

## Analysis Of Motorcycle Accident Cases And Casualties In Ilorin Metropolis, Nigeria

Abdulganiyu Tunde Ogunbiyi<sup>1</sup>, Biliyamin A. Ibitoye<sup>2</sup>, Mariam Funmilayo Daudu<sup>3</sup>, Na'Allah Abdulmumin Bolaji<sup>4</sup>, Muktar Oladapo Raji<sup>5</sup>, Mohammed Abdulkareem Adisa<sup>6</sup>

<sup>1,2,3,6</sup>Department of Civil Engineering, Kwara State University, Malete. Nigeria

<sup>4</sup>Department of Civil Engineering, Kwara State Polytechnic, Ilorin. Nigeria

<sup>5</sup>University of Ilorin Teaching Hospital

<sup>1</sup>Engrtundeogunbiyi@gmail.com, <sup>2</sup>biliyamin.ibitoye@kwasu.edu.ng, <sup>3</sup>daudu.mariam@gmail.com,

<sup>4</sup>naallah.a@kwarastatepolytechnic.edu.ng, <sup>5</sup>mraji@uithilorin.org.ng, <sup>6</sup>mickeya344@gmail.com

Corresponding Author: biliyamin.ibitoye@kwasu.edu.ng

### Abstract

Motorcycle transportation is an essential yet hazardous component of urban mobility in Ilorin, Nigeria, contributing significantly to road traffic injuries and fatalities. This study aimed to evaluate the causes, annual trends, and spatial patterns of motorcycle accidents in the metropolis while validating official records against victim reports. A mixed-methods research design was implemented, utilizing primary data from 384 questionnaires administered to motorcyclists, victims, and healthcare professionals, alongside 10-year secondary records (2015–2024) from the Federal Road Safety Corps. Analytical tools included SPSS and Microsoft Excel for statistical trends, while ArcMap 10.8's Kernel Density tool was used for spatial mapping. Results indicate that accidents are predominantly driven by behavioral factors, specifically intoxication (53.02%) and speed violations, with key flashpoints identified at Maraba, Post Office Area, and Fate Roundabout. Notably, the validation of official data revealed a very weak correlation between victim reports and institutional records ( $R^2 = 0.072$ ;  $p = 0.606$ ), suggesting potential recall bias and reporting gaps. The study concludes that motorcycle accidents in Ilorin are shaped by a synergy of risky rider behavior and infrastructure deficits. Consequently, enhancing road safety requires a multifaceted strategy involving stricter traffic enforcement, public sensitization campaigns, infrastructure upgrades, and improved emergency medical response logistics.

**KEYWORDS:** Road traffic accident, Motorcycle transportation, Injuries and Fatalities, geographical distribution, traffic enforcement.

### 1. INTRODUCTION

Motorcycles, locally known as "okada," have become an indispensable mode of transportation in many Nigerian cities, particularly in Ilorin, the capital of Kwara State. Their popularity stems from affordability, flexibility, and ability to navigate congested traffic, especially in the face of inadequate public transportation systems. This has led to a rapid increase in motorcycle usage for daily commuting, further intensified by economic pressures such as fuel subsidy removal.

However, the surge in motorcycle use has been accompanied by a sharp rise in road traffic accidents. Motorcycles are disproportionately involved in crashes despite constituting a relatively small proportion of the total vehicle fleet. According to the Federal Road Safety Corps (FRSC), Nigeria recorded 10,617 road traffic crashes in 2023, resulting in 5,081 fatalities, with a further increase to 5,421 fatalities in 2024. Studies indicate that motorcycles account for over 30% of road traffic crashes in urban areas (Ezeme et al., 2023). In Ilorin, motorcycle accidents have become a major public health concern, particularly affecting young males aged 15–44 years — the most economically productive segment of the population.

Several factors contribute to the high rate of motorcycle accidents in the city, including poor road infrastructure, absence of dedicated motorcycle lanes, inadequate enforcement of traffic regulations, and risky riding behaviours such as speeding and non-use of protective gear. Notably, helmet usage remains critically low among both riders and passengers, largely due to cultural beliefs, discomfort, and low awareness. This low compliance significantly increases the severity of injuries, especially head injuries.

Despite the growing burden of motorcycle-related accidents in Ilorin, there is limited localized research on the patterns, causes, and severity of these incidents. Existing national data often fails to capture city-specific dynamics, thereby hindering the development of targeted interventions.

