles, and motorcycle-related accidents account for a significant majority of reported road traffic accidents, underscoring the urgent need for targeted interventions to enhance VRU safety.

Further findings highlight that the challenges faced by VRUs are multifaceted, encompassing both significant infrastructural deficits and concerning behaviors from other road users. Participants overwhelmingly noted the inadequacy of existing infrastructure, including the lack of designated walkways, cycle lanes, and safe crossing points, as major impediments to their safety.

Furthermore, findings indicated that addressing these challenges requires a multi-pronged approach. A significant portion of VRUs believe that safety education (68.8%), enforcement of traffic rules and laws (62.5%), building better road infrastructure (including pedestrian crossings and sidewalks) (37.5%), and sustained public awareness campaigns that foster a culture of respect and safety for all road users would contribute to increased feelings of safety among VRUs.

5. Discussion

5.1. Key Issues Identified:

The survey (VRUs) on road safety issues in Monrovia, Liberia, has identified key issues among many that the city faces, leading to a high accident rate, particularly involving VRUs.

1. **Inadequate Infrastructure:** There's a pronounced lack of dedicated lanes for pedestrians and cyclists, forcing them into shared spaces with vehicular traffic. including numerous potholes, inadequate road capacity, and poorly designed intersections. Furthermore, poor signage and road markings are prevalent, contributing to confusion and danger for all road users.

2. **Lapses in Law Enforcement:** The survey points to weak enforcement of traffic laws, allowing for widespread

violations like speeding and reckless driving. Also, a culture of reckless driving is prevalent, characterized by speeding, driving under the influence, and disregard for traffic rules.

3. **Lack of Awareness and Education:** There's a general lack of public education and awareness regarding road safety practices among all road users, including drivers, passengers, and pedestrians. This contributes to unsafe behaviors.

4. **Poor Road Design and Maintenance:** Many roads in Monrovia are in disrepair, characterized by potholes and inadequate capacities to handle increasing traffic volumes. Poorly designed junctions, a lack of modern traffic signals, and insufficient road markings further exacerbate the problem.

5.2. Comparative Analysis:

The findings from the Monrovia VRUs road safety survey findings align significantly with broader research on road safety challenges in (LMICs), particularly within Africa. The issues identified are remarkably consistent with patterns observed globally in these regions.

1. **High VRUs Vulnerability:** The survey's focus on VRUs as disproportionately affected by accidents directly reflects global trends in LMICs, where these groups comprise the majority of road traffic fatalities.

2. **Infrastructure Deficiencies:** The identified issues of lacking pedestrian/cyclist facilities, poor road quality (potholes, inadequate design), insufficient lighting, and absent road signs are universally cited problems in LMICs, directly contributing to road hazards.

3. **Weak Law and Policy Implications:** Law enforcement of traffic laws, corruption, insufficient driver training/licensing, and the absence of vehicle road worthiness testing are consistent challenges across many developing nations, undermining safety regulations.

4. **Low Awareness and Education:** A general lack of public awareness and education on road safety is a consistent finding, contributing to risky behaviors among both drivers and VRUs.

5.3. Limitations:

This research on VRUs road safety issues in Monrovia, Liberia, face several limitations that could have affected the comprehensiveness, generalizability, and accuracy of the findings. Here are some common limitations:

1. **Poor Data Availability:** Monrovia, Liberia like many cities in LMICs, may lack comprehensive, consistently collected, and reliable official data on road traffic crashes, injuries, and fatalities, especially those disaggregated by VRUs type. This makes it difficult to establish a clear baseline or accurately assess the magnitude of the problem.

2. **Resource Constraints:** Limited funding, insufficient trained personnel, and tight time lines can restrict the scope and depth of the survey.

3. **Language Barriers:** While English is official, local dialects might require trained interviewers to ensure accurate understanding and response.

6. Solutions & Recommendations

This research findings have identified Monrovia, Liberia faces significant challenges in protecting (VRUs) including pedestrians, motorcyclists, and cyclists etc.

These challenges are exacerbated mainly to the lack of proper road infrastructure, weak enforcement of traffic laws, a lack of education, poor road conditions, maintenance, a lack of national safety ethics and culture, corruption. and prevalent unsafe driving behaviors all contribute to a high incidence of

accidents.

Addressing these issues requires a multi-faceted approach with both short-term and long-term solutions that serve as a strategic plan to enhance VRUs, this suggested solution focuses only on the applicable solutions according to the findings of the study, that means many solutions involving advanced technology and intelligent transportation systems (ITS) and rebuilding new roads etc, will not be included in the immediate solutions.

6.1. Short-Term: Immediate Impact and Awareness

These solutions can be put into action relatively quickly and with potentially lower initial costs, focusing more on behavioral changes and basic infrastructure improvements.

The immediately implementable solutions will be suggested in three categories; the first related to the actions need to be done by the government, the second related to the actions need to be done by the society initiatives, and the third done by private businesses sector.