This study therefore seeks to address this gap by analyzing the major causes and severity of motorcycle accidents in Ilorin, evaluating their annual trends and patterns, generating a spatial distribution map of accident hotspots, and validating official records against victims' reports. The objectives of this study were to analyze the major causes and severity of motorcycle accidents in Ilorin, evaluate their annual trends and patterns, and generate spatial distribution maps of these incidents. Additionally, the research sought to validate official motorcycle accident data from the Federal Road Safety Corps (FRSC) against reports provided by victims to identify potential discrepancies.

## 2. MATERIALS AND METHODS

### 2.1 Description of the Study Area

Ilorin, the capital city of Kwara State, Nigeria, serves as the focus for this study on motorcycle accidents. Located in the central region of Nigeria, Ilorin lies at approximately 8.48 ° N and 4.54 ° E and is strategically positioned at the intersection of major roads connecting the northern and southern parts of the country. Its rapid urbanisation and growing population have led to increased vehicular traffic, particularly motorcycles, which are widely used for both passenger transport and the delivery of goods. The city's road network is characterised by a mix of major highways, arterial roads and smaller, poorly maintained roads, creating a challenging environment for road users, especially motorcyclists

The urbanisation of Ilorin has led to significant infrastructure challenges, including road congestion, poorly planned traffic management systems, and insufficient pedestrian facilities. These factors have contributed to a rise in road accidents, with motorcycles being involved in a disproportionate number of crashes. The increasing reliance on motorcycles for public transportation makes them a critical component of the city's transportation system. However, the lack of regulation, combined with deficiencies in road infrastructure, has made Ilorin one of Nigeria's cities with a high incidence of motorcycle-related accidents. Fig. 1 below shows a map of Ilorin depicting the study area.





**Fig.1: Map of Ilorin depicting the study area**

**2.2 Data Collection Methods**

A mixed-methods approach was employed, utilising primary and secondary data. Structured questionnaires, as a source of primary data, were administered to four key respondent groups: motorcycle accident victims, motorcyclists, healthcare professionals, and law enforcement officers. The combination of primary and secondary data sources ensures the research captures both the ground realities and broader contextual information about motorcycle accidents in the city.

Official 10-year Motorcycle Accident records from the Federal Road Safety Commission, the Nigerian Police Force, and the University of Ilorin Teaching Hospital were obtained. The focus of both data sources was to understand the causes, severity, trends, and patterns, as well as the locational distributions, of motorcycle accidents in Ilorin.

**2.2.1 Primary Data**

The questionnaire constitutes the main primary data employed for this study. The respondent groups are motorcycle accident victims, motorcyclists, healthcare personnel from the University of Ilorin Teaching Hospital, and law enforcement officers from the Federal Road Safety Corps (FRSC), the Nigeria Police Force, and the Kwara State Roads Traffic Management Agency (KWATMA). These data are essential for understanding the on-ground dynamics of motorcycle accidents in Ilorin, as they provide first-hand insights into the actual conditions and experiences of motorcyclists, road users, and traffic officials. The sampling technique for each respondent group is presented in Table 2.1.

**Table 2.1 Respondent Group Sampling Technique**

<b>Respondent group</b>	<b>Type of sampling</b>	<b>Location</b>
Motorcyclists	Stratified	Unions, garages
Accident victims	Purposive (targeted)	Hospitals
Healthcare personnel	Purposive	Hospital
Law enforcement officers (FRSC, KWATMA, Police)	Purposive	Offices

**2.2.2 Secondary data**

Official MCA reports from the FRSC, the Nigerian Police Force, and the University of Ilorin Teaching Hospital were obtained to understand the frequency, severity, and types of motorcycle accidents in Ilorin. These records included data on the number of accidents, the parties involved, and the time and location of the incidents. According to FRSC data, between January and June 2025, 1247 motorcyclists were newly registered. However, the Motorcycle Operators Association of Nigeria, Kwara State, reported that the total number of active motorcyclists in Ilorin is currently 8,000. This Fig. was used to determine the sample size for the questionnaire-based data collection among motorcyclists, as enumerated below.

Cochran’s formula (for 95% confidence level and proportion  $p = 0.5$ ) is given by equation 3.1.

$$n_o = \frac{Z^2 \cdot p(1-p)}{e^2} \quad (1)$$

Where:

- $Z$  = Z-score for confidence level (e.g., 1.96 for 95%)
- $p$  = estimated proportion of population (use 0.5 for maximum variability)
- $e$  = margin of error (e.g., 0.05)

For this study,

$$n_o = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2} = 384.16$$

Israel (1992) explains that when the sample comprises more than 5% of the population (i.e.  $\frac{n_o}{N} > 0.05$ ) The Finite Population Correction (FPC) should be applied to adjust the sample size for better accuracy, as shown in equation 3.2

Step 2: Use the FPC when your sample size is  $> 5\%$  of the population:

$$n = \frac{n_o}{1 + (\frac{n_o - 1}{N})} \quad (2)$$

For this study,  $n_o = 384.16$ ,  $N = 8000$

$$\therefore \frac{n_o}{N} = \frac{384.16}{8000} = 0.048 < 0.05$$

Hence, the FPC is not applied. Therefore, the number of motorcyclists required for the questionnaire is 384.

### 2.2.3 Data Analysis Techniques

Data analysis is a critical component of the research process, as it involves transforming the raw data into meaningful information that can answer the research questions. The data gathered through the questionnaire, accident reports, police records, and other statistical sources were analysed using descriptive statistics, such as percentages, to summarise patterns in motorcycle accidents across locations, times, and accident severity. In addition to statistical analysis, charts were used to present the data clearly and intuitively. SPSS, OriginPro and Microsoft Excel were used to perform these analyses.

The Kernel Density tool in ArcMap 10.8 was employed for spatial distribution analysis to generate a heatmap identifying areas with high rates of motorcycle accidents. These visualisations will facilitate the interpretation of trends, accident hotspots, and relationships among variables.

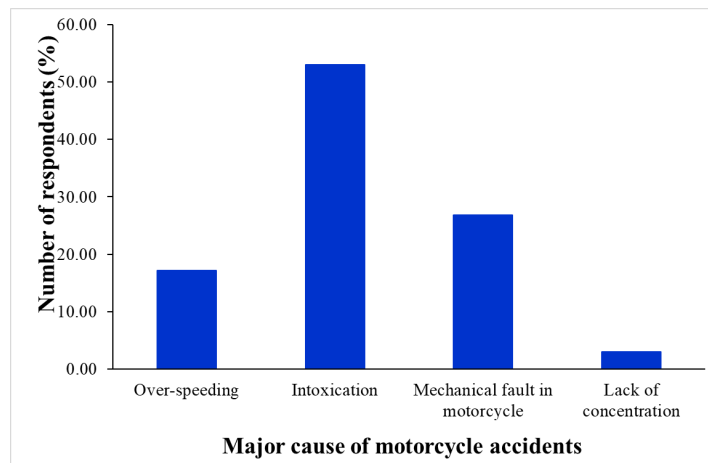
## 3. RESULTS AND DISCUSSION

### 3.1 Primary Data Results

#### 3.1.1 Major Causes of Motorcycle Accidents

Fig. 2, below, shows the major causes of motorcycle accidents in Ilorin as obtained from the primary sources.



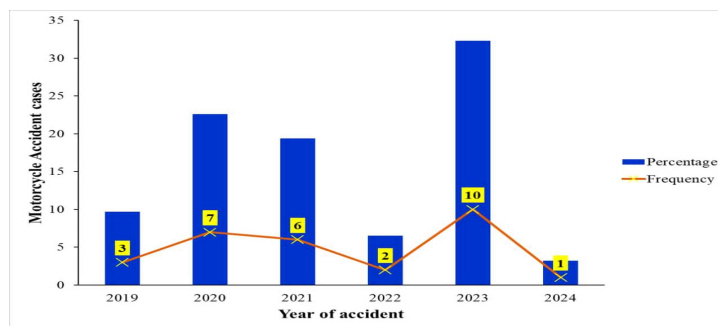


**Fig. 2: Major causes of motorcycle accidents by respondents**

The respondents attributed the major cause of motorcycle accidents to intoxication (53.02%), followed by mechanical faults (26.81%). 17.14% and 3.02% motorcycle accidents were attributed to overspeeding and lack of concentration, respectively. Mechanical faults may indicate a poor maintenance culture among the motorcyclists. Intoxication, over-speeding and lack of concentration make up for almost 75% of the causes of MCAs, which reflect the significance of behavioural factors in motorcycle accident occurrences.

**3.1.2 Accident Trends and Patterns in Ilorin**

Fig. 3 below presents the accident pattern by year from 2019 to 2024 from the primary source. Data obtained from the primary source does not reveal accident trend data for the years preceding 2019.