6.1.1. Government immediate actions to improve the VRUs safety:

This section highlights the immediate actions that can be done by the government to improve the VRUs safety in Monrovia focusing on enforcement, funding, and data collection. Key recommendations include:

Stricter Enforcement and Penalties: Implementing rigorous enforcement of traffic laws through patrols and surveillance to deter dangerous driving. This also involves stricter licensing tests that include health examinations and severe penalties for traffic violations to discourage reckless behavior. Public awareness campaigns regarding significant risks are also crucial.

Adequate Funding for Law Enforcement: Ensuring sufficient financial resources for law enforcement agencies to effectively enforce traffic regulations. Under funding can lead to reduced patrols, inadequate training, and slower emergency response times, all of which compromise VRU safety.

Dedicated Accident Data Management: Establishing a government entity responsible for collecting, publishing, and improving the quality of accident data (e.g., in Monrovia). This branch should also focus on integrating police accident data with medical data to create a more comprehensive and accurate picture of road incidents.

6.1.2. Society actions plan to improving VRUs safety:

Despite the effort need to be done by the government, without a strong support from the society like local communities leaders and religious leaders etc in Monrovia, Liberia can play crucial roles in improving the safety of VRUs through a variety of interconnected strategies like Awareness and Education Campaigns, Community-Based Safety Initiatives, and Promoting Responsible Behavior etc. Key strategies include:

1. **Public Education Campaigns:** Implementing comprehensive public education campaigns to raise road safety awareness for all road users, especially vulnerable ones (VRUs). This includes teaching pedestrians safe walking and crossing practices, training cyclists and motorcyclists on road rules and the importance of protective gear (like helmets), and educating drivers on defensive driving techniques and vigilance towards VRUs.

2. **Community-Led Local Safety Initiatives:** Establishing and supporting local road safety groups. These groups, under

the joint supervision of community leaders and government officials, would be responsible for identifying and implementing localized safety measures, such as adding speed bumps, installing warning signs, and improving nighttime lighting.

3. Community Volunteer Engagement: Supporting local road safety groups that actively train and utilize community volunteers to assist with road safety awareness campaigns, further extending their reach and impact.

6.1.3. Private sector actions to improving VRUs safety:

The significant role the private sector can play in enhancing road safety for (VRUs) in Monrovia, Liberia,

1. Promoting Road Safety Education and Awareness: Private companies can fund and execute public campaigns on pedestrian, cyclist, motorcyclist, and driver safety (e.g., safe crossing, helmet use, defensive driving). They can also partner with local safety groups and implement internal employee training programs.

2. Implementing Safer Business Practices: Businesses with vehicle fleets (e.g., transportation, logistics) can adopt stringent safety policies, including regular maintenance, driver training, and technology adoption (e.g., advanced braking).

3. Investing in infrastructure, technology, and public education, by doing this private companies can enhance safety, reduce costs associated with accidents, and contribute to a more sustainable and equitable transportation system.

6.2. Long-Term: Sustainable Solutions and Systemic Change

To achieve sustainable and significant progress in VRU road safety, a long-term commitment, substantial investment, and comprehensive strategies are required to address the underlying issues of infrastructure, regulation, and enforcement.

1. Intelligent Transportation Systems (ITS): It advocates for developing and implementing ITS solutions tailored to Monrovia's specific context, considering existing fund, infrastructure, cultural norms, and education levels. The goal is to enhance the safety of vulnerable road users (VRUs).

2. Enhanced Vehicle Safety: The plan emphasizes strengthening vehicle safety standards and promoting designs that reduce the risk of harm to individuals in the event of an accident.

3. Sustainable Transportation Management: It proposes building a robust transportation management system to improve road safety through strategies like "black spot management" (identifying and addressing high-accident locations) and "network safety management" (systematically improving safety across the entire road network).

7. Conclusion

In conclusion, this research on the poor road safety on (VRUs) issues in Monrovia, Liberia has shed light on the significant challenges faced by VRUs and the broader consequences on the socio-economic fabric of these countries. The findings have highlighted the urgent need for effective measures and policies to improve road safety for VRUs and mitigate the negative impact on the social economy.

To achieve the objectives of this study, a thorough literature review on VRUs safety issues was conducted. This review covered various factors contributing to poor VRUs road safety, the consequences of VRUs safety issues, and the

methodologies used in VRUs safety studies. Then, a comprehensive evaluation of the existing situation in Monrovia, Liberia, was carried out, including an assessment of socio-economic conditions, land use, roadway conditions, public transport infrastructure, driver behavior, and other relevant factors.

The research has shown that VRUs, including pedestrians, cyclists, and motorcyclists, are particularly at risk due to poor road safety conditions, inadequate infrastructure, and lack of awareness and education. The consequences of accidents involving VRUs are not limited to physical injuries but also extend to economic burdens, such as increased healthcare costs, loss of productivity, and reduced quality of life. These burdens disproportionately affect vulnerable populations, exacerbating social inequalities.

To address these issues, a multi-faceted approach involving both immediate and longer-term solutions is suggested. Immediate actions to be undertaken by the government, community initiatives etc, are proposed. Additionally, long-term plans and actions are outlined. Finally, by addressing infrastructure deficiencies, promoting education and awareness, strengthening policies and regulations etc, it is possible to create safer road environments in Monrovia, Liberia, as well as in other low- and middle-income countries (LMICs).

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