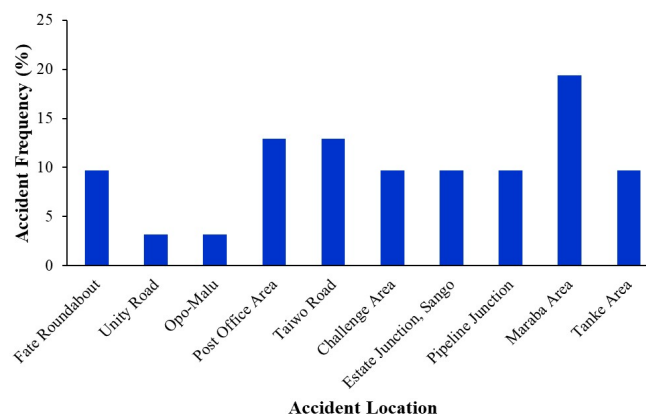


**Fig. 3: Accident pattern by year from motorcycle accident victims**

**3.1.3 Generation of Spatial Map Distribution of Motorcycle Accidents in Ilorin**

The Primary findings identified Fate Roundabout as the most accident-prone area, accounting for 90% of the reported cases, and nearly uniform distributions were observed for the Maraba area, Post Office area, and Pipeline Junction.

The use of graduated symbols (bubbles) in the map, as shown in Fig. 5 below, highlights the roads with the highest frequency of reported accidents. The size of the bubbles indicates the frequency of motorcycle accidents on a road

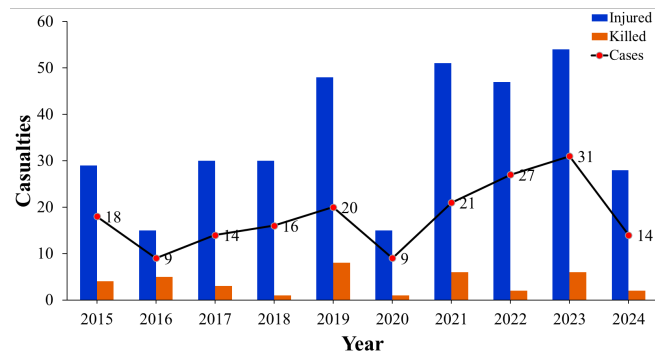


**Fig.4: Locational distribution of motorcycle accident by motorcycle accident victims**





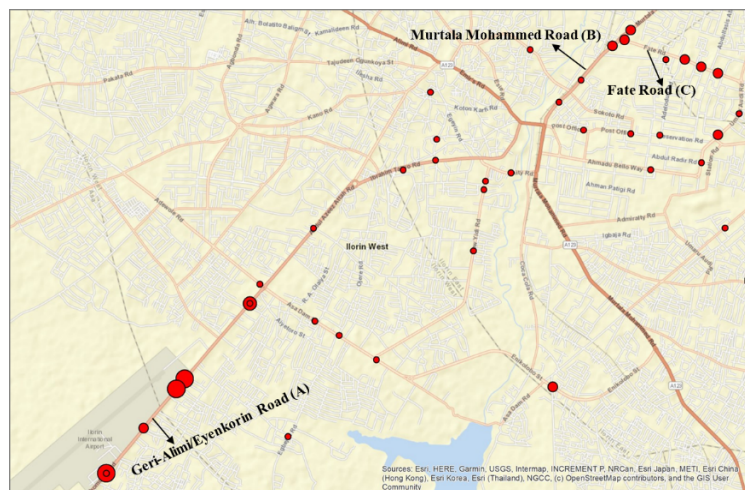
Statistics and the Federal Road Safety Corps (NBS/FRSC, 2024), overall road traffic accidents decreased in the second quarter of 2024 compared to the same period in 2023.



**Fig 7: Trends and Patterns of Motorcycle Accidents**

### 3.2.3 Spatial Distribution Map of Motorcycle Accidents

The spatial analysis of motorcycle accident locations in Ilorin reveals a highly uneven distribution across the city. Just as in the primary findings, the use of graduated symbols (bubbles) in the map is also used, as shown in Fig. 8 below, to highlight the roads with the highest frequency of reported accidents. The size of the bubbles indicates the frequency of motorcycle accidents on a road. Large bubbles in descending order can be observed on Geri-Alimi/Eyenkorin Road (marked A), Murtala Mohammed Road (marked B), and Fate Road (marked C), suggesting these roads are hotspots for motorcycle crashes. The high accident rate along the Geri-Alimi/Eyenkorin Road may be attributed to its wide carriageway and its location at the city outskirts, which often results in lower traffic volumes. This reduced congestion may encourage excessive speeding, thereby increasing the likelihood and severity of motorcycle accidents.



**Fig 8: Spatial Distribution Map of Motorcycle Accidents**

### 3.3 Comparison of Secondary and Primary Data

This section investigates the patterns, causes, and consequences of motorcycle accidents in Ilorin using both primary data collected through questionnaires to determine the perceptions and experiences of stakeholders such as victims, motorcyclists, healthcare professionals, and law enforcement agents and secondary data obtained from the Federal Road Safety Corps (FRSC) for the period 2015–2024. Key findings are highlighted below.

#### 3.3.1 Comparison of Causes of Motorcycle Accidents

To enable a meaningful comparison of the causes of MCAs between the questionnaire (primary data) and the FRSC records (secondary data), it was necessary to harmonise the categories reported by FRSC into the classifications identified in the questionnaire.

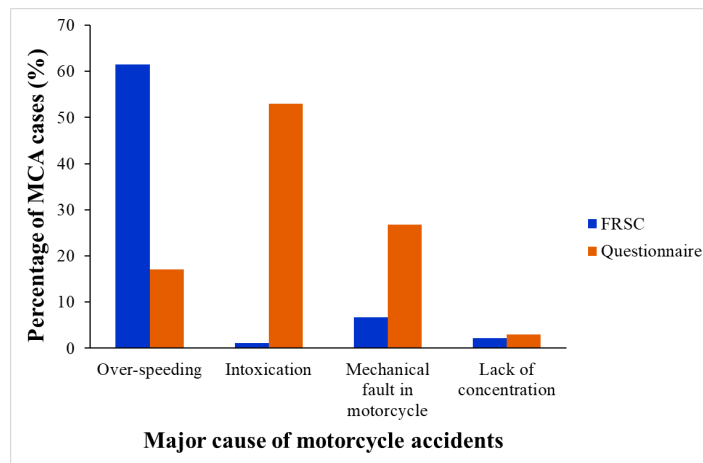


Fig.9: MCA caused by the data source

### 3.3.2 Comparison of Annual Accident Trends between FRSC Records and Questionnaire Data

Although FRSC records spanned 10 years (2015–2024), the responses from the MCA victims covered only the most recent 6 years (2019–2024). To ensure comparability, the comparison was restricted to the overlapping period between the two datasets. Fig. 10 presents a comparison of the two datasets.

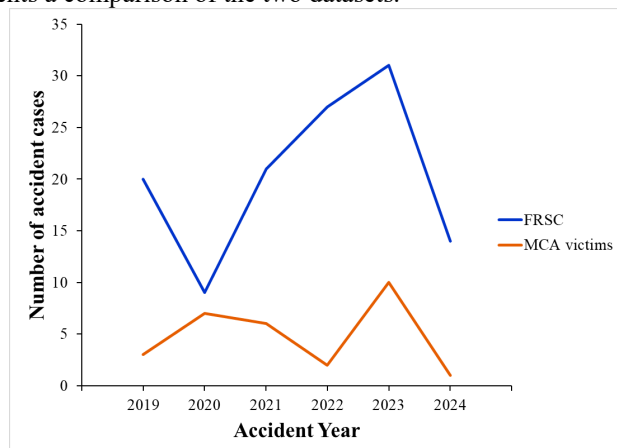


Fig. 10: Accident trend comparison

### 3.3.3 Comparison of Accident Hotspots

Fate Roundabout consistently emerged as a critical hotspot across all sources. Variations reflect differences in institutional reporting, experiences and perceptions.

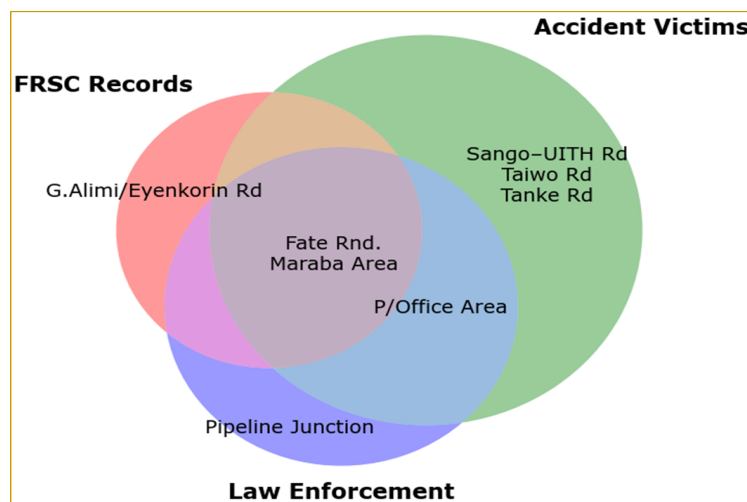


Fig.11: A Ven Diagram Comparing Different Accident Spots

### 3.4. Validation of the Official Motorcycle Accidents Record with Motorcycle Accident Victims' Reports

Fig. 12 below is a scatter plot showing the relationship between primary victim reports and secondary FRSC cases from 2019 to 2024

Regression equation:  $FRSC\ cases = 2.5143 + 0.1141 \times (victim\ reports)$

$R^2 = 0.072$  (the model explains only ~7.2% of the variance)

Pearson  $r = 0.269$  ( $p = 0.606$ ) — very weak, non-significant linear correlation

There is no meaningful linear relationship between primary victim sample counts and the official annual case counts. The model explains almost none of the variation ( $R^2 = 0.072$ ) and the slopes are not statistically significant.

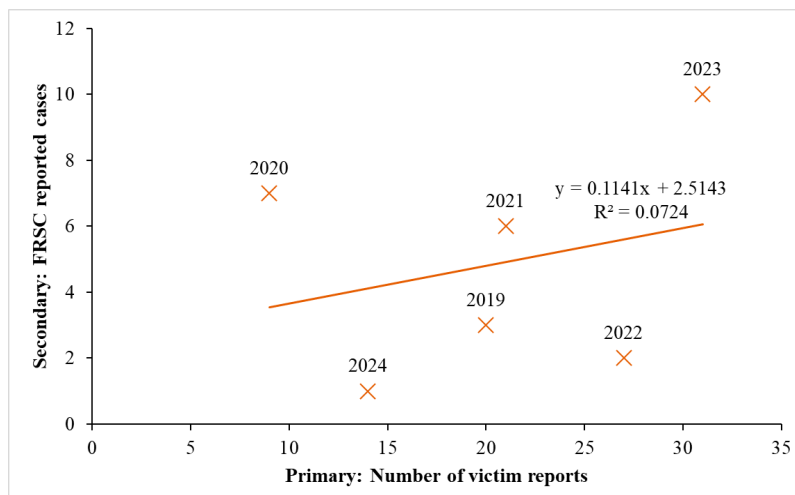


Fig.12: Regression Model Validating Official FRSC Records and Victims' Reports

## 4. CONCLUSION

This study investigated the causes, patterns, and consequences of motorcycle accidents in Ilorin Metropolis through both primary and secondary data. Questionnaires were administered to motorcycle accident victims, motorcyclists, healthcare professionals, and law enforcement officers. Secondary data were also obtained from the Federal Road Safety Corps (FRSC) for 10 years (2015–2024).

The comparative analysis indicates that victim-reported accident years do not meaningfully correspond with FRSC annual accident records from 2019 to 2024. The regression model produced a very weak relationship ( $R^2 = 0.072$ ;  $r = 0.2696$ ,  $p = 0.606$ ), indicating that variations in victim reports do not explain official case counts. This mismatch likely reflects recall bias and the small victim sample rather than any real difference in accident trends.

The findings of this study reveal that motorcycle accidents in Ilorin Metropolis are largely driven by behavioural factors, mainly intoxication and speeding. Although stakeholder groups held differing perspectives, evidence from both questionnaire responses and FRSC data confirms the critical role of human factors in accident causation, primarily speeding. Infrastructure challenges, such as inadequate rescue logistics and insufficient sensitisation campaigns, further compound the risks faced by motorcyclists and passengers.

The findings from both the questionnaire and FRSC data revealed consistent accident hotspots across Ilorin. Respondents frequently identified Maraba Area, Post Office Area, Fate Roundabout, Taiwo Road, and Pipeline Junction as high-risk zones. These locations were corroborated by FRSC data, which also identified Geri-Alimi/Eyenkorin Road, Murtala Mohammed Road, and Fate Road as having the highest accident frequency. This necessitates targeted interventions. A combination of rider behaviour, insufficient enforcement, and poor rescue response shapes the motorcycle accident problem in Ilorin. A multifaceted approach involving education, enforcement, infrastructure, and healthcare preparedness is essential to reduce accidents and enhance road safety in the metropolis.

## REFERENCES

Adesanya, M. O., & Oyekan, J. (2022). "Motorcycle Accident Trends and Road Safety Measures in Nigeria." *Journal of Transportation Safety*, 10(1), 45-61.

Adeyemi, A. O., & Salawu, O. (2023). Motorcycle Accidents in Urban Areas: A Study of Ilorin, Nigeria. *International Journal of Transport and Traffic Safety*, 12(3), 45-60.



- Akinsanya, A. O., & Durojaiye, E. A. (2021). A Study of Road Traffic Accidents and Motorcycle Safety in Nigeria. *African Road Safety Journal*, 15(2), 120-135.
- Ameen, H., et al. (2025). Risk Factors and Patterns of Road Traffic Accidents among Commercial Tricyclists in Ilorin-South LGA, Nigeria. *Zagazig University Medical Journal*, 31(3), 1320-1335.
- Argha, D. B. P. & Khan, M. J. I. (2023). Motor vehicle accidents and teenage drivers: A statistical analysis of their age and injuries.
- Champahom, T., Se, C., Jomnonkwao, S., Boonyoo, T., & Ratanavaraha, V. (2023a). A Comparison of Contributing Factors between Young and Old Riders of Motorcycle Crash Severity on Local Roads. *Sustainability*, 15(3), 2708, 1-24. <https://doi.org/10.3390/su15032708>
- Champahom, T., Se, C., Aryuyo, F., Banyong, C., Jomnonkwao, S., & Ratanavaraha, V. (2023b). Crash Severity Analysis of Young Adult Motorcyclists: A Comparison of Urban and Rural Local Roadways. *Applied Sciences*, 13(21), 11723, 1-21. <https://doi.org/10.3390/app132111723>
- Cholo, M. S., & Chukwuemeka, I. O. (2023). The catastrophic cost of motorcycle road traffic injuries: Experience from a major reference centre in a lower-middle income country. ScienceDirect. <https://doi.org/10.1016/j.safep.2023.100056>
- Cochran, W. G. (1977). Sampling Techniques (3rd ed.). New York: John Wiley & Sons.
- Díez-Navarro, J. M., Leal-Costa, C., Planes-Muñoz, D., Suárez-Cortés, M., Castaño-Molina, M., Molina-Rodríguez, A., & Agea, J. L. D. (2023). High-power motorcycle accidents in Spain: a descriptive study. *European journal of trauma and emergency surgery*, 50(2), 455–466. <https://doi.org/10.1007/s00068-023-02363-0>
- Esmailzadeh, M. H., Ahmadi Gharaei, H., Beheshti, M. H., Rajabloo, M. R. (2021). Epidemiological study of motorcycle accidents in Gonabad in 2018-2019. *Journal of Surgery and Trauma*, 9(2), 57-63. <https://doi.org/10.32592/jsurgery.2021.9.2.103>
- Farooq, D., & Juhasz, J. (2020). Simulation Analysis of Contributing Factors to Rider Visibility Issues for Car-Motorcycle Accidents. *Periodica Polytechnica Transportation Engineering*, 48(3), 203-209. <https://doi.org/10.3311/PPtr.13521>
- Federal Road Safety Corps (FRSC). (2022). Annual report on road accidents in Nigeria: Focus on motorcycle-related incidents. Federal Road Safety Corps.
- Federal Road Safety Corps (FRSC). (2024). 1st Quarter Statistical Digest.
- Ganem, G., & Fernandes, R. P. (2020). Motorcycle accidents: characteristics of victims admitted to public hospitals and circumstances. *Revista Brasileira de Medicina do Trabalho*, 18(1), 51–58. <https://doi.org/10.5327/z1679443520200447>
- Ibraheem, G. H., Nasir, A. A., Ofoegbu, C. K. P., Abdur-Rahman, L. O., Babalola, O. M., & Solagberu, B. A. (2023). Determinants of risk-taking behaviours among road users in Ilorin, Nigeria. *International Journal of Health Sciences*, 11(2), 1-10.
- Israel, G. D. (1992). *Determining Sample Size*. University of Florida, IFAS Extension. [Document PEOD-6]
- Khan, R., Ali, A., Saeed, K., Sadiq, M. A., Shah, A. A., & Amber, A. (2022). The Associated Factors in the Prevalence of Motorcycle Accidents. *Pakistan Journal of Medical & Health Sciences*, 16(07), 991. <https://doi.org/10.53350/pjmhs22167991>
- National Bureau of Statistics. (2024). *Road transport data (Q2 2024)*. Nigerian Bureau of Statistics. Retrieved from <https://www.nigerianstat.gov.ng/elibrary/read/1241582>. Accessed on 02 July 2025.
- National Road Traffic Accident Report (2022). Federal Road Safety Commission, Nigeria.
- Nguyen-Phuoc, D. Q., De Gruyter, C., Nguyen, H. A., Nguyen, T., & Su, D. N. (2020). Risky behaviours associated with traffic crashes among app-based motorcycle taxi drivers in Vietnam. *Transportation Research Part F: Traffic Psychology and Behaviour*, 70, 249–259. <https://doi.org/10.1016/j.trf.2020.03.010>
- Nigerian Bureau of Statistics. (2021). Traffic accidents in Nigeria: An overview of motorcycle accidents. *National Statistical Report*.
- Noorali, I. S., Attyia, M. A., & Alsunbuli, M. M. B. (2023). Patterns of Maxillofacial Injuries Caused by Motorcycle Accidents. *International Archives of Otorhinolaryngology*, 27(2):e309–e315, 309 – 315. <https://doi.org/10.1055/s-0042-1744256>
- Odugbesan, S. O., & Adebayo, F. J. (2023). Evaluating Motorcycle Safety in Urban Areas: A Case Study of Lagos and Ilorin. *Transportation Research Journal*, 27(3), 98-107.
- Ogunlana, M. (2021). Motorcycle Accidents and Public Health: A Comparative Study of Developing Countries. *Journal of Public Health Policy*, 33(4), 233-241.
- Ogunmodede, T., et al. (2024). Factors Influencing High Rate of Commercial Motorcycle Accidents in Nigeria. *American International Journal of Contemporary Research*, 2(11), 130-140.
- Oladejo, M. O., & Oyebanji, O. S. (2021). Road safety challenges and traffic management in Ilorin, Nigeria. *African Journal of Road Safety*, 16(1), 24-38.
- Olorunfemi, S.(2022). "Urban traffic congestion and its effects on motorcycle safety in Ilorin." *Journal of Transportation Engineering and Safety*,14(2),75-82
- Rana, A., Nasrullah, F., Hameedi, S., & Janjua, N.I. (2022). Motorcycle Accidents in Punjab: A Critical Analysis. *Pak Armed Forces Med J*, 72(2): 632-636. <https://doi.org/10.51253/pafmj.v72i2.5797>



- ResearchGate. (2024). Usage of Crash Helmet among Commercial Motorcyclists in Ilorin, Nigeria. [Link](#)
- Solagberu, B. A., Ofoegbu, C. K. P., Nasir, A. A., Ogundipe, O. K., Adekanye, A. O., & Abdur-Rahman, L. O. (2006). Motorcycle injuries in a developing country and the vulnerability of riders, passengers, and pedestrians. *Injury Prevention*, 12(4), 266–268. <https://doi.org/10.1136/ip.2005.011221>
- Tmejová, T., Zuvala, R., & Bucsuházy, K. (2022). In-depth Crash Causation Analysis of Motorcyclist Crashes. 8th International Conference on Vehicle Technology and Intelligent Transport Systems (VEHITS) (pp. 249-256). <https://doi.org/10.5220/0011033800003191>
- Tollazzi, T., Parežnik, L. B., Gruden, C., & Renčelj, M. (2025). In-Depth Analysis of Fatal Motorcycle Accidents- Case Study in Slovenia. *Sustainability*, 17(3), 876, 1-19. <https://doi.org/10.3390/su17030876>
- Umeh, P. P., Ojeh, V. N., Arisabor, L., & Ikporukpo, C. O. (2018). Spatio-temporal pattern of motorcycle accidents in Anambra State, Nigeria. *Asian Journal of Geographical Research*, 1(2), 1–28. <https://doi.org/10.9734/ajgr/2018/v1i229598>
- Yusuff, A., & Olagunju, A. I. (2023). "Road Traffic Accidents in Ilorin: A Statistical Approach." *International Journal of Civil Engineering and Transport*, 6(1), 77-89.
- Zahid, S., Ngadiman, N. I, A.Kadir, F. D., Roslan, N. F., & Moeinaddini, M. (2016). Factor Analysis of Motorcycle Crashes in Malaysia. *Planning Malaysia: Journal of the Malaysian Institute of Planners*, 14(4), 135 – 146. <https://doi.org/10.21837/pm.v14i4.154>
- Zhou, T. (2023). Analysis of the Characteristics of Motorcycle Road Traffic Accidents in Chongqing. *Advances in Education, Humanities and Social Science Research*, 8(1), 378–378. <https://doi.org/10.56028/aehtsr.8.1.378.2023>

